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<https://doi.org/10.1057/s41599-024-03136-9>

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Longitudinal trajectories of self-esteem, related predictors, and impact on depression among students over a four-year period at college in China

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Self-esteem plays a crucial role in the psychological development of college students. Based on four-wave longitudinal data, this study empirically investigated the longitudinal trajectories of self-esteem, related predictors, and the impact on depression in a sample of Chinese college students. Piecewise growth mixture modeling was utilized to identify potential self-esteem trajectories. Furthermore, multinomial logistic regression models were employed along with the Kruskal–Wallis test to analyze the factors that influence self-esteem development trajectories and assess variations in depression. The results showed that college students' self-esteem trajectories can be divided into three categories: slowly decreasing (81.04%), rising then falling (16.94%), and falling then rising (2.02%). Various personal factors (e.g. ethnicity, family residence, self-reported health status, extroversion) and socioeconomic factors (e.g. closeness with classmates, family economic level, family social status, and the mother's educational level) can influence the classification of students' self-esteem development trajectories. Moreover, notable differences in depression were observed among students in different self-esteem trajectory groups. The results emphasize the imperative of implementing interventions to enhance self-esteem among college students.

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Introduction

Self-esteem is a person's comprehensive evaluation of their worth. It is widely recognized as a relatively stable trait consisting of both motivational and cognitive components (Kernis, 2003). Despite its perceived stability, self-esteem is inherently dynamic and subject to fluctuations, which reflect changes in an individual's underlying self-esteem level (Rosenberg, 1986). Several longitudinal studies have investigated changes in self-esteem over time. For instance, the transition from adolescence to adulthood typically witnesses a decline in students' self-esteem (Luo et al., 2022). During college years, students' self-esteem also demonstrated a gradual decrease (Liu et al., 2022; Zhang et al., 2022). After this, self-esteem increases linearly as adolescents transition from academia to the workforce (Filosa et al., 2022). Moreover, some studies further recognized the variations in self-esteem across different populations and attempted to classify self-esteem trajectories among them. In a survey conducted on the level of self-esteem of a group of college students, the self-esteem trajectory of the group was categorized into three categories by Almansour (2023): low self-esteem, moderate self-esteem and high self-esteem. An additional longitudinal study followed self-esteem trajectories among Korean adults over a decade and identified three distinct categories: stable high self-esteem, low-level increasing, and medium-level decreasing (Gil and Kim, 2022). However, these investigations primarily focus on self-esteem development during adolescence, with limited analysis of self-esteem heterogeneity among college students. The college stage of life serves as a crucial transitional period between campus and society, during which students undergo the process of transitioning from adolescence to adulthood. During this period, students often face dual challenges related to academic and personal life pressures (Islam et al., 2020). Therefore, the self-esteem of students in this period deserves more attention.

The factors contributing to fluctuations in college students' self-esteem are intricate, with previous studies categorizing them into two main aspects: personal and socioeconomic. Personal factors encompass a range of variables, such as age, sex, ethnicity, body mass index (BMI), sleep duration, self-reported health status, and extroversion status. For example, McMullin and Cairney (2004) found that older individuals, both males and females, have lower self-esteem than their younger counterparts. Additionally, females generally exhibit lower self-esteem than males (Pedregosa, 2022). Ogihara and Kusumi (2020) observed changes in self-esteem trajectories among different racial groups. Frayon et al. (2021) analyzed the self-esteem of various ethnic groups in the adolescent population of New Caledonia and discovered that ethnicity significantly predicts self-esteem. Furthermore, BMI was also negatively correlated with overall self-esteem among Polish students between the ages of 19 and 26 (Krupa-Kotara et al., 2023). Lemola et al. (2012) discovered that individuals reporting symptoms of insomnia (less than 6 h of sleep) tend to have lower levels of self-esteem, while those with long sleep durations (more than 9 h) also demonstrated lower self-esteem. Arsandaux et al. (2019) conducted a longitudinal study among French college students and revealed that higher self-esteem was independently associated with better self-reported health status. Moreover, Zeigler-Hill et al. (2013) found that higher self-esteem tends to be associated with extroversion.

Socioeconomic factors also exert a notable influence on self-esteem. These included aspects such as family residence, the presence of sibling status, peer relationships, family economic level, family social status, and parental educational levels. For instance, Ersoy et al. (2008) highlighted that the number of siblings and the residence indirectly impact self-esteem, suggesting that the influence of residential areas on self-esteem is largely

determined by local educational and economic contexts. Li et al. (2023) study provided direct evidence that only children have higher levels of self-esteem compared to those with siblings. Additionally, Cameron and Granger (2018) identified a correlation between self-esteem and social acceptance as well as the development of intimate relationships. Substantial evidence indicates that people with higher incomes tend to have higher self-esteem (Bleidorn et al., 2023). Shin (2015) discovered a positive association between higher personal income levels, family economic level and self-esteem. Building upon social hierarchy theory, Mahadevan et al. (2022) noted that fluctuations in self-esteem are positively correlated with changes in social status and negatively correlated with changes in depression. Despite the comprehensive analysis of various factors influencing self-esteem, the correlation between self-esteem and different longitudinal trajectories remains unexplored.

Furthermore, self-esteem is intricately linked to psychopathology, notably depression, as evidenced by several studies (Lee and Lee, 2023). The prevailing explanatory frameworks for this relationship are the vulnerability model (which suggests that low self-esteem leads to depression) and the scar model (which posits that depression leads to low self-esteem) (Zeigler-Hill, 2010). Multiple studies support the vulnerability model (Orth et al., 2009; Cao and Liu, 2024). Low self-esteem is more likely to lead to depression (Doyle and Catling, 2022). Individuals in the low self-esteem group tend to possess negative self-beliefs and rely excessively on interpersonal relationships for validation, thereby increasing their vulnerability to depression (Joiner et al., 1999). In addition, individuals with low self-esteem often harbor negative self-beliefs and seek validation from others, further contributing to their susceptibility to depression (Abela et al., 2006). Conversely, depression can negatively affect self-esteem, leading to low self-esteem (Bhattacharya et al., 2023). Evidence indicates that depression impairs important factors that influence individuals' self-esteem, such as interpersonal relationships and negative attitudes toward problem-solving (Orth et al., 2008). This negative effect further exacerbates the negative impact of depression on an individual's self-concept and cognition, leading to a decrease in self-esteem among depressed individuals (Jhangir and Jameel, 2023). Vulnerability and scarring are not mutually exclusive models, as they can operate concurrently. This highlights the significance of distinguishing between various categories of self-esteem trajectories, which potentially lead to different impacts on depression levels.

According to the literature review, despite the substantial body of research on self-esteem, there exists a notable gap in longitudinal studies specifically targeting college students. Moreover, the factors related to different sub-trajectories and differences in depression need to be further explored. Consequently, this study utilizes four years of longitudinal data from Chinese college students and employs a piecewise growth mixture model (GMM) to classify self-esteem trajectories. This study proposed the following hypotheses based on the literature review:

Hypothesis 1: The developmental trajectories of self-esteem among Chinese college students can be classified into different subcategories.

Hypothesis 2: Both personal factors (e.g., age, sex, BMI, sleep duration, self-reported health status, and extroversion status) and socioeconomic factors (e.g., ethnicity, family residence, sibling status, closeness with classmates, family economic level, family social status, mother's educational level) can influence college students' developmental trajectory of self-esteem.

Hypothesis 3: Significant variations exist in the levels of depression among college students categorized under different categories of self-esteem trajectories.

Methods

Participants. This study utilized the Beijing College Students Panel Survey (BCSPS) dataset, which consists of a longitudinal survey of students who were enrolled in 15 public colleges. The dataset contains comprehensive information regarding the students' social, economic, and self-reported health status, which was collected annually over a span of four academic years. Moreover, the demographic characteristics and mental health status of the participants were also tracked. The sample selection procedure adopted a probability proportionate to size sampling to ensure representativeness, thus providing a reliable and inclusive overview of college students in Beijing. Previous corroborative studies have extensively utilized and validated this dataset (Liu et al., 2023a, 2023b, 2023c, 2024). The sample sizes for the four survey rounds were as follows: 2473, 2356, 2341, and 2240. The present study employed data analysis techniques to identify self-esteem trajectories and investigated their impact on depression among college students. On average, the participants were 19.60 ± 0.89 years old, with 47.15% identifying as female and 52.85% as male.

Measures

Self-esteem. Self-esteem was evaluated using the Rosenberg Self-Esteem Scale (Rosenberg, 2015). This scale consists of 10 items designed to assess an individual's overall sense of self-worth by capturing their positive and negative feelings toward themselves. The individuals who participated in the study were instructed to evaluate each item using a five-point Likert scale, with options ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores on the scale indicate higher levels of self-esteem. The Rosenberg Self-Esteem Scale was tested rigorously to ensure the reliability of the measurement tool. The internal consistency and reliability of the scale were assessed using α coefficients, which ranged from 0.8779 to 0.8870 across the four years, indicating strong internal consistency. Furthermore, the coefficients exceeded the recommended threshold of 0.8, further confirming the robustness and validity of the measurement tool.

Depression. The DASS-42 scale, developed by Lovibond and Lovibond (1995), was utilized in this study to assess the degree of depression experienced by participants. This scale is a 42-item questionnaire that includes three self-report subscales designed to measure the negative emotional states of depression, anxiety, and stress. Each of the three subscales contains 14 items, and there is a clear division between the different subscales, so it is possible to isolate one of the scales for the study. The depression subscale of the DASS-42 scale was used in this study. The participants were required to self-report their responses on a scale ranging from 0 (indicating that the item is not applicable at all) to 3 (indicating that the item is highly applicable or most applicable). The depression subscale specifically has a maximum score of 42 points, where a higher score denotes a more severe level of depression. According to the DASS-42, the severity of depression can be classified based on the following instructions: 0–9 for “normal”, 10–13 for “mild”, 14–20 for “moderate”, 21–27 for “severe”, and 28 or above for “extremely severe”.

Related factors. The baseline survey in this study collected data on various predictors. These predictors encompassed a range of variables, including demographic characteristics, economic features, self-reported health status, extroversion traits, and relationships. The demographic characteristics included age, sex (coded as 0 for female and 1 for male), ethnicity (coded as 0 for Han and 1 for other ethnicities), family residence (coded as 0 for rural and 1 for urban), and whether the participant was the only child (coded as 0 for yes and 1 for no). Economic features

included variables such as family economic level (coded as 1 for upper class, 2 for upper-middle class, 3 for middle class, 4 for lower-middle class, and 5 for lower class); perceived family social status (coded as 1 for upper class, 2 for upper-middle class, 3 for middle class, 4 for lower-middle class, and 5 for lower class); and mother's educational level (mother's years of education). The self-reported health status variables included body mass index (BMI) (coded as 0 for underweight, 1 for normal weight, and 2 for overweight), sleep duration (coded as 0 for short, 1 for adequate, and 2 for long), and a self-reported health score ranging from 0 to 100. Additionally, the measurement instrument for the extroversion variable was derived from a self-reported question (“Please rate your level of extroversion.”), and the score choices ranged from 1 to 10, with a higher score indicating greater extroversion. The level of closeness is measured in a similar way; the question is “Please rate your level of closeness with your classmates”, and the score choices ranged from 1 to 5, with a higher score indicating greater closeness to classmates.

Data analysis

In this study, growth mixture modeling (GMM) performed with Mplus 7.4 software was utilized to effectively identify variations in the patterns of change in self-esteem among college students. GMM, a sophisticated multilevel modeling technique, is employed to classify trajectories based on growth characteristics within a given population. Additionally, it allows for the examination of correlated variables between specific populations and individual trajectories (Ram and Grimm, 2007). Various criteria are employed to assess the quality and fit of statistical models. These criteria include the AIC, BIC, SABIC, LMR-LRT, B-LRT, and entropy. AIC, BIC, and SABIC are essential indices that enable the comparison of models based on factors such as the number of trajectories, sample size or number of estimated parameters. It is generally preferred to have lower values for these indices, as they indicate a better fit for the model (Kim, 2014; Nylund et al., 2007). Moreover, LMR-LRT and B-LRT are statistical tests used to compare two adjacent models, labeled k and $k-1$, respectively. These tests yielded statistically significant results ($p < 0.05$), which suggested that the k -class model was better than the $k-1$ class model. Therefore, a preference is given to the k -class model over the $k-1$ class model (Lo, 2001). Furthermore, entropy, which ranges from 0 to 1, serves as a measure of the accuracy with which cases are classified into their respective groups. Values closer to 1 indicate a more accurate classification (Celeux and Soromenho, 1996).

Additionally, StataMP 17 software was used to conduct multinomial logistic regression analysis, aiming to explore the various factors that influence the classification of different self-esteem trajectories. Finally, the study also compared the levels of depression among different trajectory groups and investigated the potential effects.

Results

Determining the number of self-esteem trajectories. This study employed various classification models and assessed their goodness-of-fit using six fit indices (Table 1). Significance tests conducted at an α level of 5% revealed that models 2–4 exhibited significant differences based on both the LMR-LRT and B-LRT tests, whereas the 5-class model did not reach statistical significance. Furthermore, when the data were grouped into 2 or 4 clusters, the entropy index decreased to less than 0.8. The AIC, BIC, and SABIC values consistently supported the idea that the 3-class model was the most logical and exhibited the best fit for the study. The B-LRT also yielded significant differences at the 5% significance level, corresponding to an entropy value of 0.82.

Characteristics of different categories of self-esteem trajectories. Figure 1 presents the diverse trajectories observed in the self-esteem groups. Group 1, constituting 81.04% of the total sample, demonstrated a significant mean intercept and slope ($p < 0.01$). This group exhibited a continuous decrease in self-esteem from the freshman year (40.40) to the senior year (36.91), characterized as the “slowly decreasing type”. Group 2 accounted for 16.94% of the total sample and had a significant mean intercept and slope ($p < 0.01$). Notably, this group showcases an initial upsurge in self-esteem from the freshman year (28.10) to the sophomore year (33.52) and a gradual decline from the sophomore year (33.52) to the senior year (32.86), termed the “rising-then-falling type”. Group 3 accounted for 2.02% of the total sample, illustrating a significant mean intercept and slope ($p < 0.01$). This group experienced a rapid decline in self-esteem from the freshman year (40.74) to the sophomore year (26.22), followed by a gradual recovery from the sophomore year (26.22) to the senior year (33.36), referred to as the “falling-then-rising type”. The analysis confirms Hypothesis I, indicating that Chinese college students’ trajectories of self-esteem can be classified into three distinct subcategories: the slowly decreasing group, the rising-then-falling group, and the falling-then-rising group.

Factors related to different categories of self-esteem trajectories. We utilized a multinomial logistic regression model to examine the predictors and the results are shown in Table 2. By using the slowly decreasing group as the reference category, we discovered that ethnicity had a significant positive impact on the likelihood of entering the falling-then-rising group (RRR = 2.09, $p < 0.05$), while family residence had a significant negative effect (RRR = 0.30, $p < 0.01$). Specifically, compared to students who experienced a decrease in self-esteem during their 4-year college period, minority students were found to be 2.09 times more likely to experience a trajectory of self-esteem that initially declined and then increased. Additionally, students from urban areas were 30% less likely than those from rural areas to experience such a trajectory.

When considering the slowly decreasing group as the reference class, the variables of self-reported health status (RRR = 0.96, $p < 0.01$), extroversion status (RRR = 0.79, $p < 0.01$), and closeness with classmates (RRR = 0.83, $p < 0.01$) exhibited noteworthy negative effects on students entering the rising-then-falling group. Conversely, perceived family socioeconomic status had a significant positive impact on students entering the rising-then-falling group (RRR = 1.38, $p < 0.01$). In essence, compared to students whose self-esteem gradually decreased over the four years, students who reported better self-reported health, higher levels of extroversion, closer relationships with classmates, and higher perceived family socioeconomic status were less likely to experience a pattern of increased-then-falling self-esteem.

When using the falling-then-rising group as the reference category, several noteworthy associations emerged. Students from urban areas had a significantly greater possibility of being in the rising-then-falling group (RRR = 0.96, $p < 0.01$). Conversely, minority students (RRR = 0.37, $p < 0.05$), those with poorer self-reported health status (RRR = 0.95, $p = 0.01$), and individuals whose mothers had lower educational levels (RRR = 0.88, $p < 0.05$) experienced noticeably decreased chances of being part of the rising-then-falling category. Thus, in comparison to those with a decreasing self-esteem pattern, minority students were less likely to experience a rising-then-falling pattern, as were students with poorer self-reported health status and mothers with lower education levels. However, students from urban areas were more likely to exhibit the rising-then-falling pattern. Notably, age, sex, family structure (having siblings or not), body mass index (BMI), sleep duration, and family income did not affect the trajectories of self-esteem.

Table 1 Fit Indices for growth mixture models of self-esteem trajectories with 2-5 latent classes.

	2 class model	3 class model	4 class model	5 class model
AIC	56,129.21	56,065.43	55,947.00	56,012.90
BIC	56,228.03	56,187.50	56,092.33	56,077.33
SABIC	56,174.02	56,120.78	56,012.90	55,985.19
LMR-LRT	$p < 0.001$	$p < 0.003$	$p < 0.001$	$p = 0.322$
B-LRT	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$
Entropy index	0.79	0.82	0.79	0.73
Mixture proportion (%)	82.41	81.04	76.38	60.82
	17.59	16.94	11.32	22.52
		2.02	6.19	6.19
			6.11	5.66
				4.81

AIC Akaike information criterion, BIC Bayesian information criterion, SABIC sample size adjusted bayesian information criterion, LMR-LRT lo Mendel-Rubin adjusted likelihood ratio test, B-LRT bootstrapped likelihood ratio test.

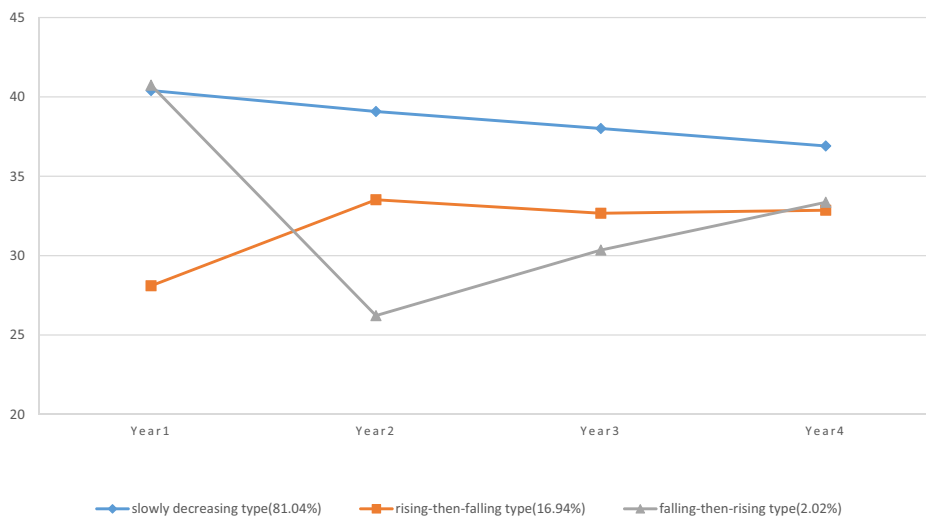


Fig. 1 Growth mixture model of self-esteem. Trajectory classes of self-esteem.

Table 2 Factors influencing different categories of self-esteem trajectories.

	Falling-then-rising (vs. slowly decreasing)			Rising-then-falling (vs. slowly decreasing)			Rising-then-falling (vs. falling-then-rising)		
	RRR	95% CIs	p-value	RRR	95% CIs	p-value	RRR	95% CIs	p-value
Age	1.01	(0.73;1.39)	0.970	1.01	(0.88;1.15)	0.922	1.00	(0.71;1.41)	0.997
Gender: Male (vs. Female)	1.81	(0.95;3.44)	0.069	0.94	(0.74;1.20)	0.609	0.52	(0.26;1.01)	0.055
Ethnicity: Minority (vs. Han)	2.09	(1.02;4.30)	0.045*	0.78	(0.53;1.16)	0.217	0.37	(0.17;0.83)	0.015*
Household registration: Urban (vs. Rural)	0.30	(0.13;0.70)	0.006*	1.02	(0.73;1.43)	0.891	3.45	(1.40;8.47)	0.007*
Sibling: No (vs. Yes)	1.60	(0.75;3.40)	0.223	0.83	(0.62;1.11)	0.210	0.52	(0.24;1.15)	0.105
BMI									
Low (vs. Normal)	1.18	(0.54;2.55)	0.667	0.86	(0.63;1.16)	0.319	0.73	(0.32;1.63)	0.439
High (vs. Normal)	1.21	(0.46;3.22)	0.699	1.20	(0.82;1.78)	0.348	0.99	(0.36;2.76)	0.991
Sleep duration									
Short (vs. Normal)	1.91	(0.86;4.23)	0.113	1.06	(0.72;1.54)	0.777	0.55	(0.24;1.30)	0.176
Long (vs. Normal)	1.55	(0.59;4.06)	0.376	1.23	(0.81;1.88)	0.328	0.80	(0.29;2.21)	0.664
Health	1.01	(0.98;1.03)	0.725	0.96	(0.95;0.97)	0.000*	0.95	(0.92;0.98)	0.001*
Personality	0.92	(0.78;1.10)	0.382	0.79	(0.74;0.85)	0.000*	0.85	(0.71;1.03)	0.096
Closeness with classmates	0.78	(0.56; 1.03)	0.137	0.83	(0.73; 0.96)	0.009*	1.07	(0.76; 1.51)	0.700
Family economic level	0.77	(0.46;1.30)	0.330	0.92	(0.75;1.14)	0.473	1.20	(0.69;2.08)	0.517
Family social status	1.49	(0.91;2.42)	0.111	1.38	(1.13;1.69)	0.002*	0.93	(0.56;1.55)	0.773
Mother's educational level	1.11	(1.00;1.23)	0.053	0.98	(0.94;1.01)	0.236	0.88	(0.79;0.98)	0.023*

Figures with * are statistically significant at $\alpha = 0.05$.
RRR relative risk ratio, 95% CIs 95% confidence intervals.

Table 3 Differences in mean scores of depression across latent classes of self-esteem trajectories.

	Slowly decreasing ^a		Rising-then-falling ^b		Falling-then-rising ^c		
	M	SE	M	SE	M	SE	
Depression at year 1	5.98	0.12	14.27	0.38	7.08	0.69	a < c < b
Depression at year 2	6.78	0.13	11.66	0.39	15.60	1.46	a < b < c
Depression at year 3	6.85	0.15	11.84	0.41	15.67	1.46	a < b < c
Depression at year 4	6.48	0.16	10.82	0.40	11.42	1.33	a < b < c

The results confirm Hypothesis II, indicating that various factors, including ethnicity, family residence, self-reported health status, extroversion, closeness with classmates, family social status, and mothers' educational level, significantly influence the developmental trajectory of self-esteem among college students.

Differences in depression for different categories of self-esteem trajectories. Table 3 displays the average differences in depression scores among participants with various self-esteem trajectories over a period of four years. The results revealed significant variations in depression scores across different self-esteem categories for each year. Individuals with a gradually declining self-esteem trajectory consistently had the lowest depression scores throughout all years, and their depression scores remained consistently low when their self-esteem was stable and high.

Significant differences in depression scores were notably evident among the groups during the freshman year ($\chi^2 = 430.42, p < 0.001$). Specifically, the group characterized by an initial increase followed by a decrease had the highest mean depression score (mean = 14.27, SE = 0.38), which was greater than that of the slowly decreasing group (mean = 5.98, SE = 0.12) and the falling-then-rising group (mean = 7.08, SE = 0.69). Similar patterns were observed for the number of sophomore years ($\chi^2 = 189.61, p < 0.001$) and junior years ($\chi^2 = 179.27, p < 0.001$). The falling-then-rising group consistently exhibited the highest mean depression score during both years, followed by the rising-then-falling and slowly decreasing groups. In the senior year, significant differences in depression scores were also observed among the groups ($\chi^2 = 129.34, p < 0.001$). The

falling-then-rising group had the highest mean depression score (mean = 11.42, SE = 1.33), which was greater than that of the slowly decreasing group (mean = 6.48, SE = 0.16) and the rising-then-falling group (mean = 10.82, SE = 0.40).

Overall, the slowly decreasing group maintained an average depression score within the normal range (ranging from 0 to 9). However, the rising-and-falling and falling-and-rising groups struggled with mild or even moderate depressive symptoms during their college years. The analysis supports Hypothesis III, which proposes significant disparities in depression levels among college students across different self-esteem trajectory categories.

Discussion

This study used a piecewise growth mixture model to investigate the development of self-esteem among college students throughout their four years, as well as the factors that influence self-esteem. Additionally, the study explored the impact of different self-esteem trajectories on students' levels of depression. Based on relevant self-esteem theory and fit indices, this study identified three distinct self-esteem trajectories. The majority of college students, known as the "slowly decreasing" group, followed a trajectory characterized by a gradual decline in self-esteem from their freshman year to their senior year. In contrast, a small percentage of students experienced fluctuations and instability in their self-esteem levels over time, having similar self-esteem levels during their first year of college. However, noticeable differences emerged in subsequent years, with one group showing a pattern of initially increasing self-esteem from the freshman year to the sophomore year, followed by a gradual

decline through the senior year (the “rising-then-falling” group), and another group experiencing a sharp decrease in self-esteem from the freshman year to the sophomore year, followed by a gradual increase through the senior year (the “falling-then-rising” group). The present study revealed that college students’ longitudinal trajectories vary across groups and identified three developmental paths in addition to those already described in previous studies. Notably, after the second year of college, students demonstrated increased adaptability to college life and the environment, resulting in a stabilization of their self-esteem trajectories. The self-esteem of both the rising-and-falling and falling-and-rising groups exhibited a rebound trend.

This study further investigated the related predictors of each trajectory of self-esteem among college students. The findings indicate that ethnicity, family residence, self-reported health, extroversion, closeness with classmates, family economic level, family social status, and mother’s education level may affect the grouping of self-esteem trajectories. First, regarding personal factors, minority students are more likely to experience a sharp decline in self-esteem from their freshman year to their sophomore year, followed by a continuous increase in their junior and senior years, compared to the slowly decreasing group. In comparison to those in the falling-then-rising group, Han students are more likely to fall into the rising-then-falling group. This factor is likely associated with Chinese social background. Because of the larger proportion of the Han population, Han students are better equipped to navigate the learning environment, regulate their psychological well-being, and maintain a stable level of self-esteem upon entering college. Conversely, minority students may experience a period of adjustment influenced by cultural or habitual differences between the university milieu and their prior environments. As a result, this transitional phase could potentially lead to a decrease in their self-esteem. Second, students with poorer self-reported health are more likely to fall into the rising-then-falling group. The findings drawn from this study provide further support for previous research conducted by Arsandaux et al. (2019). Third, the results imply that individuals who possess extroversion status are more likely to maintain a consistent level of self-esteem. This may be because extroverted college students view stress as a challenge rather than an obstacle, actively seeking out strategies to overcome difficulties, ultimately leading to higher levels of self-esteem. Consequently, it can be inferred that extroversion and self-esteem are positively correlated.

In terms of socioeconomic factors, first, college students who have closer relationships with their peers better maintain a stable, high level of self-esteem. These findings correspond with the conclusions drawn by Cameron and Granger (2018). Second, concerning family background, students from rural areas may encounter more challenges in acclimating to the college environment, potentially resulting in a marked decline in their self-esteem during the initial two years of college. Third, students from families of higher socioeconomic status are more likely to maintain a relatively stable level of self-esteem, echoing the findings of Mahadevan et al.’s (2022). This may be attributed to the wider social network and better economic conditions available to students from higher socioeconomic backgrounds, which provide them with more positive support. Additionally, students whose mothers possess higher education levels are more likely to fall into the “falling-then-rising” category of self-esteem development than into the “rising-then-falling” group. Overall, the study identified the impact of personal factors and socioeconomic factors on self-esteem and provided valuable insights into the development of self-esteem, which has substantial implications for predicting and intervening in the trajectories of self-esteem development.

Moreover, significant variations were observed in the levels of depression among college students exhibiting different trajectories of self-esteem. First, for the “slowly decreasing” group, the depression scores ranged from 5.98 to 6.85 over a span of four years, falling within the normal range. This trajectory consistently had the lowest depression score among the three groups each year. Second, the “rising-and-falling” group had depression scores that ranged from 10.82 to 14.27 over four years. In fact, their average depression score was as high as 14.27 in the first year, indicating that it fell within the moderate range. However, as their self-esteem increased from the second year onward, their depression score gradually decreased, eventually falling within the mild range. Third, the “falling-then-rising” group had depression scores ranging from 7.08 to 15.67 over four years. Apart from the first year, when the depression score was within the normal range, the depression score far exceeded the normal range from the second year and fell within the moderate range. The depression score reached a peak of 15.67 in the third year. However, in the fourth year, their self-esteem increased, leading to a gradual decrease in their depression score, which fell within the mild range. Previous studies have consistently indicated that self-esteem has a negative predictive effect on depression. These findings align with the conclusions drawn from previous studies (Gao et al., 2022).

One particularly noteworthy finding is that the depression scores of college students in the first year in the “rising-then-falling” group and in the second and third years in the “falling-then-rising” group reached a moderate level. This should serve as a warning signal, suggesting potential challenges that college students face in adapting to the college environment, as well as the lack of psychological education and services provided by schools. These results suggest that educators should be more attuned to the psychological development of college students, strengthen psychological education, and develop adequate intervention strategies. Overall, in light of these findings, universities should take proactive measures to enhance college students’ self-esteem and mitigate the risk of depression associated with low and unstable self-esteem. By doing so, universities can contribute to the cultivation of stable self-esteem and promote a positive psychological health model among college students.

Limitations

First, the data for this research were obtained solely through self-report questionnaires completed by college students. It is possible that self-reported measures have inherent measurement errors, as respondents may provide socially desirable responses or misinterpret questionnaire items. Second, it is crucial to recognize that the participants were exclusively selected from universities in Beijing, China. Therefore, further exploration is needed to determine whether the findings can be generalized to all Chinese college students.

Conclusions

First, this study validates the classification of three potential trajectories in the development of self-esteem among Chinese college students: slowly decreasing self-esteem, rising-then-falling self-esteem, and falling-then-rising self-esteem. Each trajectory exhibits distinct characteristics and patterns.

Second, various personal and socioeconomic factors emerge as influential determinants in classifying self-esteem development trajectories among college students. These factors include ethnicity, family residence, self-reported health status, extroversion status, degree of closeness with classmates, family economic level, family social status, and mother’s level of education.

Third, the study underscores the consequential impact of self-esteem trajectories on levels of depression among college students. Specifically, the group with slowly declining self-esteem maintained normal levels of depression throughout the 4-year period. Conversely, students in the initially increasing and subsequently declining groups, as well as those in the initially declining and subsequently increasing self-esteem groups, experienced mild to moderate depressive issues during the four academic years at college.

Data availability

The data ownership belongs to the National Survey Research Center, Renmin University of China. For any related questions about data, please reach the National Survey Research Center, Renmin University of China. Since the dataset has not been publicly released, the authors only obtained the right to use the dataset and do not have the authority to publicly distribute it. Therefore, a download link for the dataset cannot be provided. However, descriptive statistical analysis results regarding this dataset have been published in the appendix of the author's previously published paper. You can refer to the following paper for more information: <https://doi.org/10.1057/s41599-023-02252-2>. The data that support the findings of this study are available from the corresponding author upon reasonable request.

Received: 4 January 2024; Accepted: 29 April 2024;

Published online: 13 May 2024

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Acknowledgements

This study was supported by the Innovation Fund of Tianjin University (social influence), a key research base project of Sichuan Provincial Philosophy and Social Science (SC23E060), and a collaborative education project for industry-university cooperation of Ministry of Education (230702690214541).

Author contributions

XL and YL designed the study and wrote the protocol. XL and YY undertook the statistical analysis. XL, YY, WG, and YL wrote the first draft of the manuscript and managed the literature analyses. All the authors read and approved the final manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

Ethical approval was acquired from the Ethics Committee of Tianjin University (ethical approval number: TJUE-2022-188; name of approval committee: Ethics Committee of Tianjin University).

Informed consent

Before filling out the questionnaire, informed consent was obtained from all participants in the study.

Additional information

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