



Family socioeconomic status and adolescent depression in urban and rural China: A trajectory analysis

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ABSTRACT

Background: Depression is increasingly prevalent among Chinese adolescents, with socioeconomic status (SES) serving as a significant predictor. Understanding the link between family SES and depression is of paramount concern. This study aimed to delineate the developmental paths of depressive symptoms among urban and rural Chinese adolescents, focusing on the influence of family SES on these trajectories.

Methods: Data from the China Family Panel Studies (CFPS) for 2012, 2016, and 2018 were used in this study. Participants were individuals aged 10 to 15 in the 2012 wave who also participated in the 2016 and 2018 waves (N = 1214). Family SES was measured by household income, parental education, and occupational status, while depressive symptoms were measured by the Center for Epidemiologic Studies Depression (CES-D) scale. Employing the Growth Mix Model (GMM) unveiled depression trajectories, while logistic regression scrutinized the impact of family SES on these trajectories.

Results: The study identified three depression trajectories in urban adolescents: high-decreasing, low-stable, and low-rising levels of depressive symptoms, and two depression trajectories in rural adolescents: high-decreasing and low-stable levels of depressive symptoms. On average, rural adolescents reported higher depression levels than urban peers. In urban areas, adolescents with higher maternal education and parental occupation were more likely to be classified in the low-stable trajectory, while in rural areas only maternal education had predictive power for depression trajectories.

Conclusions: Depression trajectories differ between urban and rural in China. Maternal education is an important factor influencing rural sample grouping. Targeted interventions could be implemented to reduce depression in adolescents.

1. Background

According to the World Health Organization (WHO) survey, over 264 million people worldwide suffer from depression (about 4.4%) (WHO, 2017). Childhood depression ranges from 2% to 4%, spiking to about 20% in adolescence (Thapar et al., 2012). In China, the Report on National Mental Health Development (2019–2020) states that the detection rate of depression among adolescents is 24.6%, increasing with age (Fu et al., 2021). Depression is correlated with smoking, drinking, substance abuse, violence, and other health risks (Glied & Pine, 2002; Weller & Weller, 2000). Puberty sees a notable surge in depression rates (Duchesne & Ratelle, 2014; Mezulis et al., 2014). It is crucial to identify the developmental trajectories of adolescent depression to gain a better understanding of its dynamic nature.

SES is a pivotal social factor linked to depression, encompassing wealth, power, and relative social status (Mueller & Parcel, 1981). Many studies have demonstrated that SES significantly predicts depression (Costello et al., 2008; Weinberg et al., 2019). Despite foundational research on adolescent depression in China, limitations persist in empirical knowledge. Most studies relied on cross-sectional data, restricting insights into depression fluctuations in adolescents (Henderson et al., 2005; Boe et al., 2012). While previous studies have examined SES and depression trajectories longitudinally, there's a gap in understanding urban-rural heterogeneity (Liu, Tan, Feng, & Tu, 2022). Closing these gaps is essential for a comprehensive understanding of adolescent depression. Besides, it remains unclear whether both maternal and paternal SES play significant roles in influencing adolescent depression.

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Therefore, the primary objectives of this study were twofold. Firstly, we aimed to uncover the dynamic developmental trajectories of adolescent depression in China using longitudinal data while also considering urban-rural differences. Secondly, we examined the impact of family SES on adolescent depression trajectories.

1.1. Theoretical framework

The study of depression trajectories draws on developmental contextualism and life course theory. Developmental contextualism suggests that while individuals follow universal patterns of development, their unique circumstances lead to diverse trajectories (Lerner, 2006). Life course theory explores how social factors shape individual life paths, particularly regarding health disparities (Li et al., 1999). This study aligns with the focus of life course theory on the long-term effects of early factors and on inequalities in health.

Several theories elucidate the SES-depression relationship. Social causation theory posits that SES impacts mental health, with high SES offering protection while low SES correlates with poorer outcomes (Dohrenwend & Chin-Shong, 1967). The cumulative disadvantage (or advantage) theory suggests that SES's influence on mental health evolves over time, rooted in Merton's work on social stratification (Merton, 1968). Additionally, the family stress model and family investment theory propose that higher family SES provides resources for children's development, fostering favorable conditions (Bradley & Corwyn, 2002; Conger et al., 2010). Social causation theory underscores the direct link between SES and depression, without delving into specific influencing mechanisms. The cumulative advantage/disadvantage theory posits that early adverse experiences, like low SES, contribute to cumulative psychological symptoms. The family stress model and family investment theory extend social causation theory, elucidating specific mechanisms through which SES impacts depression symptoms. This study focuses on examining the direct relationship between family SES and depression trajectories, grounded in social causation theory.

The theoretical model, depicted in Fig. 1, explores the socioeconomic characteristics of the family of origin influencing adolescent depressive symptom development. The following discussion provides detailed information about each pathway in the model and the specific hypotheses to be tested.

1.2. Trajectories of depressive symptoms in adolescents

Many studies have investigated the depression trajectories in adolescents. Results vary due to sample differences, measurement tools, and survey duration (Rawana & Morgan, 2014; Schubert et al., 2017). Most commonly, studies categorized adolescent depressive symptoms into 3–4 groups: low-stable, low-increasing, high-stable, and high-decreasing

(Brendgen et al., 2010; Stoolmiller et al., 2005; Duchesne & Ratelle, 2014; Mezulis et al., 2014). For example, through cluster analysis, one study identified four groups of African-American adolescents with consistently high, consistently low, increasing, and decreasing depression trajectories (Repetto et al., 2004). In Korea, a study of 1432 adolescents identified three categories: high-increasing, moderate-increasing, and low-stable (Song et al., 2020). Similarly, a study in China revealed four subgroups: stable-low, moderate, increasing, and early elevated but later decreasing symptoms (Wu, 2017), with another study of 2576 Chinese adolescents identifying low-stable (75%), low-increasing (11%), high-stable (9%), and high-decreasing (5%) trajectories (Qin et al., 2021). These studies suggest that adolescent depression is a complex phenomenon with various developmental trajectories.

Gender and race impact depression trajectories. Studies have shown that girls exhibit higher depression rates than boys, with symptoms decreasing in adolescence (Dekker et al., 2007). Additionally, minorities experience higher rates of depression than whites (Adkins et al., 2009). While research on depression trajectories is extensive, there is a need for more research on heterogeneity, particularly urban-rural disparities. We expect higher levels of depression among rural than urban adolescents in China, because living conditions, infrastructure, and housing may be poorer in rural areas, and recreational activities may be less available than in urban areas. The rural context of existence may make rural adolescents more likely to be at higher levels of depression over a longer period of time.

1.3. The influence of family SES on adolescents' depression

Building on the analysis of depression trajectories, some studies have explored the influence of social factors on depression trajectories. A growing body of longitudinal research confirms the influence of SES on health trajectories over the life course. However, it is unclear whether SES predicts the trajectory of depression over time. Low family SES, encompassing factors like parental education, employment status, and income, heightens the probability of depressive symptoms (Henderson et al., 2005; Lorant et al., 2003; Zhou et al., 2018). Economic poverty within families predicts a higher probability of mental disorders (Boe et al., 2012; Perna et al., 2010). Parental education predicts the persistence and severity of various disorders, with higher parental education correlating to improved access to mental health resources (Li et al., 2022; McLaughlin et al., 2011). Low parental occupation emerges as an environmental adversity, amplifying the risk of emotional/behavioral problems in children and adolescents (Van Oort, van der Ende, Wadsworth, Verhulst, & Achenbach, 2011).

Several studies have focused on the relationship between SES and depression trajectories. Adolescents facing general stressors such as negative family life events and low household income are prone to a developmental trajectory marked by persistently high depressive symptoms (Stoolmiller et al., 2005). A study on Chinese freshmen, using a 4-month follow-up survey, found that the decline in subjective SES predicted an increase in depressive symptoms, while objective family SES, place of birth, and gender showed no significant impact (Liu et al., 2022). Other studies have shown that SES isn't significantly associated with differences in adolescent depression trajectories (Chen et al., 2011). For example, a gender-specific study of Chinese adolescents revealed that family SES had no significant impact on depression trajectories (Hou & Chen, 2016). However, most previous studies typically focused on short-term depression trajectories, with limited exploration of rural-urban disparities in adolescent depression trajectories. Considering the short duration of these studies, detecting modest changes in depression has been challenging. To address these gaps, we used a long-term investigation to explore the depression trajectories in urban and rural adolescents.

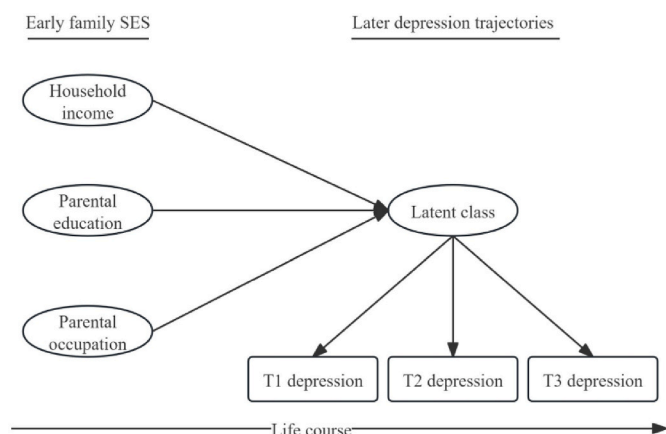


Fig. 1. Theoretical framework.

1.4. Institutional and cultural context in China

Diverse social and cultural backgrounds contribute to differing depression trajectories in Chinese adolescents compared to the West. Socioeconomic disparities across China impact mental health, particularly in the dual urban-rural social structure adopted since the 1950s. Accessibility to mental health services varies, with rural areas possibly overlooking issues due to socio-cultural perceptions. Urban settings offer more prompt treatment. A meta-analysis indicates higher depression rates in rural children, attributing it to limited support and challenging living conditions (Li, Chen, et al., 2016; Rao et al., 2019). Thus, variations in depression trajectories likely exist between urban and rural Chinese adolescents.

Chinese culture places great importance on family cohesion and harmony (Kavikondala et al., 2016), with parents exerting high control over their children (Cheung & Pomerantz, 2011; Li et al., 2020). For some families, SES symbolizes family honor and status, creating heightened expectations for children's achievements and social standing. This places additional psychological pressure on adolescents, potentially leading to depression. The correlation between adolescents' depression trajectories and family SES in China may differ from Western norms that stress independence. Within the Chinese family structure, adhering to traditional gender roles ("men outside, women inside"), the SES of parents, especially mothers, may uniquely impact adolescent depression. Mothers, often responsible for children's education, wield substantial influence. The acknowledged impact of mothers' educational attainment on children's health is notable (Mensch et al., 2019). Research indicates that fathers spend less time caring for children compared to mothers (Gimenez-Nadal & Molina, 2013). Studies highlight that childhood economic hardship and low maternal (but not paternal) education are linked to anxiety/depression symptoms (Sheikh et al., 2014). Therefore, exploring the association between parental SES and depression trajectories in Chinese adolescents is pertinent within the unique cultural context.

1.5. The current study

To address these gaps in the literature, the current research has two key objectives. First, identifying and predicting depression trajectories in Chinese urban and rural adolescents, anticipating variations. We hypothesized higher average depressive symptoms in rural areas. Second, we explore the role of family SES in predicting depression trajectories, emphasizing maternal and paternal contributions. We hypothesized that family SES could predict adolescent depression trajectories, theorizing that maternal education and occupation exert stronger influences than paternal counterparts.

2. Materials and methods

2.1. Data

We utilized data from the China Family Panel Studies (CFPS) conducted by the Institute of Social Science Survey (ISSS) at Peking University. Covering 95% of the Chinese population across 25 provinces/municipalities/autonomous regions, CFPS samples are nationally representative. Employing a multi-stage probability sampling method, the CFPS sample was drawn with implicit stratification. Three stages of sampling included administrative districts, villages/habitat committees, and households. Nationwide interviewers conducted face-to-face interviews to collect diverse survey data, adhering strictly to questionnaire requirements for accuracy and completeness. Six waves were completed between 2010 and 2018. The CFPS dataset covered relevant time periods consistent with the study objectives and included relevant SES variables and measures of adolescent depression, making it suitable for use in this study. We used CFPS 2012, CFPS 2016, and CFPS2018 data to create a balanced panel. Adolescents aged 10–15 (2012), 14–19 (2016),

and 16–21 (2018) were sampled, with an initial 1791 eligible adolescents. After excluding data for various reasons, 1214 accessible samples were retained across all three phases. The rate of missing data was 32.55% for the rural sample and 31.88% for the urban sample, which is relatively similar and not significantly different.

2.2. Measures

2.2.1. Depression

Depression was assessed via the widely used Center for Epidemiologic Studies Depression (CES-D) scale, developed by Radloff (Radloff, 1977). This scale applicable to adults, adolescents, and older adults, gauges symptoms like worthlessness, hopelessness, decreased appetite, and poor concentration. Previous studies attest to the CES-D scale's reliability and structural validity among Chinese adolescents (Chen et al., 2009; Ling et al., 2008). The original CES-D scale contained 20 questions, with truncated versions having 8 or 11 questions, as done by the Health and Retirement Study (HRS). In the CFPS2012 survey, CES-D20 was used; CFPS2016 employed CES-D8 for 80% of respondents and CES-D20 for 20%; CFPS2018 utilized CES-D8. Respondents self-rated depression frequency in the past week on a scale of 1–4, reflecting "hardly" to "most of the time." Questions included expressions like "I feel low" and "I'm not sleeping well." We used standardized CES-D20 scores from CFPS as depression variables, with higher scores denoting increased depression levels. Cronbach α values were 0.81, 0.70, and 0.74 for CFPS 2012, CFPS 2016, and CFPS 2018, respectively.

2.2.2. Socioeconomic status

SES can be measured using a composite score or individual indicators (May, 2006), such as family economy, parental education, and parental occupation (Leve et al., 2005; Vicente et al., 2012). This study used the three indicators to measure SES.

Household income. Some studies have used total household income, dividing it into two or more groups based on set thresholds (Elwell-Sutton et al., 2011). Other studies have used relative income, such as a percentage of the median household income (Costello et al., 2001; Green et al., 2018). Average household income reflects the actual living standards of each family member and serves as an important reference for social welfare policies in China (Cheng et al., 2023). In each survey, CFPS asked households about their total income (yuan) over the past 12 months and their household size, from which average household income can be calculated. We used the logarithm of average household income (yuan) as the analytical variable.

Parental educational level. Education level is usually measured by academic qualifications (Davis et al., 2010) or years of schooling (Qin et al., 2021). While academic qualifications can reflect the level of formal education, its accuracy may be questioned. To address this, some scholars suggested asking about the number of education years or the education range (Cheng et al., 2023). In the CFPS survey, individuals were asked to report their academic qualifications and years of education in the adult questionnaire. We used the educational years (range of 0–22 years) to measure parental education.

Parental occupation status. For most families, occupation is a relatively stable measure that reflects an individual's life opportunities, lifestyle, and social position. Ganzeboom et al. (1992) proposed a set of international standard occupational SES measures using multi-country data, including the international socioeconomic index (ISEI), Treiman's standard international occupational prestige scale (SIOPS) and Erikson-Goldthorpe-Portocarero (EGP) occupational classification (Ganzeboom et al., 1992). These indicators are internationally representative and address the issue of national differences, making them widely used. We utilized ISEI indicators for analysis. The index scores occupations on a continuous basis, taking into account an individual's education and income, with most occupations having an ISEI score between 20 and 80, with the higher the SES, the higher the ISEI.

2.2.3. Covariates

Numerous studies have shown gender and age differences in the effects of SES on depression symptoms (Reiss, 2013; Zhou et al., 2018). Therefore, gender and age were included as covariates in the model. Female was coded as 0, and male as 1. The definition of urban and rural areas is based on whether the interviewed family or individual lives mainly in rural or urban areas.

2.3. Statistical analyses

Analyses were conducted using Stata 17.0 and Mplus 8.0 in this study. The analysis strategy was divided into two parts:

The first step involved evaluating the fit of the latent categories model and examining latent categories within adolescent depression trajectories. Latent Growth Curve Models (LGCM) typically explore group characteristics over time, assuming homogeneity within groups. The Latent Class Growth Model (LCGM) acknowledges group heterogeneity, recognizing that individuals within a group may not share identical growth trends. However, even within assigned latent class groups, individual differences may exist. To address this, the GMM is utilized, considering latent class group heterogeneity and enhancing realism compared to LGCM and LCGM. Thus, the GMM was used to examine the adolescent depression trajectory in 2012, 2016 and 2018. The GMM can identify different trajectory profiles that may change over time (Qin et al., 2021). GMM assumes that all individuals be classified into several heterogeneous profiles, there are variance variations within each type profile, and all individuals within a single category profile have differentiated average growth curves (Wang et al., 2014). Test indices, including Akaike information criterion (AIC), Bayesian information criterion (BIC), sample-size adjusted BIC (aBIC), and information entropy (Entropy), as well as test statistics such as Lo-Mendell-Rubin (LMR) and likelihood ratio test based on bootstrap (BLRT) were also used. The optimal category model was chosen based on higher entropy and lower AIC, BIC, and aBIC values (Zhang et al., 2010). Smaller AIC, BIC, and aBIC values indicate better model fit. Significantly low P values of LMR and BLRT for a classification model indicate its superiority over others. Entropy, reflecting latent category classification accuracy (0–1), indicates 90% accuracy with an entropy over 0.8 (Wang et al., 2017).

In the second step, we utilized logistic regression models to estimate the impact of socioeconomic variables on adolescent depression trajectory categories. The model used latent category classification as the dependent variable, with predictors including average household income, parental education, and occupation. Gender and age served as control variables. We confirmed the validity of SES as a potential predictor of depression trajectories in adolescents.

3. Results

3.1. Descriptive characteristics

The baseline data show an average of 7.12 years of schooling for the fathers of adolescents and 5.71 years for their mothers. The mean occupational economic status of fathers was 31.36, and that of mothers was 30.12. The mean logarithmic average household income was 8.50. The socioeconomic characteristics differed between urban and rural areas regarding parental education level, occupation status, and average household income, as shown in Table 1.

The results showed that the mean depression of adolescents was relatively stable in the three waves, and the correlation coefficient of urban adolescents was 0.24–0.42 (P < 0.01) and that of rural adolescents was 0.14–0.42 (P < 0.01). Over time, some adolescents' depressive symptoms may change, while others may have stable levels. Thus, overall, the average level of depression is shown to be stable. The mean and standard deviation of depression in urban and rural areas showed a trend of decreasing first and then increasing, and the depression level at T1 and T3 was higher than that at T2, as shown in Table 2.

Table 1

Descriptive analysis of SES variables (Baseline).

Variable	Whole sample (n = 1214)	Urban (n = 468)	Rural (n = 746)	MeanDiff
	Mean ± SE	Mean ± SE	Mean ± SE	
paternal education	7.12 ± 4.30	8.85 ± 4.03	6.04 ± 4.11	2.81***
maternal education	5.71 ± 4.57	7.63 ± 4.72	4.49 ± 4.02	3.14***
paternal occupation	31.36 ± 12.24	36.14 ± 14.05	28.48 ± 9.96	7.66***
maternal occupation	30.12 ± 11.78	36.40 ± 14.52	26.39 ± 7.66	10.01***
household income	8.50 ± 1.19	8.80 ± 1.18	8.31 ± 1.17	0.49***

Note: n = 1214, *p < 0.05, **p < 0.01, ***p < 0.001.

Table 2

Descriptive statistics and correlation analysis of each period.

Variable	1	2	3
Depression_T1	–	0.16**	0.14**
Depression_T2	0.25**	–	0.42**
Depression_T3	0.24**	0.42**	–
M(SD)_urban	30.80 (6.62)	30.55 (6.01)	31.13 (6.19)
M(SD)_rural	31.99 (6.56)	30.70 (6.10)	31.50 (6.39)

Note: n = 1214, *p < 0.05, **p < 0.01; Depression_T1, T2, and T3 represent depression in consecutive waves. Below the diagonal is the correlation coefficient of the urban sample, and above the diagonal is the correlation coefficient of the rural sample.

3.2. Growth mixed model (GMM) analysis results

3.2.1. Model fitting and selection

To explore depression trajectory differences between urban and rural adolescents and their influencing factors, we divided the sample into rural and urban groups. We examined heterogeneous latent categories of depression among urban and rural adolescents and determined the optimal number of latent categories according to the model fitting. We select 1–5 latent categories of GMM for model fitting analysis. The fitting indices of urban and rural areas are shown in Table 3 and Table 4.

Urban adolescents exhibited a decreasing BIC value with an increasing number of profiles. The three-profile model, supported by significant LMR values and the highest entropy, was chosen for urban adolescents, with sample proportions of 7.9%, 86.5%, and 5.6%, as detailed in Table 3.

The BIC value for rural adolescents decreased gradually with an increasing number of profiles. However, the LMR and BLRT values were both significant in the two-profile model, and the entropy was higher than that of the three-profile model. Therefore, considering the simplicity and accuracy, we chose the two-profile model in the rural sample. The sample proportions of each profile were 93.5% and 6.5%, respectively, as shown in Table 4.

3.2.2. The trajectories of adolescent depression

Further exploring depression trajectories in urban and rural adolescents, we found distinct patterns. In urban areas, 7.9% experienced a decline in depression from a high level, which was defined as the high-decreasing profile (intercept I = 43.75, P < 0.001; slope S = -3.43, P < 0.01); 86.5% remained a low level, which was defined as the low-stable profile (intercept I = 29.32, P < 0.001; slope S = 0.20); and 5.6% of adolescents' depression increased year by year, which was defined as the low-increasing profile (intercept I = 32.82, P < 0.001; slope S = 3.50, P < 0.05), as shown in Table 5 and Fig. 2.

In rural areas, 93.5% maintained a low level, which was defined as the low-stable profile (intercept I = 30.64, P < 0.001; slope S = 0.18); 6.5% decreased gradually, which was defined as the high-decreasing

Table 3
Fitting information of the growth mixture model (urban).

Class	K	Log(L)	AIC	BIC	aBIC	Entropy	LMR	BLRT	Classification Probabilities
1 profile	8	-4685.21	9388.41	9426.29	9397.72	-	-	-	-
2 profile	11	-4662.97	9347.93	9394.22	9359.31	0.82	0.319	0.000	0.104/0.896
3 profile	14	-4647.08	9322.16	9381.08	9336.64	0.84	0.036	0.000	0.079/0.865/0.056
4 profile	17	-4642.65	9319.30	9390.85	9336.89	0.80	0.160	0.130	0.775/0.043/0.161/0.021
5 profile	20	-4634.89	9309.77	9393.94	9330.46	0.76	0.179	0.005	0.030/0.062/0.028/0.555/0.326

Note: K is the number of parameters estimated freely in the model, Log(L) is loglikelihood, aBIC is sample-corrected BIC, LMR is the abbreviation of the likelihood ratio test indicator (Lo-Mendell-Rubin), and BLRT is the likelihood ratio test based on bootstrapping.

Table 4
Fitting information of the growth mixture model (rural).

Class	K	Log(L)	AIC	BIC	aBIC	Entropy	LMR	BLRT	Classification Probabilities
1 profile	8	-7947.83	15911.66	15949.76	15924.35	-	-	-	-
2 profile	11	-7905.87	15833.75	15886.14	15851.21	0.87	0.005	0.000	0.935/0.065
3 profile	14	-7875.22	15778.43	15845.11	15800.65	0.86	0.202	0.000	0.891/0.045/0.064
4 profile	17	-7861.69	15757.38	15838.34	15784.36	0.88	0.372	0.000	0.884/0.034/0.039/0.043
5 profile	20	-7847.05	15734.09	15829.35	15765.83	0.79	0.462	0.000	0.248/0.675/0.015/0.021/0.041

Note: Same as Table 3.

Table 5
Intercepts and slopes from the growth mixture model for adolescents' depression.

Latent Classes	Intercept(α)				Slope(β)			
	Estimate	S.E.	Est./S.E.	P Value	Estimate	S.E.	Est./S.E.	P Value
Urban								
high-decreasing profile	43.75	2.52	17.35	0.000	-3.43	1.09	-3.15	0.002
low-stable profile	29.32	0.41	71.63	0.000	0.20	0.17	1.19	0.234
low-increasing profile	32.82	2.04	16.11	0.000	3.50	1.77	1.98	0.048
Rural								
low-stable profile	30.64	0.35	88.17	0.000	0.18	0.13	1.38	0.169
high-decreasing profile	45.76	2.58	17.73	0.000	-4.70	1.14	-4.13	0.000

profile (intercept $I = 45.76$, $P < 0.001$; slope $S = -4.70$, $P < 0.001$), as shown in Table 5 and Fig. 3.

3.3. Logistic regression: determining influencing factors

We further explored the influence of family income, parental education, and occupation on the trajectory grouping using GMM analysis. In the urban sample, disordered multivariate logistic regression employed the three profiles' results as dependent variables. The low-increasing profile served as the reference to calculate odds ratio (OR) coefficients, reflecting SES effects in different profiles.

Table 6 showed that the maternal education, paternal occupation status, maternal occupation status, and household income had significant predictive effects on the grouping. For each unit increase in maternal education, individuals were 2.08 times more likely in the high-decreasing profile than the low-increasing profile ($P < 0.01$), and 1.20 times more likely in the low-stable profile than the low-increasing profile ($P < 0.001$). A unit increase in elevated the probability of being in the low-stable profile by 2.54 times compared to the low-increasing profile ($P < 0.01$). A unit increase in maternal occupational status made individuals 1.92 times more likely in the low-stable profile than the low-increasing profile ($P < 0.001$). Household income also influenced classification. Each unit increase elevated the probability of individuals being in the low-stable profile by 1.65 times compared to the low-increasing profile ($P < 0.05$).

In the rural analysis, a binary logistic regression model with two profiles as dependent variables was utilized. The low-stable profile served as the reference, determining odds ratio (OR) coefficient to reflect SES effects across profiles.

Table 7 showed that maternal education significantly predicted grouping. With each unit decrease in maternal education, individuals

were 0.88 times more likely in the high-decreasing profile than the low-stable profile ($P < 0.05$). This implies that higher maternal education corresponds to a higher likelihood of children falling into the low-stable profile. Other variables lacked significant predictive power for grouping.

4. Discussion

We analyzed depression trajectories in Chinese adolescents using CFPS longitudinal data, exploring SES factors influencing subgroup classification. Findings highlight developmental differences in depression among urban and rural youth, deepening our understanding of depression trajectories in China's adolescent population.

4.1. The depression trajectories among urban and rural adolescents in China

The GMM analysis revealed distinction between the depression trajectories in urban and rural adolescents. Across three waves, most experienced stable depression with a slight upward trend. Urban adolescents exhibited higher heterogeneity than rural counterparts.

First, compared to previous studies that identified three to four subgroups, including (1) sustained low, (2) initially low but increasing, (3) initially high but decreasing, and (4) sustained high levels of depressive symptoms (Martinez & Armenta, 2020; Qin et al., 2021), our study found similar heterogeneity in the depression developmental trajectories of urban adolescents. However, two of these subgroups were absent in the rural sample. One study has found high levels of depression in some adolescents, with a rapid increase during adolescence (Mezulis et al., 2014), but this grouping is not present in rural sample. Our study confirmed this observation in urban adolescents but did not support it in rural adolescents. Differences in depression trajectories may stem from

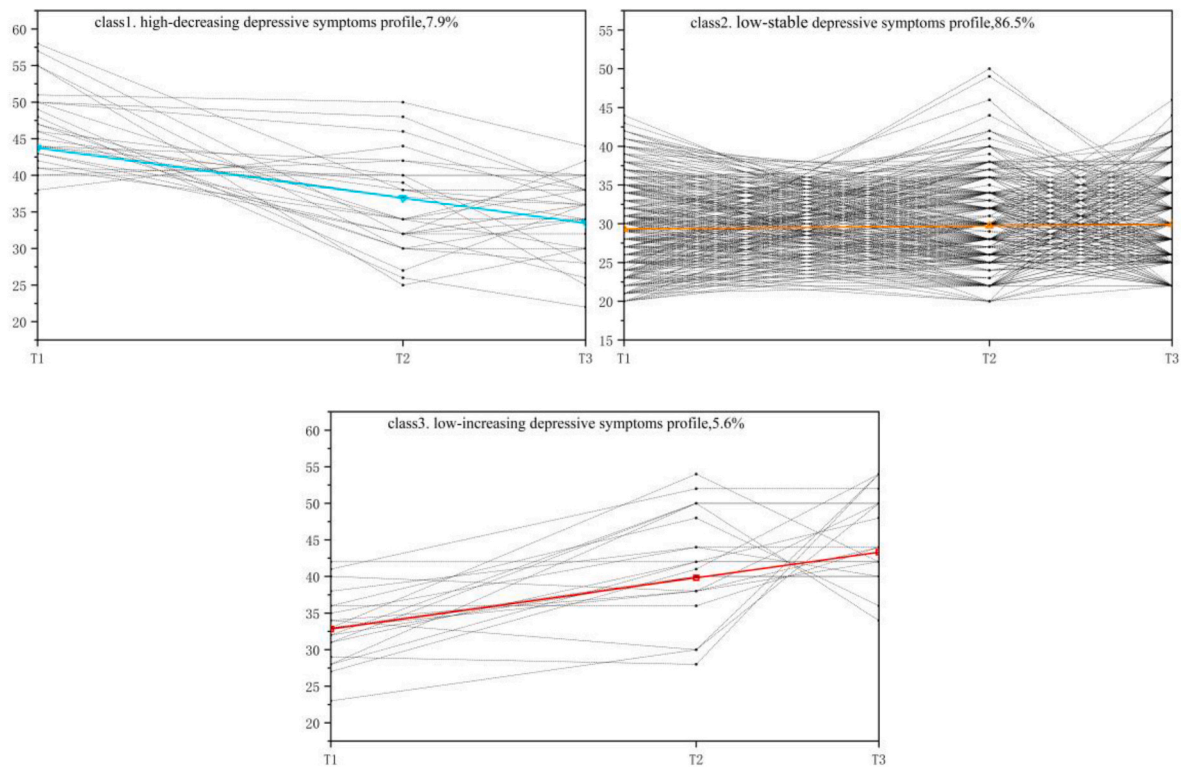


Fig. 2. Trajectories of depressive symptoms across three time points (urban). Class 1, class 2, and class 3 represent high-decreasing, low-stable, and low-increasing depressive symptoms, respectively. The solid lines with different colors represent the estimated means, and the dashed lines represent the observed individual values in different profiles. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

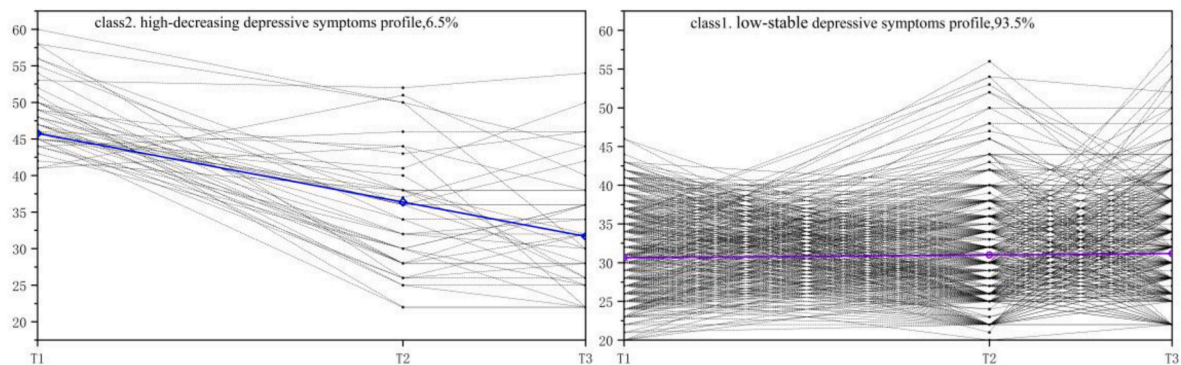


Fig. 3. Trajectories of depressive symptoms across three time points (rural). Class 1 and class 2 represent low-stable and high-decreasing depressive symptoms, respectively. The solid lines with different colors represent the estimated means, and the dashed lines represent the observed individual values in different profiles. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Table 6
Parameter estimation of logistic regression (urban).

variable	high-to-lowering group vs. low-to-rising group				constant low group vs. low-to-rising group			
	B	Wald	Exp(B)	CI	B	Wald	Exp(B)	CI
age	1.16	1.08	3.18	(2.37, 4.28)	1.06	0.18	2.89	(2.17, 3.85)
gender	1.02	0.002	2.77	(1.16, 6.62)	0.84	0.16	2.32	(1.09, 4.97)
paternal education	1.04	0.22	2.83	(2.40, 3.34)	1.00	0.002	2.73	(2.29, 3.25)
maternal education	0.73	9.94**	2.08	(1.76, 2.46)	0.68	14.68***	1.98	(1.68, 2.33)
paternal occupation	0.99	0.59	2.68	(2.60, 2.77)	0.93	11.22**	2.54	(2.44, 2.64)
maternal occupation	0.97	0.12	2.65	(2.29, 3.07)	0.65	13.63***	1.92	(1.60, 2.31)
household income	0.59	2.89	1.81	(1.13, 2.89)	0.50	5.90*	1.65	(1.11, 2.47)

Note: *p < 0.05, **p < 0.01, ***p < 0.001, low-to-rising group is the reference group. B is coefficient estimates, Wald is wald statistic, Exp(B) is odds ratio, CI is confidence limits.

Table 7
Parameter estimation of logistic regression (rural).

variable	B	Wald	Exp(B)	CI
age	-0.21	1.98	0.81	(0.61, 1.09)
gender	-0.96	1.93	0.39	(0.10, 1.48)
paternal education	0.08	1.42	1.08	(0.95, 1.24)
maternal education	-0.13	6.35*	0.88	(0.80, 0.97)
paternal occupation	-0.08	1.90	0.92	(0.82, 1.03)
maternal occupation	-0.04	1.10	0.96	(0.88, 1.04)
household income	0.03	0.01	1.03	(0.62, 1.71)

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, the constant-low group is the reference group. B is coefficient estimates, Wald is wald statistic, Exp(B) is odds ratio, CI (95%) is confidence interval.

greater socioeconomic heterogeneity among urban adolescents, as indicated by a larger standard deviation in the urban sample compared to rural youth.

Second, at baseline, depression scores for urban adolescents in low-stable and high-decreasing profiles ranged from 28 to 30 and 42–44, while rural adolescents scored 30–32 and 44–46. Initial depression levels were lower in urban than rural adolescents, consistent with previous studies that rural adolescents were more depressed than urban adolescents in China (Li, Chen, et al., 2016; Rao et al., 2019). China's urban-rural disparities in social and economic factors, particularly family SES, contribute to this trend, with advantaged families concentrated in cities and disadvantaged ones in rural areas (Song & Tan, 2022). Rural residents have less access to social resources and opportunities than their urban counterparts (Li, Chen, et al., 2016), and therefore generally have higher levels of depression.

4.2. Family SES with depression trajectories among Chinese adolescents

We found significant predictive effects of maternal education, parental occupation status, and household income on the depression trajectories in urban adolescents. Higher maternal education correlated with increased likelihood of being in high-decreasing or low-stable profiles, as opposed to low-increasing. Similarly, elevated parental occupation status associated with a higher chance of being in the low-stable profile, while increased household income linked to higher chances of a low-stable profile. Among rural adolescents, maternal education had a significant predictive effect on the low-stable profile. Compared with the low-increasing profile, rural adolescents with higher maternal education levels were more likely to be placed in the low-stable profile. Other SES indicators had no significant predictive effect on depression trajectories in rural adolescents. The impact of family SES on depression trajectories was more pronounced in urban adolescents. Overall, this study supports the social causality theory, but it also highlights differences in the impact of family SES on adolescent depression between urban and rural areas.

Studies from eastern China indicated that adolescents in families with socioeconomic disadvantage, in the form of lower educational level and occupational prestige of mothers, had greater risk of mental health problem (Li et al., 2022). Increased levels of maternal education are associated with positive health behaviors and better child health outcomes (Currie & Moretti, 2003). It is speculated that families with high maternal education tend to adopt suitable parenting styles, which can avoid adolescent depression to a large extent. China, compared to developed nations, offers limited social protection for adolescents, emphasizing the crucial role families, especially mothers, play in their development. Parental education predicts the persistence and severity of mental health problems (McLaughlin et al., 2011), while decreased family income increases the likelihood of psychological issues in adolescents, particularly in urban areas (Melchior et al., 2010). Studies highlight maternal education's stronger impact on depression trajectories compared to household income, supporting the notion that maternal education significantly influences her child's health

(Vukojević et al., 2017). This study broadly affirms the influential role of maternal education in shaping adolescent mental health.

4.3. Strengths and limitations

Different from previous studies, the marginal contribution of this study lies in the following aspects. Firstly, we study the subgroup classification of the developmental trajectory of adolescent depression in developing countries. Using nationally representative data from China, we analyze the trajectory of depressive symptoms in urban and rural adolescents from early to late adolescence. Secondly, we explore the impact of family SES on adolescent mental health by separately analyzing the heterogeneity of the influence of urban and rural family SES on adolescent depression trajectories.

However, the study has notable limitations. Firstly, the CFPS database didn't use the CES-D scale for depression measurement in 2014, rendering that year unavailable for analysis. Secondly, this study relies on balanced panel data, leading to a substantial 32% sample loss due to participants engaging in all three waves. Thirdly, the study focused on adolescents aged 10–15, omitting those under 10, leaving the impact of early SES on childhood depression development uncertain. Further research is necessary to explore these relationships. Additionally, the study did not subdivide regions further to explore nuanced trajectory differences. Future research can expand on examining urban and rural family SES and adolescent depression in China by scrutinizing specific conditions in different regions. A more nuanced analysis of cultural, economic, and social factors can elucidate variations in the impact of SES on adolescent mental health across provinces.

5. Conclusion

This study overcomes the limitations of static analyses, expanding the theoretical framework of adolescent depressive symptom research. Utilizing longitudinal CFPS data from 2012 to 2018 enhances causal explanation compared to cross-sectional data. The research investigates family SES impact on adolescent depression trajectories, emphasizing urban-rural disparities. Notably, the link between family SES and depression trajectories is stronger in urban than rural adolescents, underscoring the crucial role of maternal education in mental health. With rural adolescents experiencing higher depression levels, prioritizing attention and resources for prevention and intervention in these areas is essential. Attention has been paid to the equitable distribution of social resources between urban and rural areas to ensure that rural areas also have access to quality education, health care and social service resources to slow the widening of the urban-rural depression gap. More targeted family support programme, including family mental health counselling and family communication training, can be provided for families with low SES to strengthen the family support system. Acknowledging maternal education's significant influence, public programs promoting education may yield long-term benefits. Encouraging maternal involvement in adolescent development and fostering relationships prioritizes future policy and advocacy.

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Availability of data and materials

The datasets that support this article are publicly available from the project of the CFPS. Questionnaires are free download at website (<http://www.iss.pku.edu.cn/cfps/en/documentation/questionnaires/index.htm?CSRFT=YAC-8N0M-L215-I0D4-BP4X-GPXD-IPHR-KM6Y>) and the datasets can be obtained after sending a data user agreement to the CFPS team (<http://www.iss.pku.edu.cn/cfps/download/index#/fileTreeList>).

Consent for publication

Not applicable since the dataset used in the study is publicly available.

Ethics statement

The CFPS project is a research project involving people. In order to guarantee the rights and interests of the respondents taking part in the project to get the greatest degree of protection, the Institute of Social Science Survey (ISSS) follows the rules of "Peking university biomedical ethics committee" on a regular basis to submit an application for ethical review or continuous review, and in compliance with the approved for ethical review of cases to carry out the corresponding data collection work.

CRedit authorship contribution statement

Jing Zeng: Conceptualization, Data curation, Formal analysis, Methodology, Software, Writing – original draft, Writing – review & editing. **Yuebin Xu:** Conceptualization, Project administration, Resources, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare they have no financial interests.

Data availability

Data will be made available on request.

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