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Relationship between Academic Stress and Suicidal Ideation: Testing for Depression as a Mediator Using Multiple Regression

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Abstract Relations among academic stress, depression, and suicidal ideation were examined in 1,108 Asian adolescents 12–18 years old from a secondary school in Singapore. Using Baron and Kenny's [J Pers Soc Psychol 51:1173–1192, 1986] framework, this study tested the prediction that adolescent depression mediated the relationship between academic stress and suicidal ideation in a four-step process. The previously significant relationship between academic stress and suicidal ideation was significantly reduced in magnitude when depression was included in the model providing evidence in this sample that adolescent depression was a partial mediator. The applied and practical implications for intervention and prevention work in schools are discussed. The present investigation also served as a demonstration to illustrate how multiple regression analyses can be used as one possible method for testing mediation effects within child psychology and psychiatry.

Keywords Academic stress · Depression · Suicidal ideation · Mediator effect

Introduction

Suicide is one of the three leading causes of deaths for adolescents and young adults worldwide [1]. In Asian societies like Hong Kong, Taiwan and Singapore, suicide is rare in children under the age of 10, but like their western counterparts, the prevalence begins to increase for youths between 10 to 14 years of age, and in the 15 to 24

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age group, there is a dramatic increase in absolute numbers [2, 3]. Hence, suicide in children and adolescents is also a concern in Asian societies.

Academic Stress and Suicidal Ideation

The association between school or academic stressors and suicide ideation among adolescents has been well documented in several research studies [4–6]. In school, adolescents often see themselves as being evaluated in terms of their academic performance, and the pressure to excel is an important measure of their success in school. It is therefore not surprising that adolescents who attempted suicide often had problems in school. Toero et al. [7] argued that there is a strong link between the pressure to excel in school and suicidal behaviors among children and adolescents. In their study, Toero et al. [7] showed that the number of suicide cases in a year usually peaked during examination periods where children and adolescents experienced a high level of stress in school.

Some researchers have argued that in East Asian countries especially, this academic stress-suicidal ideation link among adolescents could possibly be even stronger given the familial and cultural demands for academic excellence. Specifically, in an Asian context, academic stress arising from adolescents' self-expectations and expectations of others (e.g., parents and teachers) are particularly salient. Academic achievement is highly valued by Asians because it is perceived as one of the few avenues for upward mobility and expanded options, thus the significance that individuals and families attribute to academic success is intensified [8, 9]. Not meeting one's own expectations and the expectations of significant others is a serious matter which could potentially result in loss of face which in turn leads to loss of confidence and support from one's family [10]. Therefore, children are socialized from young to be hypersensitive to the judgment of others, especially significant others such as parents or teachers.

Juon et al. [11] examined factors contributing to suicidal behaviors in 9,886 high school Korean adolescents and found that students who reported feeling a high level of stress regarding academic performance and higher education were more likely to have serious thoughts about suicide than those students who did not experience academic stress. Likewise, in Singapore, academic difficulties were also found to be one of the predictors of suicidal behaviors among a population of young suicide attempters besides other factors [12]. School problems accounted for 11% of adolescents who attempted suicide in Singapore [3]. In addition to students putting immense pressure on themselves to excel in school, they were also cognizant of the need to fulfill familial obligations and live up to the expectations of parents and teachers. Taken together, empirical evidence points toward academic stress and in particular, academic expectations, as a factor contributing to suicidal ideation in adolescents especially in East Asia.

The Mediating Role of Depression

Although empirical studies have documented that academic stress has a significant association with suicidal ideation in adolescents, the mechanisms by which academic stress exerts its influence remains unclear. It may be that the effects of academic stress on suicidal ideation are mediated by the effects of adolescent depression on suicidal ideation. Specifically two broad areas of research will be reviewed in this

section: (a) the influence of academic stress on adolescent depression, and (b) the influence of adolescent depression on suicidal ideation.

Academic Stress and Depression

Academic failure has consistently been found to be associated with depression [13, 14]. Similar studies have also reported that depressive mood is associated with academic problems or low academic achievement [15, 16]. In a longitudinal study, Chen et al. [17] found academic achievement to be significantly correlated with depression; specifically, results indicated that depressed children had more academic problems than their non-depressed counterparts contemporaneously and 2 years later. More importantly, poor academic achievement for students at age 8 was also found to be associated with depression at age 10. These results were identical to those found in the West [13, 14]. Chen et al. [17] reasoned that children who experienced academic difficulties in school often received negative feedback regarding their academic performance and consequently, developed depressed feelings. This is similar to Cole's [18] argument that children in Chinese schools who face academic difficulties are often shamed and humiliated, privately and publicly by parents, teachers and peers, and this repeated exposure to negative feedback about cognitive competencies inhibits the development of positive self-schemata, thereby facilitating the development of depression.

Depression and Suicidal Ideation

Depression is frequently associated with suicidal ideation and suicidal behavior in adolescents [19, 20]. The depression-suicidal ideation link has also been documented in research studies conducted with Asian adolescents. In a sample of more than 9,000 Korean high school students, Juon et al. [11] found depression to be the strongest and most consistent predictor of suicidal behaviors; students who had high scores on depression were 5.31 times more likely to report suicidal ideas and 3.19 times more likely to attempt suicide, as compared to those with low scores.

While the depression-suicidal ideation link is fairly well established, interestingly, using partial correlational analyses, De Man [21] found that removal of the effect of depression resulted in a reduction in the respective relationships between suicide ideation and its correlates (e.g., stress and social support satisfaction). De Man [21] argued that adolescent depression could function possibly as a third variable accounting for the relationship between stress (among other variables) and suicidal ideation. However, De Man [21] did not specifically test for depression as a mediator as defined by Baron and Kenny [22]. Similarly, with a sample of adolescents from Hong Kong, Stewart et al. [23] found a variety of stressors (including academic stress) and depression to predict 33% of the variance in suicidal ideation. Using stepwise multiple regression, Stewart et al. [23] argued that when depression was accounted for in boys, the other stressors did not contribute additional separate variance suggesting therefore, that the relationships between stressors and suicidal ideation were mediated primarily by depression. However, like De Man's [21] study, Stewart et al.'s [23] study did not test specifically for mediation.

Taken together, if academic stress is positively linked to adolescent depression and adolescent depression is positively linked to suicidal ideation, then the effects of academic stress on adolescent suicidal ideation may be mediated by its effects on

adolescent depression. Therefore, it is important to conceptualize and design the model linking academic stress and suicidal ideation and to specifically test for adolescent depression as a mediator.

Present Study and Predictions

The research reviewed suggests that academic stress is positively associated with adolescent depression, and with suicidal ideation. As reviewed, the literature also suggests a significant association between adolescents' depression and adolescent suicidal ideation. In the present investigation, the hypothesis that adolescent depression serves as a mediator of the relationship between academic stress and suicidal ideation was investigated. This paper also illustrated in a step-by-step manner how multiple regression analyses can be used to test for mediation effects. Specifically, four predictions were examined in the present study. First, academic stress was predicted to be significantly and positively linked to suicidal ideation in adolescents. Second, academic stress was expected to be significantly and positively associated with adolescent depression. Third, a significant positive association between adolescent depression and suicidal ideation was expected. Finally, adolescent depression was expected to mediate the association between academic stress and adolescent suicidal ideation.

Method

Participants

A total of 1,108 adolescents (596 males, 508 females, and 4 did not specify gender) from a secondary school in Singapore participated in the study. This was a convenience sample and participants were from Grades 7 through 10. The age of the participants ranged from 12 to 18 with a mean age of 14.33 (SD = 0.93). Self-reported ethnic identification for the sample was as follows: 75.6% of the participants were Chinese, 18.1% were Malay, 2.7% were Indian, and 2.9% endorsed Others (which includes all other ethnic groups not listed). Eight participants (0.7%) did not provide information on ethnicity.

Measures

Academic Expectations Stress Inventory (AESI)

The AESI [24] is a 9-item scale designed to measure academic stress arising from self-expectations and expectations of parents and teachers. The response format for the AESI is a Likert-type scale ranging from 1 (*never true*) to 5 (*almost always true*). Items were scored such that higher scores indicated greater perceived academic stress. The total score for the AESI was used in the present investigation. The Cronbach α for the AESI scores in the present sample was 0.88. Based on exploratory and confirmatory factor analyses, Ang and Huan [24] found the AESI measure to have a stable factor structure and good test–retest reliability ($r = 0.85$). In addition, evidence of AESI's convergent and discriminant validity were also reported to be adequate [24].

Children's Depression Inventory—Short Form (CDI-Short)

The CDI-Short [25] is the 10-item brief version of the 27-item inventory that measured a variety of self-reported depressive symptoms in children and adolescents. Each CDI item consisted of three choices, keyed 0 (absence of symptom), 1 (mild symptom) or 2 (definite symptom), with higher scores indicating more severe self-reported depressive symptoms. The Cronbach α for the present sample was 0.81. The validity of CDI scores has been well established [25].

Suicidal Ideation Questionnaire—Junior High School Version (SIQ-JR)

Participants completed the SIQ-JR [26] which is the junior high school version of the SIQ consisting of 15 items. The SIQ-JR was designed to provide an estimate of an individual's current level of suicidal ideation. Participants were asked to rate the frequency with which a particular suicidal cognition occurs, on a 7-point scale, ranging from 0 (*I never had this thought*) to 6 (*I have this thought almost every day*). A high score is indicative of many suicidal cognitions occurring with significant regularity. The SIQ-JR has been demonstrated to yield scores that are reliable and valid [26]. The Cronbach α for the present sample was 0.94.

Consent and Procedure

In Singapore, permission for conducting research and data collection is typically granted by the school Principal. After weighing the risks and potential benefits, the Principal together with a school-based committee, have the autonomy to approve or reject research proposals. Approval was sought and obtained for the researchers to conduct the research investigation at the school prior to data collection. Written parental consent is not a requirement for survey research in Singapore. However, researchers were required to explain the purpose of the study and to explicitly seek the consent of the students regarding participation, as well as to ensure that students' responses were kept either anonymous or confidential. The purpose of the study was clearly explained to the students and consent to participate in the study was obtained from all students involved. Participation was strictly voluntary and students' responses were kept anonymous as they were instructed not to write their names. Students were also informed that they could refuse or discontinue participation at any time, without penalty. All questionnaires were administered in English. No translation is needed as English is the main language of instruction for all schools in Singapore.

Data Analytic Plan

The data were analyzed according to Baron and Kenny's [22] and Holmbeck's [27] conceptual and statistical recommendations for assessing the presence of mediator effects. Three equations were tested using multiple regression [22, 27]. First the suicidal ideation measure was regressed on the academic stress measure to establish that there was an effect to mediate (Path c in Fig. 1A). Second, the measure of depression was regressed on the academic stress measure to establish Path a (see Fig. 1B) in the mediational chain. In the third equation, the suicidal ideation measure was regressed on both the academic stress and depression measures. This provided a test of whether depression was related to suicidal
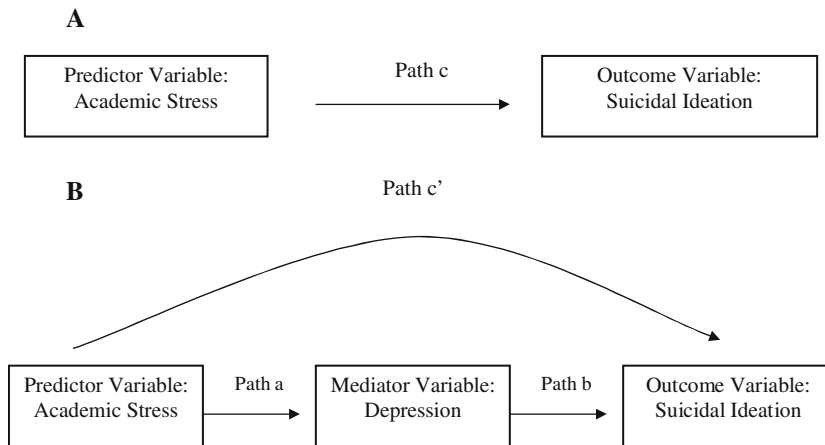
A

| Predictor Variable: Academic Stress | Path c → | Outcome Variable: Suicidal Ideation |

B   Path c'

| Predictor Variable: Academic Stress | Path a → | Mediator Variable: Depression | Path b → | Outcome Variable: Suicidal Ideation |

Fig. 1 Diagram of paths in the hypothesized mediational model

ideation (Path b) and an estimate of the relation between the academic stress measure and the suicidal ideation measure controlling for depression (Path c'). To demonstrate that depression functioned as a mediator in this model, the strength of the relation between the predictor (e.g., academic stress) and the outcome (e.g., suicidal ideation) should either be eliminated (a complete mediator) or significantly decreased (a partial mediator; compare Path c in Fig. 1A with Path c' in Fig. 1B). Baron and Kenny [22] discussed that it would be unusual for the effect of Path c' to be reduced from statistical significance to zero especially in psychological research. Thus the degree to which the effect was reduced (i.e., the change in regression coefficients) would serve as an indicator of the potency of the mediator, and the statistical significance of this decrement in predictive power can be tested.

Results

Table 1 presents the means, standard deviations, reliability estimates, and inter-correlations of all variables in the present study. Adolescents' self-report of academic stress was significantly correlated with both adolescent depression and suicidal ideation in the expected direction: academic stress was positively correlated with both adolescent depression ($r = 0.25$, $P < 0.01$, Cohen's $d = 0.52$), and suicidal ideation ($r = 0.22$, $P < 0.01$, Cohen's $d = 0.45$). Adolescent depression was also positively correlated with suicidal ideation ($r = 0.62$, $P < 0.01$, Cohen's $d = 1.58$) as expected.

Table 1 Means, standard deviations, reliability estimates, and intercorrelations for study variables

Variable	M	SD	α	1	2	3
1. Academic stress	26.69	8.19	0.88	–	0.25**	0.22**
2. Depression	4.28	3.62	0.81		–	0.62**
3. Suicidal ideation	12.32	16.41	0.94			–

Note. α = Cronbach's coefficient α. **$P < 0.01$

Table 2 contains the analyses necessary to examine the mediational hypothesis. Following the steps outlined earlier for testing mediation, we first established that the predictor, academic stress, was related to the outcome variable, suicidal ideation, by regressing suicidal ideation on academic stress (Step 1). Academic stress was significantly associated with suicidal ideation ($B = 0.44$, $\beta = 0.22$, $P < 0.001$), path c was significant and requirement for mediation in Step 1 was met. Next, to establish that academic stress was related to the hypothesized mediator, depression, we regressed depression on academic stress (Step 2). Academic stress was also significantly associated with depression ($B = 0.12$, $\beta = 0.25$, $P < 0.001$), and thus the condition for Step 2 was met (Path a was significant). To test whether the hypothesized mediator, depression, was related to the outcome, suicidal ideation, we regressed suicidal ideation simultaneously on both academic stress and depression (Step 3). Depression was significantly associated with suicidal ideation controlling for academic stress ($B = 2.71$, $\beta = 0.60$, $P < 0.001$). Path b was significant and condition for Step 3 was met. This third regression equation also provided an estimate of path c′, the relation between academic stress and suicidal ideation, controlling for depression. When path c′ is zero, we have evidence for complete mediation. However, path c′ was still significant ($B = 0.14$, $\beta = 0.07$, $P < 0.01$), although it is much smaller than path c ($B = 0.44$, $\beta = 0.22$, $P < 0.001$), and this suggests partial mediation.

However, it is not sufficient to demonstrate that the relation between academic stress and suicidal ideation was smaller when depression was added to the model. Rather, one of several methods for testing the statistical significance of the mediated effect should be used [22, 28]. There are several ways to assess whether this drop from 0.44 to 0.14 of the unstandardized regression coefficients (i.e., from path c to path c′) is statistically significant. The difference in paths c and c′ is equal to the product of paths a and b [28] and the statistical significance of the difference between c and c′ can be estimated by testing the significance of the products of paths a and b. Specifically, you divide the product of paths a and b by a standard error term.

For the present investigation, we used the standard error term used by Barron and Kenny [22]: the square root of $b^2 sa^2 + a^2 sb^2 + sa^2 sb^2$, where a and b are unstandardized regression coefficients and sa and sb are their standard errors. The mediated effect divided by its standard error yields a z-score of the mediated effect. If the z-score is greater than 1.96, the effect is significant at the 0.05 level. For our study,

Table 2 Testing for depression as a mediator using multiple regression

Steps in testing for mediation	B	SE B	95% CI	β
Testing Step 1 (Path c)				
Outcome: suicidal ideation				
Predictor: academic stress	0.44	0.06	0.33, 0.56	0.22**
Testing Step 2 (Path a)				
Outcome: depression				
Predictor: academic stress	0.12	0.01	0.09, 0.14	0.25**
Testing Step 3 (Paths b and c′)				
Outcome suicidal ideation				
Mediator: depression (Path b)	2.71	0.11	2.49, 2.92	0.60**
Predictor: academic stress	0.14	0.05	0.04, 0.23	0.07*

Note. CI = confidence interval. *$P < 0.01$; **$P < 0.001$

the z-score was calculated to be 10.78. Thus, adolescent depression was a statistically significant partial mediator even though path c′ was significant. In addition, a 95% confidence interval around the estimated effect can be calculated and the formula is as follows: product of paths a and b $\pm s_{ab}z.975$, where $z.975$ is equal to the constant 1.96 and s_{ab} is the standard error term calculated earlier [29]. In the present study, the 95% confidence interval would be 0.27–0.38. This confidence interval does not include zero and this is consistent with the conclusion that there is mediation (i.e., the mediated effect is not zero).

Shrout and Bolger [29] also suggested another way of describing the amount of mediation, which is in terms of the proportion of the total effect that is mediated as defined by ab/c. This method does not test the statistical significance of the mediated effect; rather, it provides a way of describing the amount of mediation. Using the unstandardized regression coefficients from our study, we get a calculated value of 0.74. Therefore, approximately 74% of the total effect of academic stress on suicidal ideation was mediated by adolescent depression. MacKinnon et al. [30] reasoned that a sample size of about 500 was needed for accurate point and variance estimates of the proportion of total effect mediated, a condition that was fulfilled in the present study.

Discussion

One objective of this investigation was to examine whether the relations between academic stress in terms of expectations of self and others, and suicidal ideation could be accounted for by adolescent depression. In addition, this paper also provided a step-by-step demonstration on how multiple regression analyses can be used to test for mediation in psychological research. Specifically, four predictions were examined and tested using Baron and Kenny's [22], and Holmbeck's [27] conceptual and statistical recommendations for assessing the presence of mediator effects. Adolescent depression partially mediated the relationship between academic stress and suicidal ideation. That is, the previously significant relationship between academic stress and suicidal ideation was significantly reduced in magnitude when depression was included in the model. The results suggested that suicidal ideation increases with depressed mood for adolescents in this sample. This is similar to De Man's [21] and Stewart et al.'s [23] findings which indicated that depression significantly accounted for the relationship between academic stress and suicidal ideation in adolescents.

The present findings may have applied and practical implications for intervention and prevention work with children and adolescents in schools. Intervention programs targeted at students at-risk for suicide might want to address issues of adolescent depression in addition to focusing on issues concerning academic stressors. Although stressors from the academic sphere in the form of expectations of self and others are positively correlated with suicidal ideation especially in Asian societies [3], focusing exclusively on academic stress in intervention work may have limited effectiveness especially when adolescent depression has been shown to influence the relationship between academic stress and suicidal ideation as a partial mediator. In addition, knowing that both academic stress and depression play a role in influencing suicidal ideation may be particularly important especially in an Asian context, where individuals with suicidal ideation are less likely to reveal this to

others than are Westerners [31]. It is interesting also, to speculate about the role of adolescent depression in other non-Asian cultures; specifically, whether depression would serve as a complete or partial mediator. Future research testing for depression as a mediator using non-Asian samples would be able to shed light on this issue.

There are a few limitations of the present study that should be noted. First, our data were based exclusively on adolescents' self-reports. It is possible that because adolescents were the sole respondents, significant associations obtained may reflect problems associated with shared method variance [32]. One drawback in the present study is that these statistically significant associations found among academic stress, depression, and suicidal ideation variables may be due to the fact that the measures consisted of questionnaires completed by adolescents as sole respondents. Shared method variance may result in spuriously high correlations among constructs [33]. Future studies could consider a multiple informant and multiple method strategy to overcome the problem of shared method variance.

Second, a related concern is that of omitted variables [28]. On the basis of previous empirical evidence, the present investigation focused on adolescent depression as a possible mediator of the relations between academic stress and suicidal ideation. It is possible that other variables not included in the present study could be stronger mediators of the relationship between academic stress and suicidal ideation. Adolescent depression may be one of many possible mediators. Also, the association between the depression and suicidal ideation may be due to omitted third variables that cause both.

A third limitation of our investigation is the correlational and cross-sectional nature of the study, specifically regarding the direction of the association between academic stress and depression. We demonstrated that adolescent depression partially mediated the relation between academic stress and suicidal ideation. In terms of directionality and causation, a strong argument can be made that academic stress preceded both depression and suicidal ideation as demonstrated in the study. However, it is also plausible that depression preceded academic stress and suicidal ideation. In order to establish causal directions of the relations found, longitudinal research is needed.

Summary

The relationship between academic stress, depression and suicidal ideation was examined in a sample of Asian adolescents from Singapore. Following Baron and Kenny's [22], and Holmbeck's [27] framework and statistical recommendations for testing mediator effects, adolescent depression was found to partially mediate the relationship between academic stress and suicidal ideation in a four-step sequential process, via the use of multiple regression. When depression was included in the model, the previously significant relationship between academic stress and suicidal ideation was significantly reduced, providing evidence in this sample that adolescent depression was a partial mediator. Limitations of self-report and correlational data were noted, as were omitted variables. Despite some of the shortcomings, this study has extended research by specifically testing for mediation using a large Asian adolescent sample. This general methodological approach may be transferable to other areas of research within child psychiatry and psychology.

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