



Original article

# Peers' Private Tutoring and Adolescent Depressive Symptoms: Quasi-Experimental Evidence From Secondary Schools in South Korea

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 A B S T R A C T

**Purpose:** The aim of the study is to investigate the relationship between peers' private tutoring and an individual student's depressive symptoms. Potential mechanisms that underlie this link were also explored.

**Methods:** Data are from the Gyeonggi Education Panel Study of 7th and 10th graders in South Korea. The present study exploited quasi-experimental variation generated from random assignment of students to classes within schools to examine whether having peers who receive private tutoring is associated with students' self-reported depressive symptoms. The following mechanism variables were explored: hours spent doing leisure/hobby activities, test-related stress, hours spent playing with friends, and friend attachment.

**Results:** The proportion of classmates who receive private tutoring was associated with an increase in students' depressive symptoms ( $b = 0.326, p < .05$ ), even after adjusting for individual- and peer-level covariates as well as school fixed effects. Results showed that exposure to a higher proportion of classmates who receive private tutoring leads to a decrease in hours spent engaging in leisure/hobby activities and an increase in test-related stress. Sobel-Goodman mediation tests suggested that test-related stress explains about 20% of the association between peers' private tutoring and students' depressive symptoms.

**Conclusions:** As more peers receive private tutoring, academic competition intensifies among students in East Asian and Southeast Asian countries. The findings of this study suggest that emotional pressure and anxiety generated by such environments threaten the mental health of adolescents. Policymakers may consider creating school-based interventions that foster a culture of cooperation, not competition.

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 IMPLICATIONS AND  
 CONTRIBUTION

This study found that students who have a higher proportion of peers who receive private tutoring have worse mental health. An increase in test-related stress partly explains this relationship. Policymakers and practitioners need to consider how academic rivalry and competition induced by private tutoring may threaten adolescent mental health.

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

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South Korea (Korea, hereafter) is characterized by its distinctive, sometimes excessive, commitment to education. Reflecting what some call education fever, about 70% of Korean students received private tutoring in 2019 [1]. Widespread private tutoring has been long regarded as a unique cultural feature

**Table 1**  
Summary statistics, GEPS (N = 7,885)

	Mean or proportion	SD	Minimum	Maximum
<b>Dependent variables</b>				
Depressive symptoms (Wave 1)	−0.004	0.937	−1.6	2.7
Depressive symptoms (Wave 2) <sup>a</sup>	−0.003	0.937	−1.8	2.7
<b>Mechanism variables</b>				
Hours spent doing leisure activities	1.907	1.527	0.0	12.0
Test-related stress	−0.001	0.918	−2.8	1.8
Hours spent playing with friends	1.136	1.270	0.0	10.5
Friend attachment	0.007	0.925	−4.3	1.8
<b>Key independent variable</b>				
Peer private tutoring	0.637	0.201	0.0	1.0
<b>Individual control variables</b>				
Own private tutoring	0.639		0.0	1.0
Women	0.507		0.0	1.0
Living with father	0.877		0.0	1.0
Living with mother	0.901		0.0	1.0
Birth order	1.573	0.670	1.0	9.0
Number of siblings	2.135	0.653	1.0	11.0
Log parental income	5.951	0.646	0.0	9.2
Married parents	0.887		0.0	1.0
Parental education (in years)	14.305	2.320	9.0	20.0
Parental homeownership	0.629		0.0	1.0
Observations	7,885			

Chi-squared tests for categorical variables and *t*-tests for continuous variables were performed.

GEPS = Gyeonggi Education Panel Study; SD = standard deviation.

<sup>a</sup> The number of observations for depressive symptoms (Wave 2) is 7,605.

of Korean society [2,3], and it has also become a social concern because of its detrimental effects on child's mental health. According to the 2018 Programme for International Student Assessment, while test scores of Korean students are very high internationally, their life satisfaction was very low (65th among 71 countries). From the mid-1990s to early 2010s, the mean suicide rate of adolescents aged 10–19 was 4.7 (per 100,000 adolescents) in Korea, while the OECD average was 3.9 [4].

The excessive academic burden is often considered as one of the main causes of the poor psychological well-being and high stress among Korean students. For example, receiving private tutoring tends to exhaust students and increase their academic stress [5]. Although a number of previous studies have focused on the adverse psychological consequences of receiving private tutoring at the individual level [6], little attention has been paid to whether and how the extent to which peers receive private tutoring shapes students' own depressive symptoms. As the proportion of students receiving tutoring worldwide has increased and the tutoring market is expected to grow further after the COVID-19 pandemic, it is important to analyze the impact of peer tutoring on students' mental health.

Peer private tutoring may affect an individual student's depressive symptoms through *psychological* and *behavioral* pathways. Academic-related anxieties and concerns are a major source of stress among Korean students [7]. This

psychosocial response is rooted in the belief that obtaining a degree from a selective university guarantees high socioeconomic standing and power [8]. Korean education policies also contribute to this context. In Korea, students' school records during secondary school are linked to their college admissions applications. This creates substantial pressure to earn good grades in examinations. More importantly, since the relative evaluation system in Korean secondary schools stirs up fierce competition between peers, peer environments in which private tutoring is common may heighten test-related stress among students [9]. Extant studies document that high levels of academic stress harm the mental health of Korean adolescents (e.g., depressive symptoms, suicidal ideation, anxiety, insomnia) [10,11]. Thus, an increase in peers receiving private tutoring might lead to more depressive symptoms of adolescents by intensifying academic stress.

An additional consequence of a competitive academic environment generated by having many peers who receive private tutoring is that students may lack time and peace of mind to enjoy leisure and hobby activities. Engagement of one's leisure time and in hobbies creates positive emotions and relieves stress, which are beneficial for psychological health [12]. If students feel high levels of pressure to focus on academics because they see other peers receiving private tutoring, students may be unable to fully enjoy their leisure time and hobbies [13,14]. Such peer environments may generate anxiety and guilt, preventing students from relaxing. In this regard, peers' private tutoring can create pressure on students and disturb activities that would normally relieve academic stress.

Being surrounded by peers who receive private tutoring may be related to increased depressive symptoms among students through *social* pathways. Students may lack time to hang out with friends. In 2019, 65.4% of Korean adolescents aged 15–19 reported having <3 hours of free time in a day [15]. This is attributed to students' engagement in private tutoring after school [16]. In contexts in which many students invest a substantial amount of time in private tutoring, even students who do not receive private tutoring are deprived of the opportunity to interact and play with their peers that do. Playtime with friends provides developmental benefits that can improve teens' mental health, such as the opportunity to form quality friendships [17,18]. If students struggle to form bonds with each other in school, this may lead to a decline in peer attachment. Feeling attached to peers improves adolescents' psychological health [19]. In contrast, low peer attachment during adolescence causes a series of emotional problems and deteriorates mental health [20]. A reduction in peer attachment may lead to school dissatisfaction and detachment [21]. As more and more students receive private tutoring, the distinctive role of schools as an institution that facilitates peer relationships and socialization may fade away [22] and this may tax students' psychological health.

In this study, we use the Gyeonggi Education Panel Study (GEPS) to examine whether and how peers' private tutoring is associated with students' depressive symptoms. To address selection and confounding factors, we leverage a quasi-experimental design that exploits variation generated from the random assignment of students to classes within schools in Korea. To shed light on how peers' private tutoring shapes students' depressive symptoms, we explore potential mechanisms described above, including psychological/behavioral and social pathways.

## Data and Methods

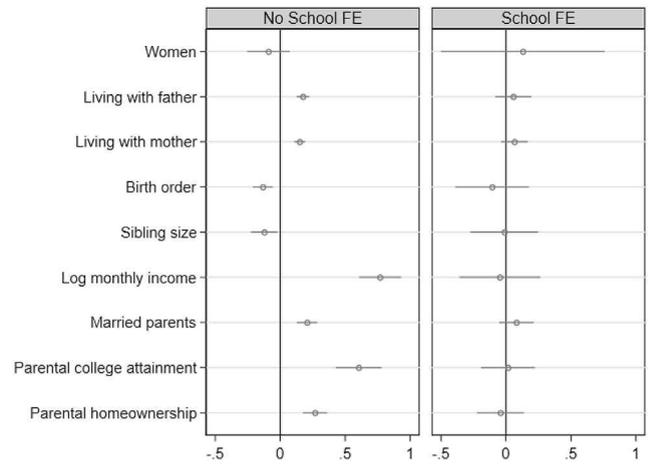
### Data

This study uses the GEPS, which surveyed 8,293 students (4,051 seventh grade and 4,242 tenth grade students) in Gyeonggi Province in 2012. Gyeonggi Province, one of Korea's 17 provinces, is the second-largest province in Korea, after Seoul. Students were sampled via a two-stage cluster sampling design. First, 63 middle schools and 64 high schools were randomly chosen from the population of 593 middle schools and 306 high schools in Gyeonggi Province. Then, two classrooms were randomly drawn within each school, and all students in selected classrooms were surveyed. The survey followed up with the initial sample of 7th and 10th graders for 3 years. Respondents' parents, teachers, and school principals were also surveyed each year. In this study, through personal identifiers, student and parent surveys were merged.

From the total 8,293 students, we drop 408 observations that have missing information on variables used in this study. Our final sample includes a total of 7,885 students (3,859 middle school students [14 years old] and 4,026 high school students [17 years old]). Due to a relatively small percentage of missing data (4.9%), we employed listwise deletion [23]. In the supplementary analysis (Table A1 in Online Supplementary File), we found that students who live with both parents and have better-educated parents are more likely to be included in the analytic sample. However, we found no statistical evidence that peer private tutoring, our key independent variable, is associated with the probability of being in the analytic sample. The Gyeonggi Institute of Education granted approval of the GEPS study and obtained written consent. Because this study is an analysis of secondary data with no identifying information, it is exempt from Institutional Review Board approval.

Since our analytic strategy exploits variation generated from the random assignment of students to classes within schools (described in greater detail below), it is important to understand class assignment practices in Korean schools. Tracking (i.e., separating students by academic ability into groups) has been traditionally avoided in Korea due to strong parental resistance and a long tradition of the government's equalization policies in secondary education. Secondary schools in Korea randomly assign students to classrooms and random assignment could take two different forms [24,25].

The two possible methods of class assignment in secondary schools in Korea are: (1) pure random assignment and (2) "average" assignment according to students' previous academic performance, such as diagnostic examinations when students first enroll in middle school [25]. In the first case, at the beginning of each school year (March 1st), students are assigned to classes based on lottery numbers or another random criterion. In the second case, the most important rule is not to group students with similar grades together. Theoretically, the distribution of academic ability among students should be similar across classes at the beginning of the school year. Once assigned, students stay in the same classroom all year round. The entire class experiences the identical national curriculum throughout the year. Students are rerandomized from year to year in a similar manner. In 2015, a study surveyed local Offices of Education on schools' rules for classroom assignment for 197 schools in Korea [24]. They confirmed that all but one school used the aforementioned method of classroom assignment.



**Figure 1.** Balancing tests for peer private tutoring. Note. Each dot represents a coefficient from a separate regression. In all models, robust standard errors are clustered at the school level. The spikes represent 95% confidence intervals.

### Variables

**Dependent variable.** The primary dependent variable is depressive symptoms. This measure is based on students' responses to the following statement (Cronbach's alpha = .85) [26]: (1) I do not have interest in anything; (2) I am worried about everything; (3) I sometimes feel very anxious for no reason; (4) I sometimes feel very lonely for no reason; (5) I sometimes feel sad and depressed for no reason; and (6) I sometimes feel I want to die for no reason. Responses to the statements ranged from 1 (strongly disagree) to 5 (strongly agree). Following previous studies [27], we used factor analysis for data reduction and constructed summary scales based on scores for items in the scale. We found that the results of this study are robust across different data reduction techniques such as principal component analysis and average scores (results available upon request).

**Mechanism variables.** This study examines four potential mechanism variables. The first is leisure/hobby activities, which are based on students' response to the following question: "How many hours, on average, do you spend on leisure or hobby activities per day?" The second is test-related stress, which is based on students' responses to the following statements (Cronbach's alpha = 0.81): (1) I feel nervous about taking exams; (2) I feel even more nervous just before exams; (3) For exams, I even forget what I know; (4) I wish exams were gone; (5) I am worried about results after exams; (6) I want to avoid exams if I can; and (7) I am just worried about exams. The third mechanism variable is playing with friends and is based on students' response to the following question: "How many hours, on average, do you spend playing with your friends?" The last mechanism variable, friend attachment, is based on students' responses to the following statements (Cronbach's alpha = 0.87): (1) I feel comfortable with my classmates; (2) I have classmates to play with me; (3) I learn a lot from classmates; (4) I try my best at cooperating with others for group activities; (5) I tell my classmates honestly what I want; and (6) I listen carefully to classmates when they talk. Responses to the statements ranged from 1 (strongly disagree) to 5 (strongly agree).

**Table 2**  
Regression models of depressive symptoms on peer private tutoring

	(1)	(2)	(3)	(4)	(5)	(6)
	Depressive symptoms (Wave 1)	Depressive symptoms (Wave 1)	Depressive symptoms (Wave 1)	Depressive symptoms (Wave 2)	Depressive symptoms (Wave 2)	Depressive symptoms (Wave 2)
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Individual controls	No	Yes	Yes	No	Yes	Yes
Peer-level controls	No	No	Yes	No	No	Yes
Peer private tutoring	0.356** (0.174)	0.326** (0.163)	0.353** (0.177)	0.221 (0.177)	0.191 (0.173)	0.274 (0.196)
Own private tutoring	-0.025 (0.106)	-0.001 (0.102)	0.002 (0.102)	-0.111 (0.107)	-0.084 (0.105)	-0.086 (0.105)
Women		0.494*** (0.022)	0.507*** (0.023)		0.424*** (0.022)	0.436*** (0.024)
Live with father		-0.013 (0.039)	-0.019 (0.040)		-0.004 (0.041)	-0.006 (0.041)
Live with mother		-0.059 (0.039)	-0.052 (0.039)		-0.148*** (0.041)	-0.148*** (0.041)
Birth order		0.012 (0.018)	0.014 (0.018)		0.011 (0.018)	0.011 (0.019)
Number of siblings		-0.005 (0.019)	-0.003 (0.019)		-0.015 (0.019)	-0.013 (0.019)
Log parental income		0.023 (0.019)	0.026 (0.019)		-0.013 (0.020)	-0.013 (0.020)
Married parents		-0.152*** (0.043)	-0.150*** (0.043)		-0.057 (0.044)	-0.057 (0.045)
Parental education		0.008 (0.005)	0.007 (0.005)		0.007 (0.005)	0.007 (0.005)
Parental homeownership		-0.029 (0.023)	-0.028 (0.023)		-0.041* (0.024)	-0.042* (0.024)
(Peer) Women			-0.083 (0.057)			-0.093 (0.059)
(Peer) Live with father			-0.351 (0.326)			-0.102 (0.337)
(Peer) Live with mother			0.357 (0.298)			-0.024 (0.307)
(Peer) Birth order			0.077 (0.131)			0.023 (0.135)
(Peer) Number of siblings			0.065 (0.144)			0.085 (0.147)
(Peer) Log parental income			0.153 (0.148)			0.009 (0.152)
(Peer) Married parents			0.081 (0.315)			-0.105 (0.325)
(Peer) Parental education			-0.098* (0.040)			0.012 (0.041)
(Peer) Parental homeownership			0.144 (0.201)			-0.083 (0.208)
N	7,885	7,885	7,885	7,605	7,605	7,605

Following Guryan et al. (2009), all models control for school-level composition omitting the student's contribution in order to address the mechanical negative correlation between student's own attributes and cohort composition variables that omit the student. Robust standard errors are clustered at the school level.

\**p* < 0.1.  
\*\**p* < .05.  
\*\*\**p* < .001.

**Independent variable.** For the peer measure, we use the percentage of classmates (excluding the respondent) who receive private tutoring. Private tutoring is based on parental reports of whether the child receives any kind of private tutoring (one-on-one tutoring, group tutoring, and/or Hagwon [private tutoring institute]). Parents indicate subjects on which their child receives private tutoring: mathematics, English, Korean, science, social studies, and so on. We only include mathematics, English, and Korean because these three subjects are the most common subjects for which students receive private tutoring in Korea. In supplementary analyses, when operationalizing the peer measure using a separate subject, we found that our results are robust across subjects (Tables A2 and A3 in Online Supplementary File).

**Control variables.** We control for the following individual-level covariates: gender, living with father, living with mother, birth order, sibling size, log parental income, married parents, parental education, parental homeownership, and an indicator of attending high school. Peer-level covariates are leave-out means of all aforementioned individual-level characteristics. The correlation matrix of study variables is available in Online Supplementary File (Table A4).

**Analytic strategy**

When examining the association between peers' private tutoring and students' depressive symptoms, we address

problems presented by endogenous school choice and nonrandom student sorting by exploiting idiosyncratic variation in classmate composition within the same school across classes [28]. This analytic strategy is based on the assumption that the distribution of classmate characteristics is quasi-random across classes and within schools. In other words, families are assumed to select schools based on the average school composition, but not on the attributes of the child's classmates. Using balancing tests [29], we empirically test whether this assumption holds.

We estimate a reduced form ordinary least squares with fixed effects equation that measures the link between classmate private tutoring and depressive symptoms. The primary empirical specification is as follows:

$$y_{ics} = \beta \bar{T}_{-ics} + \mathbf{X}_{ics} \gamma + W_s + \delta T_{ics} + \epsilon_{ics} \dots (2)$$

where  $y_{ics}$  is the depressive symptoms of individual  $i$  in class  $c$  in school  $s$ . We look at depressive symptoms measured at both Wave 1 and Wave 2. The key independent variable of interest is  $\bar{T}_{-ics}$ , the proportion of classmates who receive private tutoring.  $\mathbf{X}_{ics}$  is the set of individual-level characteristics and  $T_{ics}$  is own private tutoring. By controlling for school fixed effects ( $W_s$ ),  $\beta$ , the coefficient of interest, captures the estimated within-school association between the proportion of classmates receiving private tutoring and depressive symptoms. It is worth noting that, even if schoolwide peer private tutoring may influence students' depressive symptoms through other channels, our school fixed effects framework only captures peer private tutoring effects that operate through mechanisms that vary

**Table 3**  
Regression models of mechanism variables on peer private tutoring

	(1) Hours spent doing leisure activities	(2) Test-related stress	(3) Hours spent playing with friends	(4) Friend attachment
School fixed effects	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes
Peer private tutoring	–0.628** (0.272)	0.317** (0.151)	–0.158 (0.225)	0.001 (0.168)
Own private tutoring	–0.287* (0.166)	0.153 (0.103)	–0.270** (0.137)	0.097 (0.103)
Women	–0.274*** (0.035)	0.060*** (0.022)	–0.125*** (0.029)	0.114*** (0.022)
Live with father	–0.024 (0.064)	0.004 (0.040)	0.018 (0.053)	0.111*** (0.039)
Live with mother	0.039 (0.063)	0.019 (0.040)	–0.205*** (0.052)	–0.037 (0.039)
Birth order	0.110*** (0.029)	–0.003 (0.018)	0.122*** (0.024)	–0.043** (0.018)
Number of siblings	–0.046 (0.030)	–0.014 (0.019)	–0.019 (0.025)	0.039** (0.019)
Log parental income	0.014 (0.031)	–0.012 (0.019)	0.049* (0.026)	0.060*** (0.019)
Married parents	–0.015 (0.069)	0.087** (0.043)	–0.127** (0.057)	–0.017 (0.043)
Parental education	–0.027*** (0.008)	–0.002 (0.005)	–0.030*** (0.007)	0.016*** (0.005)
Parental homeownership	–0.106*** (0.037)	–0.020 (0.023)	–0.066** (0.031)	0.007 (0.023)
N	7,885	7,885	7,885	7,885

Following Guryan et al. (2009), all models control for school-level composition omitting the student's contribution in order to address the mechanical negative correlation between student's own attributes and cohort composition variables that omit the student. Robust standard errors are clustered at the school level.

\* $p < 0.1$ .

\*\* $p < .05$ .

\*\*\* $p < .01$ .

\*\*\*\* $p < .001$ .

across classes within the same school. Finally,  $\varepsilon_{ics}$  is the error term. Robust standard errors are allowed to be clustered at the school level.

To investigate potential mechanisms linking peers' private tutoring to depressive symptoms, this study conducts Sobel-Goodman mediation tests [30]. Sobel tests present the proportion of the observed association that can be attributed to mediating variables and the significance of the indirect effect.

## Results

Table 1 presents descriptive statistics of the variables. About half of the sample was female. About 88% of the sample lived with father and about 90% lived with mother. The average birth order was 1.57, and the average number of siblings was 2.14. About 89% of parents were currently married. On average, parents completed about 14.31 years of schooling. About 64% of respondents reported receiving private tutoring in major subjects. Moreover, on average, respondents spend 1.91 hours doing leisure/hobby activities and 1.14 hours playing with friends per day.

This study's empirical strategy is persuasive only for schools that adhere to strict random assignment and that do not engage in student tracking. The identification strategy of this study assumes that variation in peer composition across cohorts within a school is quasi-random. Thus, we test whether random class assignment and school fixed effects allow us to identify quasi-random variation in the independent variable of this study. Specifically, we conduct balancing tests to examine whether our independent variable is correlated with predetermined student attributes (e.g., a host of individual-level characteristics), and the inclusion of school fixed effects removes the observed correlation. If this turns out to be the case, we interpret it as evidence that school fixed effects combined with random assignment of students to classes account for school selection.

Figure 1 shows the results of balancing tests. The left panel presents results without school fixed effects. The right panel includes school fixed effects. The left panel shows that the associations between peer private tutoring and most individual characteristics, except gender, are statistically significant at conventional levels. This is strong evidence of endogenous school selection. For example, students who have a lower birth order, have fewer siblings, live with parents, have married parents, and are from high-SES families (higher parental income, higher educational attainment, and parental homeownership) are more likely to attend classrooms (or schools) with a higher proportion of peers who receive private tutoring. However, in the right panel, when controlling for school fixed effects, all statistically significant correlations disappear. This is evidence in support of our argument that students are not sorted purposefully into particular classes within schools. These results suggest that the proportion of classmates who receive private tutoring is plausibly exogenous (or quasi-random) within schools. This approach of exploiting the feature of random classroom assignment in Korea to estimate peer effects has been used in several recent studies [25,31].

Table 2 reports results from our main analysis of the association between exposure to peers' private tutoring and depressive symptoms in Wave 1 (Columns 1–3) and Wave 2 (Columns 4–6). In the first column, we present the bivariate relationship between peer private tutoring and students' depressive symptoms with school fixed effects included in the model. In the second column, individual-level covariates are added. In the third column, we control for peer-level covariates.

Column 1 of Table 2 shows that peer private tutoring is associated with an increase in depressive symptoms ( $b = 0.356$ ). Despite some attenuation, the coefficient is relatively unchanged when individual-level covariates are added ( $b = 0.326$ ) (Column 2). Consistent with results from balancing tests (Figure 1), this implies that within-school differences in peer private tutoring are likely quasi-exogenous (i.e., uncorrelated with student characteristics). In

**Table 4**  
Mediation models linking peer private tutoring to depressive symptoms

	(1)	(2)	(3)	(4)	(5)
	Depressive symptoms (Wave 1)				
School fixed effects	Yes	Yes	Yes	Yes	Yes
Individual controls	Yes	Yes	Yes	Yes	Yes
Peer private tutoring	0.326** (0.163)	0.329*(0.168)	0.263 (0.165)	0.329* (0.168)	0.326** (0.164)
Hours spent doing leisure activities		0.006 (0.007)			
Test-related stress			0.199*** (0.011)		
Hours spent playing with friends				0.019** (0.008)	
Friend attachment					−0.227*** (0.011)
Sobel–Goodman mediation tests					
Indirect effect		−0.003	0.063*	−0.003	−0.000
% mediated		−0.9%	19.3%	−0.9%	0.0%
N	7,885	7,885	7,885	7,885	7,885

Following Guryan et al. (2009), all models control for school-level composition omitting the student's contribution in order to address the mechanical negative correlation between student's own attributes and cohort composition variables that omit the student. Individual controls include gender, living with father, living with mother, birth order, number of siblings, log parental income, parental marital status, parental education (highest number of years of schooling completed by parents), parental homeownership, and own receipt of private tutoring. Robust standard errors are clustered at the school level. The table presents the Sobel test coefficient, its statistical significance, and the proportion of the total effect that is mediated (%). To perform Sobel–Goodman mediation tests, the user-written Stata command (*sgmediation* in Stata) is used.

\*  $p < 0.1$ .

\*\*  $p < .05$ .

\*\*\*  $p < .001$ .

Column 3, as a robustness check, we show that controlling for peer-level characteristics does not change our results ( $b = 0.353$ ). This rules out the possibility that the association is spuriously driven by other peer-level characteristics.

The point estimate in Column 2 indicates that, on average, a 10-percentage point increase in the proportion of classmates who receive private tutoring is associated with about a 0.035 standard deviation increase in depressive symptoms ( $(0.326 \times 0.10)/0.937$ ). To give readers a sense of the effect size for our finding, we use the magnitude of the associations between having married parents and depressive symptoms as a benchmark. Considering that having married parents is associated with about a 0.162 standard deviation decrease in depressive symptoms ( $-0.152/0.937$ ), the estimated association between peers' private tutoring and an individual student's depressive symptoms is not trivial (nearly one-quarter as large as the impact of parental divorce).

In Columns 4–6, we investigate whether this association persists over time. The association between peers' private tutoring measured in Wave 1 and depressive symptoms measured in Wave 2 (a year later) is not statistically significant at conventional levels. This suggests that the association between peers' private tutoring and depressive symptoms may be transitory. These results may reflect the fact that students are exposed to different student compositions each year due to annual random class assignment.

To shed further light on our findings, we conduct a series of supplementary analyses. First, we examined whether the association between peer private tutoring and depressive symptoms differs between middle and high school students. Although the association between peer private tutoring and depressive symptoms was larger among high school students than middle school students, these differences were not statistically significant at conventional levels (Table A5 in Online Supplementary File). Second, to investigate whether the association between peer private tutoring and depressive symptoms differs between those who receive and do not receive private tutoring, we

included the interaction term of peer private tutoring and own private tutoring. However, we found that the interaction term is not statistically insignificant, indicating that the association is similar regardless of one's own receipt of private tutoring (Table A6 in Online Supplementary File).

In Table 3, to explore potential mechanisms that drive the link between peers' private tutoring and students' depressive symptoms (at Wave 1), we regress the proposed mechanism variables on peers' private tutoring. Column 1 shows that an increase in peers' private tutoring decreases hours spent doing leisure/hobby activities ( $b = -0.628$ ). Column 2 shows that peers' private tutoring is associated with an increase in test-related stress ( $b = 0.317$ ). In contrast, peers' private tutoring is not statistically significantly associated with hours spent playing with friends (Column 3) nor with friend attachment (Column 4).

In Table 4, we examine whether proposed mechanism variables mediate the association between peers' private tutoring and depressive symptoms. We begin by presenting baseline results from Column 2 of Table 2 for comparison (Column 1). All mediating variables except hours spent in leisure/hobby activities predict depressive symptoms. Inclusion of the test-related stress variable attenuates the estimated association by 19.3%, rendering it statistically insignificant ( $b = 0.263$ ) (Column 3) at conventional levels. The indirect effect (Sobel test coefficient) is statistically significant ( $b = 0.063$ ). Test-related stress partially explains the association between peers' private tutoring and students' depressive symptoms.

## Discussion

This study investigated whether and how peers' private tutoring shapes students' depressive symptoms. Using a quasi-experimental research design, we found that peers' private tutoring is associated with an increase in students' depressive symptoms, net of a set of individual- and class-level covariates. The magnitude of the association is economically meaningful: an increase in depressive symptoms associated with a

10-percentage point increase in the proportion of classmates who receive private tutoring is equivalent to one third of the increase in depressive symptoms associated with parental divorce. This association, however, is short-term. One possible explanation for this is that students are randomly assigned to different classes every year, and consequently, exposed to different peer compositions each year.

This study also examined underlying mechanisms that link peers' private tutoring to students' depressive symptoms. We found that an increase in peers' private tutoring leads to a decrease in hours spent in leisure/hobby activities and an increase in test-related stress. Results suggest that as more peers receive private tutoring, academic competition intensifies. This, in turn, may aggravate the psychological burdens of secondary school students. Test-related stress mediates about 20% of the association between peers' private tutoring and students' depressive symptoms. This indicates that an increase in peers' private tutoring increases emotional anxiety and pressure, worsening students' psychological health.

The contributions of this study are multifold. First, this study contributes to a burgeoning literature on the influence of peers. Despite the large literature on the influence of peers on students' academic outcomes [32,33], the social effect that peer groups (especially peers' academic behaviors rather than health behaviors) have on adolescent health has been largely understudied. This study is the first to show the importance of considering peers' private tutoring as a risk factor for depressive symptoms among Korean adolescents. Given the proliferation of private tutoring in Korea [5], our results call for more research into the causes and consequences of peers' engagement in private tutoring. Second, this study is a notable contribution to the adolescent mental health literature. This study adds crucial nuance to discussions about how to combat teen suicide, the leading cause of death among Korean youth for decades. Scholars and policymakers have identified academic stress as a primary risk factor for suicidal ideation and suicide attempts [34]. This study adds a new dimension to our understanding of the determinants of stressful academic environments by presenting evidence on how peers' private tutoring creates competition in classes to shape students' test-related stress, and consequently, depressive symptoms. Third, this study provides an important methodological contribution because it addresses the problem of endogenous school selection, a major methodological threat to estimating peer effects, by relying on quasi-exogenous variation generated from random assignment of students to classes.

This study has limitations. First, although this study provides initial evidence about pathways that underlie the link between peers' private tutoring and mechanism variables, results from mediation analyses should be interpreted with caution due to our inability to establish the temporal ordering of mechanism variables and depressive symptoms. It is possible that depressive symptoms affect the proposed mechanism variables [35]. There may also be additional pathways that this study did not examine due to the lack of appropriate variables. Second, we were unable to directly test whether and how an increase in peers' private tutoring shapes a school's competitive atmosphere. The data used in this study (GEPS) do not contain measures about students' perceptions about school contexts. Future studies may wish to unpack the mechanisms by which peers' engagement in private tutoring creates peer environments that have adverse consequences for mental health. Third, the depression measure used in this study is limited in scope because it does not cover

other symptom groups such as appetite, sleep, thinking/concentration, guilt, and movement. Although the symptom groups covered in this measure—i.e., worries/anxiety, loneliness, depression/sadness, loss of interest, and suicidal ideation—are particularly relevant for children and adolescents, future research may consider other mental health outcomes such as eating and sleep behaviors.

Findings of this study hold policy implications for societies with intense levels of academic competition such as many East Asian and Southeast Asian countries [36]. Given that peers' engagement in private tutoring may be a risk factor for adolescent mental health, policymakers need to consider how to help students' learning activities to take place within the school rather than outside the school. Moreover, this study may inform public health policies that aim to enhance adolescent mental health via school-based interventions. This study calls for formulating school-based interventions that promote friendly and sociable school environments [37]. Policymakers may also consider developing incentives for schools that make strong commitments to practices that foster a culture of cooperation, not competition. For instance, school-based extracurricular activities that lead to positive social interactions between students can be encouraged and supported. These efforts should be accompanied by building teachers' capacity to implement and manage school-based programs that promote positive and collaborative peer cultures [38].

Parents also need to make efforts to relieve children's excessive academic burden and improve their mental health. In particular, forcing children to receive private tutoring for the sole purpose of competing with other children will exacerbate excessive competition in Korea, which in turn harms their mental health [39]. As a competitive culture among students is formed from the deeply rooted social belief that children must go to a good university and get a good job in order to have a good life [40], protecting the mental health of students from excessive academic stress requires a social consensus and parents will have to play a pivotal role. More fundamentally, there is also a need to reform the social system that allows the ranking of the universities to determine too much of one's future lives and contributes to creating socioeconomic inequality.

Our findings emphasize that exposure to a higher proportion of peers who receive private tutoring is associated with an increase in depressive symptoms among Korean adolescents. The results of this study also suggest that test-related stress explains part of the association between peers' private tutoring and students' depressive symptoms. As more peers receive private tutoring, academic competition may further intensify, and therefore, emotional pressure and anxiety generated by such environments may threaten the mental health of adolescents in Korea. This may also imply that the negative impact of peer tutoring on mental health may be greater in more competitive environments such as Korea than in less competitive academic environments. An international comparative study to investigate the relationship between the degree of competition in the educational environment and the psychological consequences of peer private tutoring may be an especially fruitful avenue for future research.

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## Supplementary Data

Supplementary data related to this article can be found at <http://doi:10.1016/j.jadohealth.2021.10.040>.

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