

The Impact of Academic Pressure and Peer Support on Adolescents' Loneliness: A Polynomial Regression and Response Surface Analysis

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Purpose: To explore the impact of the match between academic pressure and peer support on adolescents' sense of loneliness and examine whether social connectedness played a mediating role, using a polynomial regression and response surface analysis.

Methods: A questionnaire survey was conducted with 1277 adolescents from two cities in Sichuan Province, China, to investigate their academic pressure, peer support, social connectedness, and sense of loneliness.

Results: (1) Adolescents' sense of loneliness positively correlated with their level of academic pressure and negatively correlated with their degree of peer support. (2) Social connectedness played a mediating role in the relationship between academic pressure, peer support, and sense of loneliness. (3) Adolescents with high academic pressure and low peer support had weaker social connectedness than those with low academic pressure and high peer support. (4) Adolescents with high academic pressure and high peer support had stronger social connectedness than those with low academic pressure and low peer support.

Discussion: The study revealed the mechanism through which a match (or mismatch) between academic pressure and peer support influenced adolescents' sense of loneliness and validated the mediating role of social connectedness. The study enriches the developmental theory of adolescent loneliness and provides research experience for future interventions targeting adolescent loneliness.

Keywords: academic pressure, peer support, social connectedness, loneliness, adolescents, polynomial regression and response surface analysis

Introduction

Loneliness is a subjective feeling of social isolation or a perceived lack of contact with others that results in a distressing experience.¹ It is also a significant but underestimated public health risk.² Loneliness pervades the entire human lifespan but is most common among adolescents and young people.^{3,4} Statistics show that nearly 80% of adolescents frequently experience loneliness.⁵ The causes of their loneliness include limited familial interaction or increased familial conflict,^{6,7} hindered development of intimate social relationships,⁸ academic maladaptation,⁹ and transitions to new environments or roles.^{10,11} Context development theory suggests that support from friends and parents interact in adolescents' emotional adaptation, with one form of support compensating for the absence of the other.^{12,13} Academic pressure also seems to play a role in the increase in adolescent loneliness.¹⁴ This study aims to explore this interaction.

The Relationship Between Academic Pressure and Sense of Loneliness

Academic pressure is defined as stress related to academic performance.¹⁵ Research has shown that the significant increase in loneliness during adolescence is often associated with poor academic performance.¹⁶ One reason is that, in many countries, teachers, and parents place great emphasis on education, making educational expectations one of the

main sources of immense pressure on adolescents.¹⁷ There may thus be a positive correlation between academic pressure and loneliness, with high academic pressure leading to higher levels of loneliness, and lonely adolescents feeling a greater academic burden.¹⁴ Although loneliness has been extensively explored as a variable, academic pressure has not received much attention as a factor contributing to a sense of loneliness. However, it has been proven to be a significant variable that should not be overlooked.¹⁴ Previous researches have not much studied on the relationship between academic stress and loneliness among Chinese adolescents. In view of the background that Chinese adolescents generally face greater academic pressure, it is necessary to further examine this relationship.

This study therefore proposes Hypothesis 1: There is a significant positive correlation between academic pressure and a sense of loneliness in adolescents.

The Relationship Between Friend Support and Sense of Loneliness

High-quality friendships are crucial for the well-being of adolescents.¹⁸ Peers and parents are important factors in an individual's developmental environment, and different types of social relationship can meet different interpersonal needs.¹⁹ Each type of relationship provides essential functions, and a lack of necessary relationship provisions can lead to painful experiences of loneliness.⁴ During adolescence, peer relationships in predicting adolescent well-being becomes more prominent.²⁰ Evidence suggests that a lack of intimate friendships is one of the main causes of adolescent loneliness.¹³ In view of the fact that social relationships can meet interpersonal needs and the impact of intimate relationships on adolescents' loneliness, previous studies have also lacked the relationship between peer support and loneliness. This study attempts to further explore the impact of peer support on adolescents' loneliness, in order to explore the improvement of adolescents' peer support to improve their loneliness in the future.

Therefore, this study proposes Hypothesis 2: There is a significant negative correlation between peer support and a sense of loneliness in adolescents.

The Relationship Between Academic Pressure, Friend Support, Social Connectedness, and Sense of Loneliness

Social connectedness refers to an individual's subjective perception of the intimacy of interpersonal relationships and the cognitive recognition of patterns in these relationships. It reflects an individual's attachment and commitment to social entities.²⁰⁻²² Loneliness occurs when there is a discrepancy between an individual's expectations and the actual level of interpersonal interactions. It is a subjective experience of perceived unsatisfactory social connectedness and interpersonal relationships, indicating that lonely individuals often experience poor social interactions.^{20,23} One study found that middle school students with better school connectedness and social connectedness had better mental health outcomes.²⁴ This suggests that when individuals feel lonely, they may need to enhance their social connectedness and engage in friendly interactions and conversations with others to promote positive emotional experiences and alleviate the distress caused by loneliness.¹⁴

Research has shown that social connectedness is positively correlated with social support and is a protective factor for common psychological distress symptoms such as loneliness,^{25,26} while a decrease in social support is closely associated with increased feelings of loneliness in adolescents.²⁷ In addition, scholars have found that higher levels of academic pressure are associated with lower levels of social support.²⁸ Previous studies focused on the impact of academic stress, peer support or social connection on adolescent loneliness, lacking of research experience to explore how academic stress and peer support work together to affect adolescent loneliness. In addition, peer support is passive support, while social connection is active connection, so it is necessary to explore the mediating role of social connection in it.

Therefore, in order to investigate the mechanisms through which academic pressure and peer support influence feelings of loneliness in adolescents, as well as the mediating role of social connectedness in this mechanism, this study proposes Hypothesis 3: Social connectedness plays a mediating role between the matching effect of "academic pressure-peer relationship" and loneliness in adolescents.

Methods

Participants

This study selected adolescents in grades 7 to 12 from four middle schools in L City and Y City, Sichuan Province, China, in January 2023 as participants. Cluster sampling was conducted at the class level with two classes selected from each grade in the four schools, resulting in a total sample of 1320 adolescents. A paper-based questionnaire survey was administered in a group setting. Prior to the administration of the tests, informed consent was obtained from all participants. A total of 1320 questionnaires were distributed; after excluding invalid responses, 1277 valid questionnaires were obtained, accounting for 96.74% of the total. The study was approved by the Human Research Ethics Committee of Yibin University (approval number: 2022042101Y).

In the valid sample, the average age of the adolescents was 14.34 years ($SD = 1.72$), including 678 (53.1%) males and 599 (46.9%) females. There were 211 (16.5%) students in grade 7, 245 (19.2%) in grade 8, 255 (20.0%) in grade 9, 194 (15.2%) in grade 10, 183 (14.3%) in grade 11, and 189 (14.8%) in grade 12. There were 193 (15.1%) only children and 1084 (84.9%) children with siblings.

Measurements

Academic Pressure Questionnaire

This study used the Academic Pressure Questionnaire developed by Wang et al.²⁹ The questionnaire consists of 35 items covering four dimensions of academic pressure: academic performance pressure, setback pressure, external environmental pressure, and competitive pressure. The behavioral measurement frequency of the participants was scored on a 5-point Likert scale, with (0 = Never, 1 = Occasionally, 2 = Sometimes, 3 = Often, and 4 = Always). After reverse-scoring transformation, higher scores indicated higher levels of academic pressure. In this study, Cronbach's α for this scale was 0.96, and the KMO and Bartlett's test values were 0.97, indicating good reliability and validity for the scale.

Child and Adolescent Social Support Scale

This study used the Chinese version of the Child and Adolescent Social Support (CASS) scale, which was revised by Luo, Chen, and Mu.³⁰ The revised scale consists of five subscales with a total of 60 items. The peer support subscale is a subscale of the CASS scale, consisting of 12 items. The behavioral measurement frequency of the participants was scored on a 5-point Likert scale (0 = Never, 1 = Occasionally, 2 = Sometimes, 3 = Often, and 4 = Always). After reverse-scoring transformation, higher scores indicated lower levels of social support. In this study, Cronbach's α coefficient for this scale was 0.96, and the KMO and Bartlett's test values were 0.97, indicating good reliability and validity for the scale.

Social Connectedness Scale

The Social Connectedness scale, revised by Fan et al.,³¹ was used to measure the degree of social connectedness. It comprises 20 items across three dimensions: sense of integration, sense of acceptance, and life involvement. Participants rated each item on a five-point Likert scale (0 = never, 1 = occasionally, 2 = sometimes, 3 = often, and 4 = always). After reverse-scoring transformation, the higher the score, the lower the social connectedness. In this study, Cronbach's α was 0.92, and the KMO and Bartlett's test values were 0.95, indicating good reliability and validity.

Loneliness Scale

A revised version of the "Adolescent Loneliness Scale" developed by Zou,³² was used to measure adolescent loneliness. The scale consists of 21 items. Participants were required to rate their agreement with each item. Each item was scored on a 5-point Likert scale (1 = Never, 2 = Occasionally, 3 = Sometimes, 4 = Often, and 5 = Always). After reverse-scoring transformation, higher scores indicated a stronger sense of loneliness. In this study, Cronbach's α coefficient for this scale was 0.93, and the KMO and Bartlett's test values were 0.94.

Method of Analysis

The reliability and validity of the questionnaire were assessed using SPSS software (version 23.0; IBM Corp., Armonk, NY, USA). Descriptive statistics and correlation analyses were conducted on the research variables. Polynomial regression and

response surface analyses were performed using R language. The important features of the three-dimensional response surface were estimated, and significance tests were conducted. In addition, a three-dimensional response surface graph was plotted.

The polynomial regression analysis was used to test a set of linear and nonlinear equations derived from the regression model.^{33,34} The independent variables in this model included academic stress (XX) and peer support (HY) as well as their squared and interaction terms. This method of analysis was used to examine the independent, consistency, and differentiation effects (ie, inconsistent effects) of the two independent variables on the dependent variable. The model was constructed using a quadratic polynomial regression as follows: $GD = b_0 + \text{control variables} + b_1(XX) + b_2(HY) + b_3(XX)^2 + b_4(XX) \times (HY) + b_5(HY)^2 + \text{Gender} + \text{Age} + e$. Here, GD represented the dependent variable, XX and HY were the two independent variables, b_0 was the intercept, b_1 – b_5 were the non-standard regression coefficients, gender and age were control variables, and e represented the error term. The analysis process in this study mainly involved three steps.

Step 1 involved conducting the polynomial regression analysis.^{34,35} First, the predictor variables XX and HY were normalized and the ratio of sample consistency or inconsistency in the direction of XX and HY was examined³⁵ to validate the suitability of the polynomial regression analysis. Second, the control and independent variables XX and HY were entered into the regression equation to test the linear effects of XX and HY on the dependent variable (GD). Finally, the interaction term ($XX \times HY$) and squared terms ($(XX)^2$ and $(HY)^2$) were included in the equation to test the curve relationship and interaction effects.

Step 2 involved the construction of a three-dimensional response surface based on the results of the polynomial regression analysis.³³ The regression coefficients (b_1 – b_5) were transformed into parameters (a_1 – a_5) for response surface analysis.³⁶ The analysis of data features, such as the stationary point of the response surface, (in)consistency lines, and the relationship between the first principal axis and the a_1 – a_5 parameters, was used to interpret the results.^{33,36}

Step 3 involved evaluating the direct and indirect effects of the mediation model between XX and HY in consistent and inconsistent matching pairs using a block variable.^{34,35} First, the five polynomials (XX, HY, $(XX)^2$, $(XX) \times (HY)$, and $(HY)^2$) were combined into a block variable. The block variable was then used as the independent variable to test the matching (consistency or inconsistency) of XX–HY and its impact on loneliness (GD) through the social connectedness (SL) hypothesis. The PROCESS plugin in SPSS was used, and bootstrap resampling was performed 5000 times to estimate the 95% confidence interval of the effect values and to test the mediation effect.³⁷

Results

Descriptive Statistical and Correlation Analyses

The statistical results of the mean, standard deviation, and correlation matrix of each variable are shown in Table 1 using descriptive statistics and correlation analysis. The results showed no significant correlations between sex, age, social connectedness, and loneliness among adolescents ($R_s = -0.043$ to 0.036 , $p > 0.05$). However, there were significant positive correlations among academic stress (XX), peer support (HY), social connectedness, and loneliness ($R_s = 0.314$ – 0.817 , $p < 0.001$). Thus, Hypotheses 1 and 2 were supported. The loneliness score among adolescents in this study was 25.16 ± 16.27 , which is at a lower level (with a maximum score of 82.0 points). However, 212 adolescents (16.60%) scored higher than the median score of 42.0.

Table 1 Descriptive Statistics and Correlation Analysis (N = 1277)

Variables	M	SD	1	2	3	4	5	6
1. Gender	0.47	0.50	I					
2. Age	14.34	1.72	0.078**	I				
3. XX	46.08	15.60	0.032	0.134***	I			
4. HY	18.53	11.33	−0.103***	−0.073**	0.314***	I		
5. SL	29.60	14.26	−0.012	−0.004	0.470***	0.625***	I	
6. GD	25.16	16.27	−0.043	0.036	0.501***	0.566***	0.817***	I

Notes: Statistically significant values ** $p < 0.01$, and *** $p < 0.001$; Gender: 0 for Boy and 1 for Girl; XX = academic pressure; HY = peer support; SL = social connectedness; GD = loneliness.

The results showed that the proportion of consistent cases between academic stress (XX) and peer support (HY) was 34.85% (445 participants), the proportion of cases where academic stress (XX) was greater than peer support (HY) was 32.03% (409 participants), and the proportion of cases in which academic stress (XX) was less than peer support (HY) was 33.12% (423 participants). These proportions met the analysis requirements (each category was greater than 10%) and allowed the polynomial regression analysis to be conducted.

The Effect of Academic Pressure–Peer Support Matching on Adolescents’ Social Connectedness

The impact of matching academic stress (XX) with peer support (HY) on adolescents’ social connectedness was examined using polynomial regression and response surface analyses. Table 2 presents the results of the study.

According to the data in Table 2, after controlling for gender and age, XX($b_1=0.299$) and HY($b_2=0.524$) positively predicted the social connectedness(SL) levels ($p < 0.001$). The significance of ΔR^2 in the polynomial model increased significantly ($p < 0.001$), indicating a significant relationship between the independent variables (XX–HY) and the dependent variable (social connectedness, SL) in the opposite direction (“one high and one low”).³⁸ In addition, the response surface significantly shifted along the inconsistent line ($a_5 = -0.071$, $p < 0.01$), indicating that the first principal axis representing the response surface did not coincide with the consistent line.

The slope ($a_1 = 0.823$, $p < 0.001$) and curvature ($a_2 = 0.053$, $p < 0.05$) along the consistent line (XX = HY) of the response surface indicated that the dependent variable (social connectedness, SL) formed an upward concave surface along the consistency of the independent variable (XX–HY) (Figure 1). In other words, the response surface first decreased along the consistent curve, reached its lowest point near the stationary point, and then increased. Compared to the “low XX–low HY” level of consistency, when the consistency level of the independent variable was “high XX–high

Table 2 Polynomial Regression Results and Response Surface Analysis (N = 1277)

Variable	SL	GD
b0	−0.071**	−0.123***
Gender	0.030	−0.012
Age	0.001	0.044*
b1	0.299***	0.350***
b2	0.524***	0.445***
b3	0.004	0.026
b4	−0.026	0.043
b5	0.075***	0.083***
$a_1 = b_1 + b_2$	0.823***	0.796***
$a_2 = b_3 + b_4 + b_5$	0.053*	0.153***
$a_3 = b_1 - b_2$	−0.225***	−0.095**
$a_4 = b_3 - b_4 + b_5$	0.106*	0.066
$a_5 = b_3 - b_5$	−0.071**	−0.057*
R^2	0.481	0.455
ΔR^2	0.479	0.452
F-statistic	168.23***	151.02***

Notes: Statistically significant values * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$; Gender: 0 for Boy and 1 for Girl; SL = social connectedness; GD = loneliness. The regression coefficients in the table are unstandardized regression coefficients. ΔR^2 represents the change in the model’s explanatory power after including the quadratic terms XX^2 , $XX \times HY$, and HY^2 . R^2 represents the variance explained by the polynomial regression model as a whole. a_1 and a_2 represent the slope and curvature of the consistent line, respectively, a_3 and a_4 represent the slope and curvature of the inconsistent line, respectively, and a_5 indicates whether the first principal axis of the surface lies on the consistent line.

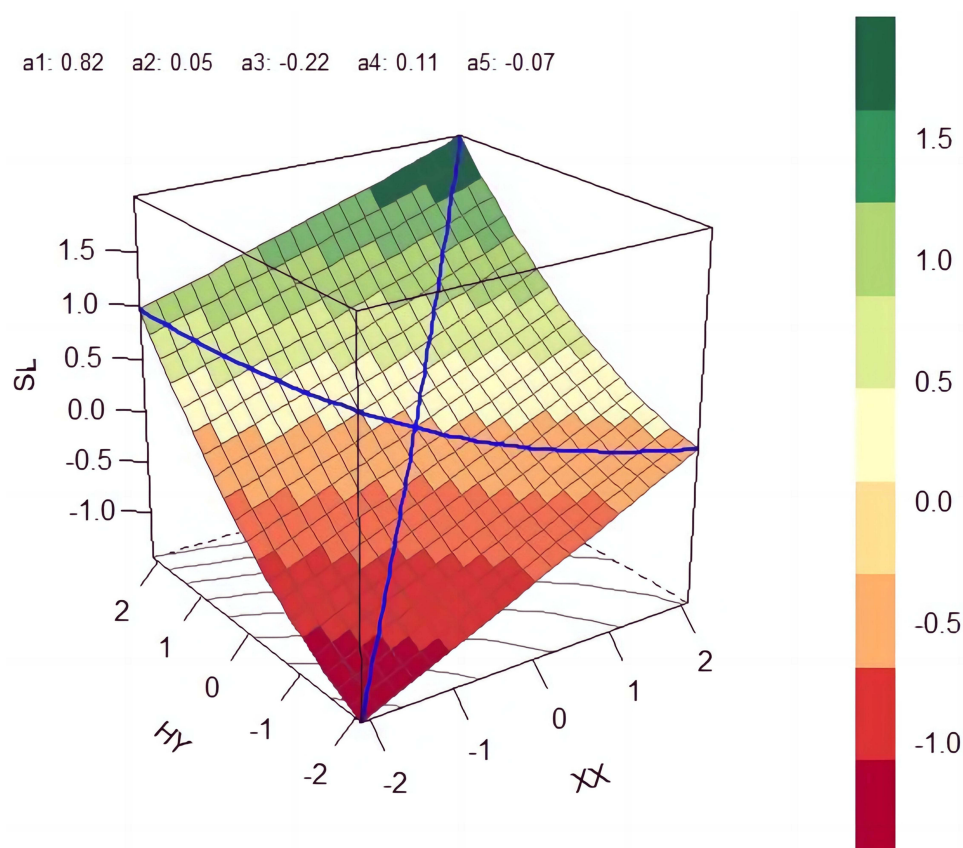


Figure 1 Response surface analysis of academic pressure (XX) and peer support (HY) matching with social connectedness (SL).

Notes: a1 and a2 represent the slope and curvature of the consistent line, respectively, a3 and a4 represent the slope and curvature of the inconsistent line, respectively, and a5 indicates whether the first principal axis of the surface lies on the consistent line.

HY”, the level of social connectedness (SL) was higher ($Z\text{-hat} = 23.490$, 95% CI [21.829, 25.141]). As higher scores indicate weaker peer support and social connectedness (SL) in adolescents, the social connectedness (SL) of adolescents with strong academic stress (XX) and weak peer support (HY) was weaker than that of adolescents with weak academic stress (XX) and strong peer support (HY).

The curvature ($a4 = 0.106$, $p < 0.05$) along the inconsistent line ($XX = -HY$) of the response surface indicates a concave increase from left to right (Figure 1), which means that the consistency of the independent variables (XX and HY) had a negative impact on social connectedness (SL), the lowest value of which occurred within the region where $HY > XX$. In addition, the slope ($a3 = -0.225$, $P < 0.001$) of the inconsistent line suggests a significant difference in the level of social connectedness (SL) owing to the difference in the independent variables. When using the point selection method³⁹ for calculation, it was found that the level of social connectedness (SL) was lower for “high XX–low HY” than for “low XX–high HY” ($Z\text{-hat} = -2.768$, 95% CI [-5.104, -0.530]). Higher scores indicate weaker peer support(HY) and social connectedness (SL) in adolescents; the social connectedness (SL) of adolescents with strong academic stress (XX) and peer support (HY) was stronger than that of adolescents with weak academic stress (XX) and peer support (HY).

The Effect of Academic Pressure–Peer Support Matching on Adolescents’ Loneliness

The impact of matching academic stress (XX) with peer support (HY) on adolescents’ loneliness was examined using polynomial regression and response surface analyses. Table 2 presents the results of the study.

According to the data in Table 2, after controlling for gender and age, $XX(b1=0.250)$ and $HY(b2=0.445)$ positively predicted the loneliness(GD) levels ($p < 0.001$). The significance of ΔR^2 in the polynomial model increased significantly ($p < 0.001$), indicating a significant relationship between the independent variables ($XX-HY$) and the dependent variable (loneliness, GD) in the opposite direction (“one high and one low”).³⁸ In addition, the response surface

significantly shifted along the inconsistent line ($a_5 = -0.071$, $p < 0.01$), indicating that the first principal axis representing the response surface did not coincide with the consistent line.

The slope ($a_1 = 0.796$, $p < 0.001$) and curvature ($a_2 = 0.153$, $p < 0.001$) along the consistent line ($XX = HY$) of the response surface indicated that the dependent variable (loneliness, GD) formed an upward concave surface along the consistency of the independent variable ($XX-HY$) (Figure 2). Compared to the “low XX –low HY ” level of consistency, when the consistency level of the independent variable was “high XX –high HY ”, the level of loneliness (GD) was higher ($Z\text{-hat}=26.435$, 95% CI [24.442, 28.495]). As higher scores indicate weaker peer support (HY) and loneliness (GD) in adolescents, the loneliness (GD) of adolescents with strong academic stress (XX) and weak peer support (HY) was weaker than that of adolescents with weak academic stress (XX) and strong peer support (HY).

The results of slope ($a_3 = -0.095$, $P < 0.01$) and curvature ($a_4 = 0.066$, $P > 0.05$) of the response surface along the inconsistency line show that the response surface presents an approximate straight line with lower left and higher right along the inconsistency line (left corner to right corner) (Figure 2). That is to say, the value of loneliness (GD) varies with the degree of differentiation between academic pressure (XX) and peer support (HY). Compared with “low XX –high HY ”, the level of loneliness (GD) is higher when “high XX –low HY ”. That is, the greater the difference of ‘ $XX > HY$ ’, the higher the level of loneliness (GD).

Mediating Effect Test

On the basis of the above analysis, we now examine the impact of the block variable ($XX-HY$) on adolescents’ feelings of loneliness and the mediating effect of social connectedness between the block variable ($XX-HY$) and adolescents’ feelings of loneliness. As polynomial regression and response surface analysis include sex and age as control variables, this study incorporated them as control variables in the equation. All variables were standardized. As shown in Figure 3,

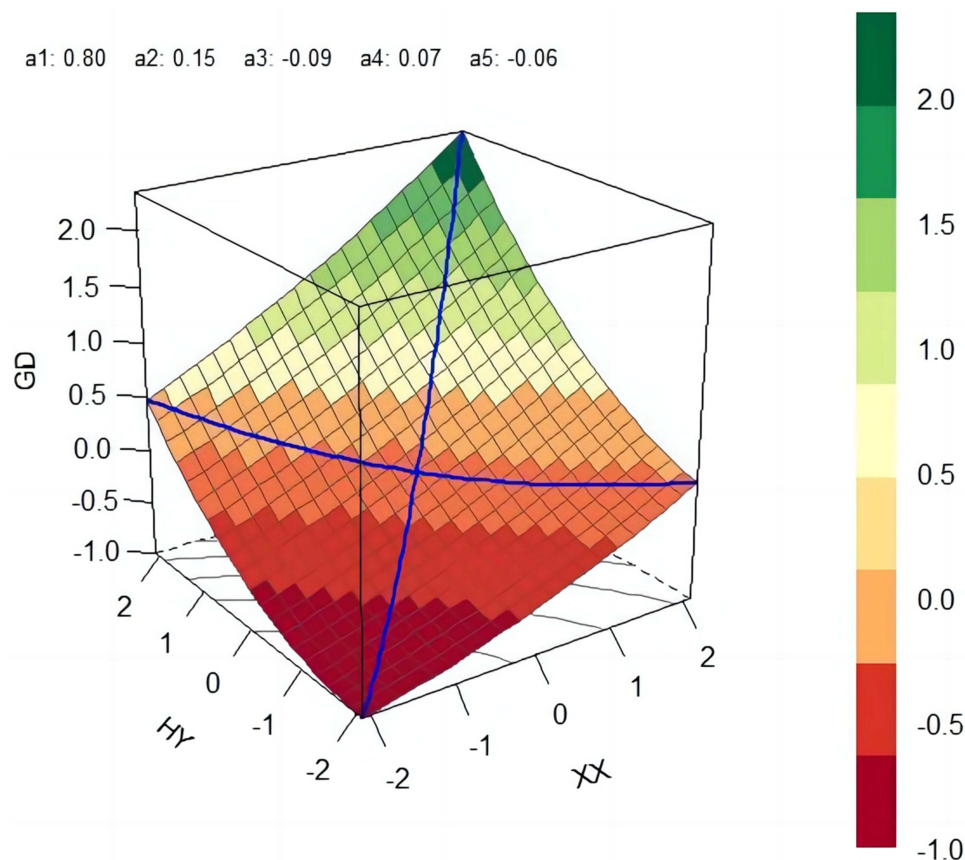


Figure 2 Response surface analysis of academic pressure (XX) and peer support (HY) matching with loneliness (GD).

Notes: a_1 and a_2 represent the slope and curvature of the consistent line, respectively, a_3 and a_4 represent the slope and curvature of the inconsistent line, respectively, and a_5 indicates whether the first principal axis of the surface lies on the consistent line.

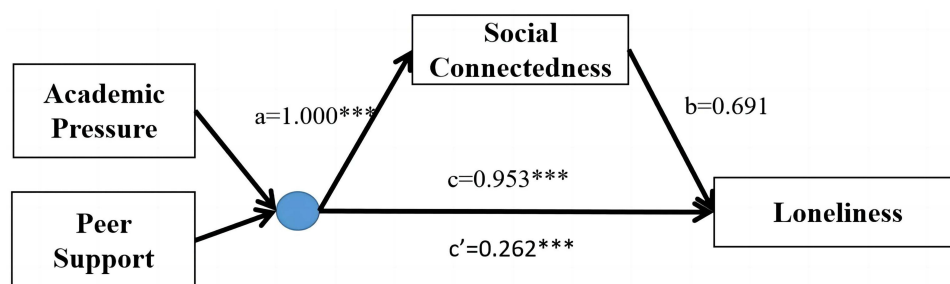


Figure 3 Mediating effect of social connectedness between the block variable (academic pressure–peer support) and loneliness among adolescents.

Notes: Statistically significant values *** $p < 0.001$; a is the effect of the independent variable “Block variable(academic pressure–peer support)” on the intermediary variable “Social Connectedness”; b is the effect of intermediary variable “Social Connectedness” on dependent variable “Loneliness” after controlling the influence of independent variable “Block variable(academic pressure–peer support)”; c is the total effect of independent variable “Block variable(academic pressure–peer support)” on dependent variable “Loneliness”; c' is the direct effect of independent variable “Block variable(academic pressure–peer support)” on dependent variable “Loneliness” after controlling the influence of intermediary variable “Social Connectedness”.

with gender and age as control variables, the block variable (XX–HY) was the independent variable, social connectedness was the mediating variable, and adolescents’ feelings of loneliness was the dependent variable. The effect of the block variable (XX–HY) on social connectedness was 1.000 ($t = 34.36$, $p < 0.001$, 95% CI [0.943, 1.057]); the effect of social connectedness on adolescents’ feelings of loneliness was 0.691 ($t = 31.77$, $p < 0.001$, 95% CI [0.648, 0.734]); the total effect of the block variable (XX–HY) on adolescents’ feelings of loneliness was 0.262 ($t = 8.36$, $p < 0.001$, 95% CI [0.200, 0.323]); and the direct effect was 0.953 ($t = 31.52$, $p < 0.001$, 95% CI [0.894, 1.012]).

Therefore, social connectedness in adolescents was found to partially mediate the relationship between the block variable (XX–HY) and adolescents’ feelings of loneliness, with a mediation effect size of 72.51%. Hence, Hypothesis 3 is supported.

Discussion

The Effect of Academic Pressure–Peer Support Matching on Adolescents’ Social Connectedness

Due to the emphasis on academic achievement in the Chinese educational environment, adolescents in China generally experience high levels of academic pressure.¹⁷ Moreover, Chinese adolescents face reduced family connections and increased academic pressure.¹⁴ This results confirm that the stronger the academic pressure faced by adolescents, the weaker their social connectedness.²⁸ This result is consistent with the earlier findings, academic pressures can reduce adolescents’ level of social engagement,⁴⁰ and peer support was positively correlated with social connectedness, meaning that the stronger the level of support from friends, the stronger the social connectedness of adolescents.

In this study, academic pressure and peer support had interdependent effects on adolescents’ social connectedness. Furthermore, adolescents with high academic pressure and low peer support had weaker social connectedness than those with low academic pressure and high peer support. Moreover, the degree of adolescent social connectedness showed a concave response surface consistent with academic pressure and peer support. This indicates that, with increasing academic pressure, peer support initially has a weakening effect on the reduction of social connectedness, followed by an additional effect. This finding highlights the importance of considering both academic pressure and peer support and reveals the unique and independent impact of peer support on academic pressure and social connectedness. These results may have practical implications for the implementation of measures and programs to alleviate academic pressure and promote the development of friendships among students.

The research findings also revealed that the level of social connectedness among adolescents tends to increase in a concave shape from left to right in the mismatch of academic pressure and peer support. This means that consistency between academic pressure and peer support has a negative impact on the level of social connectedness among adolescents. Furthermore, the maximum value of social connectedness among adolescents occurs in the region where peer support is strong and academic pressure is high (HY > XX). In other words, adolescents with high academic pressure and strong peer support have stronger

social connectedness than those with low academic pressure and weak peer support. This indirectly indicates that adolescents who face less academic pressure and receive effective peer support have a stronger level of social connectedness, and peer support seems to have a more prominent impact on their social connectedness. Conversely, positive peer support provides adolescents with greater coping resources, enabling them to adapt better to environmental changes⁴¹ and thus improve their academic performance.⁴²

The Mediating Role of Social Connectedness in the Match Between Academic Pressure and Peer Support and Loneliness

Loneliness is a prominent issue in early adolescence;³ however, it is currently unclear which factors are closely related to it. Our research findings suggest that social support is closely associated with feelings of loneliness among adolescents.²⁷ Social support is also closely related to social connectedness, serving as a protective factor against loneliness.^{25,26} One possible explanation is that adolescents who feel lonely often report lower social skills, and these subjective negative cognitions hinder their behavior in seeking social support and connections because they perceive their functioning in social environments negatively.⁴³ Research has shown that academic pressure has a unique relationship with feelings of loneliness.¹⁶ Greater academic pressure is associated with stronger feelings of loneliness, and in turn, loneliness negatively affects academic pressure.¹⁴

Furthermore, after examining the multivariate effects of academic pressure and friend support on feelings of loneliness, social connectedness, academic pressure and loneliness were found to be positively correlated. Peer support and social connectedness scores increased, indicating lower levels of peer support and social connectedness among adolescents. This confirms that the higher the level of peer support and social connectedness among adolescents and the greater the academic pressure they face, the stronger their feelings of loneliness.

The results also showed that social connectedness mediated the relationship between academic pressure and peer support matching and feelings of loneliness among adolescents, with a mediation effect size of 72.51%. This indicates that the level of social connectedness among adolescents has a significant mediating effect between the matching of academic pressure and peer support and feelings of loneliness. This study is the first to focus not only on the specific effects of academic pressure, friend support, and social connectedness on feelings of loneliness but also on the associations and differential effects among these factors. Doing so not only confirmed the positive role of more social connections in facilitating friend interactions and communication, and reducing feelings of loneliness¹⁴ but also validated the view that positive social connections are beneficial for the well-being of adolescents who experience loneliness due to increased academic pressure.²⁴

Conclusion

The main contribution of this study is its use of polynomial regression combined with response surface methodology to reveal the mechanism underlying the joint influence of academic pressure and peer support on social connectedness and feelings of loneliness among adolescents.

Although this study provides new insights, its research design still has some limitations. First, the sampling limitations make it difficult to generalize from the research findings, as the sample size of four secondary schools in two cities is relatively small compared to a national sample. Second, this study focused on junior high and high school students, and it is not known whether the research findings could be replicated. Finally, this was a cross-sectional study, and further longitudinal research data are needed to examine the practical and theoretical effects of social connectedness intervention practices for preventing and intervening in adolescent loneliness.

Declaration of AI-Assisted Technologies in the Writing Process

During the preparation of this work the author(s) used Chat AI in order to proofread the language. After using this tool, the author(s) reviewed and edited the content as needed and takes full responsibility for the content of the publication.

Data Sharing Statement

All data generated or analysed during this study are included in this published article.

Ethical Approval and Consent to Participate

This study and its research programs were approved by the Ethics Committee of Human Research Ethics Committee of Yibin University, China (2022-04-21-01Y). All methods were carried out in accordance with the Declaration of Helsinki and approved by the aforementioned ethics committee. All participants were informed about the contents of the survey and obtained their consent, as well as the informed consent of the participants' parents or legal guardians and the class teacher.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors of this study declare no conflict of interest and that the study has not been submitted for publication anywhere else.

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