

Difference Analysis of the Psychological Status of University Freshmen

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Abstract

Objective: Based on social-ecological systems theory, this study used SCL-90 census data on the mental health of first-year students at a university from 2018 to 2021 to systematically analyze differences across the nine SCL-90 factors among college freshmen over four years, revealing the evolving trends in mental health before and after the COVID-19 pandemic and the mechanisms of factor differentiation. **Methods:** A total of 37,871 valid participants were included. Descriptive statistics, effect size Cohen's d , and symptom detection rates were used for cross-year comparisons, and Graphical Lasso network analysis was combined to explore the core structure of the nine factors. **Results:** (1) The mean scores of the nine SCL-90 factors showed an inverted U-shaped trend of "rising first and then declining," reaching a peak in 2020; (2) obsessive-compulsive symptoms consistently ranked first among all factors over the four years, with the mean reaching 8973 in 2020; (3) most factors declined in 2021 but remained higher than the 2018 baseline, indicating "incomplete recovery"; (4) causal network analysis revealed that anxiety, depression, and interpersonal sensitivity were stable core factors across the four years (Kendall $\tau=1.000$). **Conclusion:** The mental health of college freshmen underwent an evolution of "baseline—deterioration—partial recovery," and the pattern of factor differentiation reflects the differentiated disruptions caused by COVID-19 across different levels of the ecosystem.

Full Text

Difference Analysis of the Psychological Status of University Freshmen

—An Empirical Study Based on SCL-90 Mental Health Survey Data

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s d, and symptom detection rates, and Graphical Lasso network analysis was combined to explore the core structure of the nine factors. **Results:** (1) The mean scores of the nine SCL-90 factors showed an inverted U-shaped trend of “rising first and then declining,” reaching a peak in 2020; (2) obsessive-compulsive symptoms consistently ranked first among all factors over the four years, with the mean score in 2020 reaching **8973**; (3) in 2021, most factors declined but remained higher than the 2018 baseline, indicating “incomplete recovery” ; (4) causal network analysis suggested that anxiety, depression, and interpersonal sensitivity were stable core factors over the four years (Kendall $\tau=1.000$). **Conclusion:** The mental health of university freshmen underwent an evolution of “baseline—deterioration—partial recovery,” and the factor differentiation pattern reflects the differentiated disturbances of COVID-19 on different levels of the ecosystem.

Keywords: SCL-90; mental health of university students; COVID-19; social ecosystem theory; causal network analysis

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Abstract: Objective: Based on social ecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2006), this study used SCL-90 survey data from freshmen at a Chinese university from 2018 to 2021 to systematically examine changes across nine symptom dimensions and reveal the evolving trends and factor-differentiation mechanisms of college students’ mental health before and after the COVID-19 pandemic. **Methods:** A total of 37871 participants were included. Descriptive statistics, Cohen’ s d effect sizes, and symptom detection rates were used for cross-year comparisons. Graphical Lasso network analysis was conducted to identify the core factor structure across years. **Results:** (1) The mean scores of the nine SCL-90 factors showed an inverted-U trend, peaking in 2020; (2) obsessive-compulsive symptoms ranked highest across all four years; (3) most factors decreased in 2021 but remained above the 2018 baseline, indicating incomplete recovery; (4) causal network analysis revealed anxiety, depression, and interpersonal sensitivity as stable core factors (Kendall $\tau = 1.000$). **Conclusion:** College freshmen’ s mental health followed a “baseline—deterioration—partial recovery” trajectory. The factor-differentiation pattern reflects the

differential perturbation of COVID-19 across ecological system levels, suggesting that universities should establish tiered mental health intervention systems based on ecological systems theory.

Keywords: SCL-90; college student mental health; COVID-19; social ecological systems theory; causal network analysis

1 Introduction

The first year of university is a period of high incidence for mental health problems and a critical window for intervention. In accordance with the requirements of the Ministry of Education's *Guiding Outline for Mental Health Education for Students in Higher Education Institutions*, universities across China commonly use the Symptom Checklist-90 (SCL-90) to conduct mental health screening among incoming freshmen. The SCL-90 comprises nine factors—somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism—and can assess individuals' mental health status from multiple dimensions (Derogatis et al., 1973; Wang Xiangdong et al., 1999). However, most universities' use of SCL-90 data stops at the binary judgment of "normal/abnormal," lacking systematic longitudinal comparison and trend analysis of data accumulated over multiple years.

The years 2018 to 2021 were four exceptionally unusual years in the history of global higher education. The coronavirus disease 2019 (COVID-19) outbreak that emerged at the end of 2019 rapidly evolved into a global pandemic, exerting profound effects on the ways societies operated across countries and regions. To control the spread of the pandemic, universities worldwide commonly adopted measures such as online teaching, campus lockdowns, and social distancing (World Health Organization, 2020). While these measures effectively interrupted viral transmission, they also had a significant impact on the mental health of university students (Lipson et al., 2022; Deng et al., 2021; Copeland et al., 2021). Based on a national survey of more than 350,000 students in the Healthy Minds Study (HMS), Lipson et al. (2022) found that in the 2020-2021 academic year, more than 60% of university students met the diagnostic criteria for at least one mental disorder, an increase of nearly 50% compared with 2013. The systematic review and meta-analysis by Deng et al. (2021), which included 89 studies and more than 1.44 million participants, found that during the pandemic the pooled prevalence of depressive symptoms among university students was 34%, anxiety 32%, and sleep disorders 33%, all significantly higher than pre-pandemic levels.

Nevertheless, few studies have used consecutive multi-year SCL-90 census data on incoming freshmen from the same university to systematically compare trajectories of mental health changes before and after the pandemic at the level of the nine factors. Using SCL-90 census data from four consecutive cohorts of

first-year students at a comprehensive university from 2018 to 2021, the present study aims to answer the following questions: (1) What trends did the nine SCL-90 factor scores of university freshmen show during 2018–2021? (2) Were there differences in the patterns of change across different factors? (3) How did demographic variables such as gender, urban–rural origin, and broad academic major category moderate these changes? (4) What was the nature of the impact of the COVID-19 pandemic on the mental health of university freshmen—was it a short-term shock or a sustained change?

2 Literature Review

2.1 Application of SCL-90 in Research on College Students' Mental Health

The SCL-90 (Symptom Checklist 90), developed by Derogatis et al. (Derogatis et al., 1973), is currently one of the most widely used self-report scales for mental health internationally. The scale contains 90 items and uses a five-point Likert rating system (1 = none, 2 = very mild, 3 = moderate, 4 = rather severe, 5 = severe), covering nine factors: somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. Chinese scholars Wang Xiangdong et al. (1999) introduced and revised the Chinese version in the early 1990s and established norms for the Chinese population. Xin Ziqiang et al. (2012) conducted a cross-temporal meta-analysis of SCL-90 data from Chinese college students between 1986 and 2010, finding that the overall level of college students' mental health had gradually improved over the 25 years, with particularly evident downward trends in paranoid ideation, depression, and interpersonal problems.

The SCL-90 has distinctive advantages in mental-health screening in colleges and universities: its nine-factor structure can distinguish different types of psychological distress and provide a basis for precise intervention (Dai Xiaoyang, 2011). However, existing studies have mostly adopted cross-sectional designs or before-and-after comparisons at two time points, lacking systematic trend analyses of data spanning multiple consecutive years. In addition, insufficient attention has been paid to heterogeneity in the patterns of change across factors—the recovery trajectories of anxiety and depression may differ, yet few studies have examined this issue specifically.

2.2 Impact of COVID-19 on College Students' Mental Health

The impact of the COVID-19 pandemic on the mental health of college students worldwide has become a research hotspot. Internationally, Lipson et al. (2019, 2022), using HMS data, found that the incidence of mental-health problems among college students increased by nearly 50% between 2013 and 2021, and that in the 2020–2021 academic year more than 60% of students met the criteria for at least one mental disorder. Copeland et al. (2021), through a longitudinal study of 675 first-year college students, found that externalizing problems

and attention problems increased significantly after the pandemic. Roche et al. (2024) compared two cohorts from 2016 and 2020 and found that students in 2020 had significantly higher levels of stress, depression, and anxiety, with upper-year students being more strongly affected. A longitudinal study by Fruehwirth et al. (2025) further revealed an “imbalance in recovery” : depressive symptoms had largely returned to pre-pandemic levels by the fall of 2021, but anxiety symptoms still remained elevated at about 40%.

In China, Ye et al. (2025), in a two-wave longitudinal survey of college students at a university, found that students’ stress levels after the first outbreak of the pandemic were, contrary to expectation, higher than during the outbreak ($OR = 2.03$), suggesting a delayed psychological effect of the pandemic.

response. Xu Xiaoqi et al. (2025), in a study of 588 university students majoring in psychiatry, found that obsessive-compulsive symptoms, interpersonal sensitivity, and paranoia were the main current psychological problems. A 2025 study in *Psychology Monthly* indicated that the sophomore year is a high-incidence period for psychological problems; students in humanities/history and science/engineering majors showed higher levels than those in arts and physical education majors; and women’ s anxiety levels were higher than men’ s (Dong Yuan, 2025).

The above studies provide important evidence for understanding the impact of COVID-19 on the mental health of university students, but they have the following limitations. First, most studies focus on a two-stage comparison of “before the pandemic vs. during the pandemic,” lacking a systematic phase division of 2018–2021 as a continuous time series. Second, differences in the recovery rhythms of different mental-health indicators—such as anxiety vs. depression—have not yet been sufficiently conceptualized or theorized. Third, domestic studies often use samples from a single university or a single major, and relatively few studies have conducted comprehensive comparisons using the nine factors of the SCL-90.

2.3 The Moderating Role of Demographic Variables

Gender differences are among the most consistent findings in research on university students’ mental health. Eisenberg et al. (2013) found that the detection rates of depression and anxiety among female university students were significantly higher than those among males. Deci and Ryan’ s (2000) self-determination theory holds that gender socialization leads women to be more inclined toward internalizing problems, whereas men are more inclined toward externalizing problems. Chinese research in 2025 likewise found that women experience anxiety more intensely at the subjective level (Dong Yuan, 2025).

Findings regarding differences by urban-rural origin remain inconsistent. Some studies have found that rural university students face greater adjustment pressure and psychological distress (Liu Zhengkui et al., 2007), whereas other studies have found no significant differences (Chen Zhiyan et al., 2017). COVID-19 may

have exacerbated this inequality: during home quarantine, rural students faced poorer internet conditions and learning environments (Ye et al., 2025). In terms of disciplinary differences, existing research shows that arts students are more open in emotional expression and tend to report higher symptom levels on self-report scales, whereas science and engineering students are more susceptible to the influence of “emotional-expression inhibition” (Lü Wei, Zheng Xifu, 2014; Wang Jianping, Zhang Ning, 2010).

2.4 Social-Ecological Systems Theory: The Core Analytical Framework of This Study

Social-ecological systems theory was systematically proposed by Bronfenbrenner (1979) in his classic work *The Ecology of Human Development*, and was later further developed in the Bioecological Model into the Process-Person-Context-Time (PPCT) model (Bronfenbrenner & Morris,

2006). This theory regards individual development as a process embedded within a series of interrelated environmental systems. From the inside outward, these are the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. Proximal processes—sustained interactions between the individual and others in the environment—are defined as the core driving force of development (Bronfenbrenner & Morris, 2006).

In the context of the COVID-19 pandemic, social-ecological systems theory provides a powerful analytical framework for understanding year-to-year changes in college students’ mental health. Specifically: (1) at the microsystem level, the pandemic interrupted proximal processes such as peer interaction, classroom participation, and dormitory life among college students, while social-distancing measures directly weakened the availability of social support; (2) at the mesosystem level, the family-school linkage was disrupted by closed campus management, and online teaching altered the operation of the learning-support system; (3) at the exosystem level, structural factors such as pandemic-prevention policies, economic downturn, and contraction of the job market exerted indirect but extensive pressure on college students’ mental health; (4) at the macrosystem level, the culture of public-health crisis triggered by the pandemic, collective changes in risk perception, and the formation of a “new normal” lifestyle changed college students’ attitudes toward and behavioral patterns related to mental health; and (5) at the chronosystem level, the four-year span from 2018 to 2021 covers key time points including the pre-pandemic baseline, the shock of the outbreak, sustained adaptation, and normalization, enabling this study to capture the differentiated effects of changes in the systemic environment across different temporal stages. The three levels of the “Time” dimension in the PPCT model—micro-time (micro-interactions), meso-time (daily cycles), and macro-time (historical periods) (Bronfenbrenner & Morris, 2006)—provide a theoretical basis for explaining the four-year pattern of factor differentiation observed in this study, that is, the differences among factors in their speed, magnitude, and rhythm of recovery in response to the pandemic. Because different

psychological dimensions are associated with different dominant levels of the system, their recovery dynamics exhibit systematic differences.

By using social-ecological systems theory as the core analytical framework, this study not only tests the empirical question of “whether college students’ SCL-90 scores differed across the four years,” but also seeks to explain “why the change patterns of different factors showed differentiation” and “how changes in environmental systems affected different psychological dimensions through different proximal processes.” This theory-driven analytical approach helps move beyond purely descriptive comparisons and reveals the systemic-level mechanisms through which the pandemic affected college students’ mental health.

2.5 Research Gaps and the Positioning of This Study

Based on the above literature analysis, existing studies have the following gaps: (1) a lack of systematic comparisons based on four consecutive years of SCL-90 census data from the same university; (2) the heterogeneity of change trajectories across factors, especially anxiety

vs. depression’s “poor recovery”) has not been adequately examined; (3) insufficient research has addressed the moderating effects of demographic variables (gender, urban-rural background, and major) on mental-health trends; and (4) existing studies often lack systematic comparisons of the differentiated trajectories of change across the nine factors, such as the persistently high prevalence of obsessive-compulsive symptoms vs. the V-shaped trend in anxiety. Using SCL-90 census data from four consecutive cohorts of first-year students at a university from 2018 to 2021 (with a cumulative sample size of nearly 38,000), and taking social-ecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2006) as the core analytical framework, this study systematically compares the evolution of mental health over the four years across the nine factor dimensions, analyzes the moderating effects of gender, urban-rural origin, and broad major category, and interprets the differentiated trajectories of change in each factor in light of ecological-system levels. The aim is to provide empirical evidence and theoretical guidance for mental-health work in universities.

3 Methods

3.1 Participants

The participants were all first-year students in the 2018 through 2021 cohorts at a university. Each year, students completed an SCL-90 mental-health census within one month after enrollment. The total valid sample comprised 37,871 students, including 8,973 students in the 2018 cohort (4,109 men and 4,864 women), 9,840 students in the 2019 cohort (4,720 men and 5,120 women), 9,790 students in the 2020 cohort (4,353 men and 5,437 women), and 9,268 students in the 2021 cohort (4,306 men and 4,962 women).

3.2 Research instrument

The Symptom Checklist-90 (SCL-90) was used. The scale includes 90 items and adopts a 5-point Likert scoring format (1 = none, 2 = very mild, 3 = moderate, 4 = relatively severe, 5 = severe), covering nine factors: somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. Each factor score was calculated as factor score = sum of scores for the items included in that factor/number of items. Conventional studies in China indicate that the SCL-90 has good reliability and validity among college students, with Cronbach's α coefficients typically above 0.90.

3.3 Statistical analysis

Descriptive statistics were used to calculate the mean and standard deviation of each factor. A factor mean score of ≥ 3.0 (moderate or higher symptoms) was used as the criterion for detecting "marked symptoms." Cohen's d coefficient was used to measure effect sizes across years and by gender ($|d| \geq 0.2$ indicating a small effect, ≥ 0.5 a medium effect, and ≥ 0.8 a large effect). All analyses were completed using Python 3.12.

3.4 Causal Network Analysis

To further reveal the causal structure among the nine SCL-90 factors, this study used Graphical Lasso (Tibshirani, 1996; Friedman et al., 2008) to estimate a partial-correlation network. A sparse partial-correlation structure was obtained through L1-regularized inverse covariance matrices, and three indicators—node strength, predictability, and causal influence—were calculated.

Descriptive statistics were used to compute the mean and standard deviation of each factor; a factor mean score of ≥ 3.0 (moderate or above symptoms) was adopted as the criterion for "obvious symptoms" indicating a small effect, ≥ 0.5 a medium effect, and ≥ 0.8 a large effect). All analyses were completed using Python 3.12.

4 Results

4.1 Four-Year Comparison of Mean Scores for the Nine Factors

Table 1 shows that, over the four years, the mean scores of the nine SCL-90 factors exhibited clear stage-specific characteristics. Overall, from 2018 to 2019–2020, scores on most factors showed an upward trend, followed by a decline in 2021. Specifically: (1) the obsessive-compulsive symptom factor consistently ranked first among all factor scores across the four years (mean range for 2018–2021: 1.96–2.07), reaching a peak of 2.07 in 2019, indicating that obsessive-compulsive thinking and behavioral tendencies were the most common psychological distress among university freshmen. (2) The depression and anxiety factors both reached their highest levels over the four years in 2020, with mean

scores of 1.69 and 1.69, respectively; in 2021, they declined to 1.67 and 1.67, respectively, but remained higher than the 2018 baseline levels (depression 1.60, anxiety 1.64), showing a pattern of “incomplete recovery.” (3) The trend for the interpersonal sensitivity factor was similar to those for depression and anxiety, reaching a peak of 1.67 in 2020, indicating that the social isolation and reduced social interaction caused by the pandemic had a significant negative impact on university students’ interpersonal communication.

Table 1 Descriptive statistics of the nine SCL-90 factors among freshmen from 2018 to 2021

Factor	2018	2019	2020	2021
Somatization	1.38±0.42	1.45±0.46	1.27±0.35	1.40±0.46
Obsessive-compulsive symptoms	1.96±0.57	2.07±0.60	1.82±0.55	2.00±0.61
Interpersonal sensitivity	1.82±0.61	1.94±0.65	1.67±0.56	1.86±0.64
Depression	1.60±0.56	1.72±0.61	1.49±0.52	1.67±0.60

Note: Data are presented as mean ± standard deviation. The scoring range is 1–5 points.

4.2 Comparison of Effect Sizes

The effect-size analysis revealed (see Table 2): in the comparison between 2018 and 2020, interpersonal sensitivity ($d = 0.259$), obsessive-compulsive symptoms ($d = 0.257$), depression ($d = 0.213$), and anxiety ($d = 0.283$) reached medium effect sizes ($|d| \geq 0.5$), indicating that the impact of the pandemic on these dimensions was the most substantive. In the comparison between 2018 and 2021, the effect sizes all decreased markedly, but the differences in obsessive-compulsive symptoms and interpersonal sensitivity still remained at a small-to-medium level ($|d| = 0.2-0.35$), indicating insufficient recovery. In the comparison between 2020 and 2021, the effect sizes for most factors were relatively small, suggesting that although there was improvement between the two years, its magnitude was limited.

Table 2 Comparison of Effect Sizes Across Years

Factor	2018 vs 2020	2018 vs 2021	2020 vs 2021
Somatization	0.283	-0.054	-0.326
Obsessive-compulsive symptoms	0.257	-0.066	-0.316
Interpersonal sensitivity	0.259	-0.061	-0.316
Depression	0.213	-0.110	-0.316
Anxiety	0.283	-0.051	-0.327
Hostility	0.176	-0.052	-0.225

Phobic anxiety	0.213	-0.058	-0.264
Paranoid ideation	0.270	-0.062	-0.324
Psychoticism	0.246	-0.051	-0.291

Note: A positive Cohen's d indicates that the former is greater than the latter; a negative value indicates that the latter is greater than the former.

4.3 Detection Rate of Clinically Significant Symptoms (Factor Mean Score ≥ 3.0)

The analysis of symptom detection rates (see Table 3) further confirmed the trends described above. The detection rate for obsessive-compulsive symptoms ranked first across all four years and reached its highest level in 2019; the detection rates for interpersonal sensitivity and depression rose sharply in 2020 and then declined in 2021. Notably, the detection rates for somatization, phobic anxiety, and psychoticism were relatively low and showed only small fluctuations, suggesting that the psychological impact of the pandemic was concentrated mainly at the cognitive and emotional levels rather than at the somatic level.

Table 3 Detection Rate of Clinically Significant Symptoms (Factor Mean Score ≥ 3)

Factor	2018	2019	2020	2021
Somatization	0.8% (68)	1.2% (114)	0.3% (33)	1.0% (94)
Obsessive-compulsive symptoms	6.1% (545)	8.8% (863)	3.9% (384)	7.9% (733)
Interpersonal sensitivity	5.6% (499)	8.2% (809)	3.5% (338)	6.8% (630)
Depression	3.0% (271)	4.9% (479)	2.2% (219)	4.6% (422)
Anxiety	3.1% (277)	4.3% (424)	1.8% (172)	3.9% (357)
Hostility	2.5% (220)	3.8% (371)	1.7% (168)	3.0% (274)
Phobic anxiety	2.2% (195)	3.0% (299)	1.4% (135)	3.0% (279)

Factor	2018	2019	2020	2021
Paranoid ideation	2.1% (192)	3.9% (388)	1.5% (147)	3.1% (288)
Psychoticism	1.7% (154)	2.8% (272)	1.1% (112)	2.3% (209)

Note: A factor mean score ≥ 3 indicates a symptom level of “moderate or above.”

4.4 Gender Differences

The analysis of gender differences (see Table 4) shows that women had higher mean scores than men on several factors. Among them, the effect sizes for anxiety ($d = 0.190$), depression ($d = 0.277$), and interpersonal sensitivity ($d = 0.096$) reached a moderate or higher level, consistent with the existing literature (Eisenberg et al., 2013; 2025 Chinese study). Notably, these gender differences remained consistent over the four years and did not expand or shrink significantly due to the pandemic.

Table 4. Gender Differences in the Nine SCL-90 Factors in 2021

Factor	Male (N=4306)	Female (N=4962)	Cohen' s d
Somatization	1.35±0.43	1.44±0.48	0.197
Obsessive-compulsive symptoms	1.97±0.62	2.02±0.60	0.081
Interpersonal sensitivity	1.82±0.63	1.88±0.64	0.041

4.5 Urban-Rural Differences

The analysis of urban-rural differences (see Table 5) shows that, overall, the differences between college students from urban and rural backgrounds on the nine SCL-90 factors were small, but there was a consistent trend: urban students had slightly higher mean scores than rural students on six factors—somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, and hostility—whereas the differences on the three factors of phobic anxiety, paranoid ideation, and psychoticism were not significant. Effect-size analysis (Cohen' s d) showed that the urban-rural differences for all factors were small effects ($|d| < 0.2$), indicating that the impact of urban-rural background differences on the mental health of college freshmen was smaller than that of gender and year differences. This finding challenges the common assumption that “rural students have more serious psychological problems.” Possible reasons include:

Students admitted to the same university had already undergone similar educational selection before enrollment, which partially reduced differences associated with urban-rural background.

Table 5. Summary of Urban-Rural Differences

Factor	Urban (N=23799)	Rural (N=13992)	Cohen' s d
Somatization	1.37±0.43 1.38±0.43 —	—	-0.062
	0.018 <i>Obsessive —</i>		
	<i>compulsivesymptoms</i> 1.95±0.59 1.97±0.58 —		
	0.031 <i>Interpersonalsensitivity</i> 1.81±0.62 1.84±0.62 —		
	0.057 <i>Depression</i> 1.62±0.59 1.63±0.57 —		
	0.018 <i>Anxiety</i> 1.63±0.56 1.64±0.55 —		
	0.032 <i>Hostility</i> 1.50±0.55 1.46±0.51 0.072 <i>Phobic anxiety</i> 1.51±0.52 1.58±0.55 —		
	0.120 <i>Paranoid ideation</i> 1.57±0.55 1.54±0.52 0.058 <i>Psychoticism</i> 1.57±0.50 1.60±0.51		

4.6 Differences by Major Category

The analysis of differences by major category (see Table 6) revealed clear differentiation among the four categories. Overall, students in the arts category had the highest scores on multiple factors, especially interpersonal sensitivity (1.6309), depression (1.6156), and anxiety (1.4829), which were significantly higher than those of the other categories; the humanities-history-law-management category followed, while the science-engineering category and the agriculture-forestry category were relatively lower. This pattern may be related to disciplinary culture, gender composition, and the effects of major selection: arts students tend to be more open in emotional expression and more inclined toward self-disclosure, and therefore tend to report higher symptom levels on self-report scales; science and engineering students, by contrast, may report fewer symptoms because of greater inhibition in emotional expression. At the same time, the proportion of female students is higher in arts majors, and female students themselves have a higher reporting rate of psychological distress, which also partly explains the higher scores in the arts category.

Table 6. Overall Differences by Major Category over Four Years

Factor	Humanities/History/Law/Management (N=3677)	Science and Engineering (N=3677)	Agriculture and Forestry (N=3677)	Arts (N=3928)
Somatization	1.38±0.44 1.36±0.41 1.38±0.43 1.40±0.46	—	—	—
	<i>Obsessive —</i>			
	<i>compulsivesymptoms</i> 1.97±0.60 1.95±0.59 1.97±0.58 1.93±0.58			
	<i>Interpersonalsensitivity</i> 1.84±0.62 1.81±0.62 1.84±0.62 1.84±0.62			

Year-by-year analysis (see Table 7) shows that students in the Arts category and the Humanities/History/Law/Management category generally had higher depression scores in each year than those in Science and Engineering and in Agriculture and Forestry. Notably, in 2020 (students admitted after the outbreak of the pandemic), depression scores across all major categories were the lowest among the four years, whereas in 2019 (students admitted before the pandemic), scores across major categories were generally the highest. This trend was con-

sistent across all major categories, further confirming the overall judgment of this study that “the year effect is greater than the major-category effect.”

Table 7. Differences in the Depression Factor by Major Category Across Years

Year	Humanities/History/Philosophy/Literature	Science and Engineering/Management	Agriculture and Forestry	Arts
2018	1.62±0.58	1.59±0.55	1.61±0.55	1.58±0.54
2019	1.78±0.64	1.67±0.58	1.71±0.61	1.71±0.64
2020	1.78±0.64	1.67±0.58	1.71±0.61	1.71±0.64

4.7 Core Factor Network Analysis

The above difference analysis revealed phased fluctuations in the mean values of the nine factors over the four years, but did not clarify whether a stable causal structure exists among the factors. This study used Graphical Lasso to construct a partial-correlation network. By summing the rankings of three indicators—node strength (Strength), predictability (Predictability), and causal influence (Influence)—a Composite Score was obtained to comprehensively measure the centrality of each factor; the higher the value, the more central the factor. The year 2018 is taken as an example. (See Tables 8–11)

Table 8 Rankings of the Factor Network in 2018

Rank	Factor	Strength	Predictability	Influence	Composite
1	Anxiety	1.136	0.761	0.503	27
2	Depression	1.032	0.747	0.495	23
3	Interpersonal sensitivity	1.046	0.739	0.484	22
4	Psychoticism	0.927	0.693	0.463	18
5	Obsessive-compulsive symptoms	0.862	0.649	0.441	15
6	Paranoid ideation	0.834	0.643	0.419	12
7	Hostility	0.678	0.544	0.360	9
8	Somatization	0.608	0.506	0.330	6
9	Phobic anxiety	0.550	0.480	0.315	3

4.8 Cross-Year Comparison of Core Factors

The results of Table 9 comparing the cross-year Composite Scores of core factors show that the Top 3 core factors in 2018 were anxiety, depression, and interpersonal sensitivity; in 2019, they were depression, anxiety, and interpersonal sensitivity; in 2020, they were anxiety, depression, and interpersonal sensitivity; and in 2021, they were anxiety, interpersonal sensitivity, and depression. Therefore, it can be stated that regardless of whether a sudden major safety incident occurred, these three types of factors always ranked at the very front. The cross-year Kendall rank correlation was $\tau = 1.000$ ($p < 0.0001$), indicating that the structure of the core factors was completely consistent across the four

years. The strongest partial-correlation edges were depression-anxiety (0.24), somatization-anxiety (0.22), and hostility-paranoid ideation (0.21). Somatization and phobic anxiety consistently ranked in the last two positions in the network across the four years and were the most peripheral factors.

Table 9 Top 3 Core Factors by Year

Year	Core 1	Core 2	Core 3
2018	Anxiety	Depression	Interpersonal sensitivity
2019	Depression	Anxiety	Interpersonal sensitivity
2020	Anxiety	Depression	Interpersonal sensitivity
2021	Anxiety	Interpersonal sensitivity	Depression

5 Discussion

5.1 The Phased Nature of Four-Year Change and “Incomplete Recovery”

The most important finding of this study is that, from 2018 to 2021, the nine SCL-90 factors displayed a staged pattern of “baseline → deterioration → partial recovery.” The nine-factor scores of the 2018 cohort of first-year students (before the pandemic) served as the baseline reference. Although the 2019 cohort entered university before the pandemic, their scores had already risen slightly. The 2020 cohort, which entered university after the outbreak of the pandemic, experienced the most pronounced impact on mental health. The 2021 cohort, which entered university after the normalization of pandemic conditions, showed improvement, but most factors did not return to the 2018 baseline level. This pattern of “incomplete recovery” is highly consistent with the findings of Fruehwirth et al. (2025) in their longitudinal study of first-year college students in the United States. From the perspective of social-ecological systems theory, this pattern reflects the “cascading disturbance” effect of key historical events in the chronosystem on multiple layers of the ecological system (Bronfenbrenner & Morris, 2006): as a historical event at the macro-temporal level, the COVID-19 pandemic progressively disturbed the macrosystem (public health policies, sociocultural climate), the exosystem (labor market, economic environment), and the microsystem (peer interaction, classroom participation). Because recovery proceeded at different rhythms across system levels—structural changes in the macrosystem and exosystem (such as employment pressure and economic uncertainty) recovered more slowly than immediate changes in the microsystem (such as the lifting of social isolation)—psychological adaptation exhibited a three-stage evolution of “impact → partial recovery → residual effects.” This pattern is also consistent with the “secondary appraisal” framework of stress-and-coping theory (Lazarus & Folkman, 1984): in the early stage of the pandemic, individuals appraised COVID-19 as a direct threat; as the pandemic became normalized, the focus of appraisal shifted toward secondary stressors such as academics and employment, resulting in an asymmetric recovery. Integrating

Bronfenbrenner's ecological systems framework with Lazarus's cognitive appraisal theory helps explain why different factors show differentiated rates of recovery according to the dominant system level with which they are associated and the cognitive appraisal patterns involved.

5.2 Persistent Characteristics of Obsessive-Compulsive Symptoms

The obsessive-compulsive symptom factor consistently ranked first among all factors across the four years (mean range: 1.9607–2.0683), a finding with important theoretical implications. The core feature of obsessive-compulsive tendencies is difficulty tolerating uncertainty and an excessive need for cognitive control (Obsessive-Compulsive Inventory-Revised; Foa et al., 2002). From the perspective of social-ecological systems theory, the “persistence” of obsessive-compulsive symptoms reflects the long-term shaping effect of deep-seated cultural-cognitive patterns at the macrosystem level on individual psychology: the public-health crisis culture triggered by COVID-19 and excessive attention to “safety” formed, at the macrosystem level, a social norm of “continuous vigilance.” Through proximal processes—such as routine practices including continuous health testing, mask wearing, and maintaining social distance—this norm was internalized into individuals' cognitive schemas. Although obsessive-compulsive symptoms in 2021 had declined, they remained higher than the 2018 baseline, suggesting a “lag effect” in cultural-cognitive change at the macrosystem level: even after pandemic-prevention measures at the microsystem level were relaxed, macrosystem-level risk perceptions and a culture of vigilance continued to affect individuals' cognitive schemas. This interpretation is also consistent with the PPCT model's view of “process-context” interaction—the nature of proximal processes is shaped by the larger systemic contexts in which they are embedded (Bronfenbrenner & Morris, 2006). Therefore, recovery from obsessive-compulsive symptoms was slower than for other psychological dimensions that are more strongly driven by immediate changes in the microsystem environment. From the perspective of resilience research (Masten, 2001), the pace of functional recovery after the pandemic was inconsistent across the three major microsystems of school, family, and peers: the academic system was the first to return to offline modes, whereas recovery in peer social systems and family support systems lagged, producing a phenomenon of “asynchronous microsystem recovery” and further prolonging the duration of obsessive-compulsive symptoms.

5.3 The “Social Isolation Effect” of Interpersonal Sensitivity

The interpersonal sensitivity factor reached a peak of 1.666 in 2020, making it the factor with the largest increase over the four years. From the perspective of social-ecological systems theory, this finding centrally reflects a disruption of linkages between the microsystem and mesosystem (Bronfenbrenner, 1979). At the microsystem level, peer-interaction proximal processes were abruptly interrupted by social isolation, and the daily supportive functions of dormitory

communities were suspended, directly weakening the most immediate sources of social support for university students. At the mesosystem level, the home-school connection was fractured by campus lockdown management, and online teaching changed the operating mode of the learning support system, disrupting “positive cross-system interaction” between the microsystem and the mesosystem (Bronfenbrenner & Morris, 2006). The partial recovery of this factor in 2021 (declining to 1.856) was related to the limited return of social opportunities under blended online-offline teaching models, but it still had not fully recov-

returned to pre-pandemic levels, suggesting that functional reconstruction at the microsystem and mesosystem levels requires the re-establishment of sustained and stable offline interpersonal interaction contexts. This pattern is consistent with the findings of Copeland et al. (2021) in their longitudinal study of U.S. college students: after social isolation was lifted, the speed of improvement in interpersonal sensitivity depended on the extent to which face-to-face interaction was restored.

5.4 Implications for Mental Health Work in Higher Education Institutions

The findings of this study have multiple implications for mental health work in higher education institutions. Based on the analytical framework of social-ecological systems theory, this study suggests that university psychological services should expand from “individual intervention” to “ecological-level intervention” (Bronfenbrenner, 1979). At the microsystem level, institutions should systematically reconstruct the proximal processes of peer interaction that were damaged by social isolation, restoring everyday social support networks through structured group activities, dormitory mental health liaison systems, and similar measures. The application of SCL-90 screening results should not stop at a binary judgment of “normal/abnormal”; rather, attention should be paid to dynamic changes in factor distributions and cross-year trends. The differentiated trajectories of change across the nine factors indicate that different psychological dimensions respond to pandemic shocks in distinct ways, and psychological service work therefore requires “factor-specific” intervention strategies.

At the mesosystem level, institutions should repair the ruptured connections among family, school, and community, and establish home-school communication mechanisms that integrate online and offline channels. At the exosystem and macrosystem levels, university administrators should recognize that structural factors such as pandemic prevention and control policies and the economic environment exert indirect yet extensive permeating effects on college students’ mental health. This study’s finding of “incomplete recovery” serves as a warning: the psychological impact of the pandemic will persist over the long term even after surface-level normalization—essentially because macrosystem-level changes in cultural cognition, namely the social norm of “sustained vigilance,” have not yet returned in synchrony. Universities should formulate a “post-pandemic psychological service plan” covering at least 2–3 years, rather than cutting mental

health service budgets immediately after campus control measures are relaxed. The persistently high prevalence of obsessive-compulsive symptoms and the delayed recovery of anxiety suggest that the allocation of psychological service resources should take into account differences in the recovery rhythms of different psychological dimensions; the obsessive-compulsive and anxiety dimensions require longer-term follow-up and intervention.

Third, the higher detection rate among female students calls for gender-sensitive mental health service strategies. At the same time, this study found that the year effect was far greater than the moderating effects of demographic variables such as gender, urban-rural background, and major. From an ecosystem perspective, this result indicates that historical events in the chronosystem exert systematic shocks on the macro-environment, with effects far exceeding demographic differences among individuals at the microsystem level. Against the background of a major public health crisis, the allocation of mental health service resources should take temporal stage as the primary dimension and demographic characteristics as a supplementary dimension.

6 Research Contributions and Limitations

6.1 Research Contributions

The contributions of this study are mainly reflected in the following aspects. First, taking social ecological systems theory (Bronfenbrenner, 1979; Bronfenbrenner & Morris, 2006) as its core analytical framework, and drawing on large-sample SCL-90 census data from universities collected over four consecutive years (nearly 38,000 participants in total), this study systematically compared differences in the mental health of four cohorts of university freshmen from 2018 to 2021 across the nine factor dimensions, revealing a phased pattern of “baseline → deterioration → partial recovery.” From the perspective of the chronosystem, this staged pattern extends the application of social ecological systems theory to the context of major public health crises: as historical events at the macro-temporal level, major crises generate “cascading disturbances” across multiple ecological systems, and the speed of psychological recovery depends on the degree of synchrony in recovery across system levels.

Second, this study explains the pattern of “factor differentiation” from the perspective of differentiation across ecological system levels. The “persistence” of obsessive-compulsive symptoms reflects the delayed recovery of cultural-cognitive patterns at the macrosystem level; the “social isolation effect” of interpersonal sensitivity primarily embodies the disruption of linkages at the microsystem and mesosystem levels; and the “recovery gap” in anxiety-depression reflects the asynchrony between recovery rhythms in the exosystem and microsystem. This theory-driven explanatory framework indicates that the mechanisms by which COVID-19 affected different psychological dimensions differed qualitatively rather than merely in magnitude: different psychological dimensions are associated with different dominant ecological system levels, and

therefore their recovery dynamics also differ.

Third, this study systematically examined the moderating effects of demographic variables (gender, urban-rural background, and broad field of major). The results showed that the year effect was far greater than differences by gender, urban-rural background, and major category. From an ecological systems perspective, this finding suggests that the impact of historical events in the chronosystem far exceeds the moderating power of individual demographic differences at the microsystem level, revealing the systematic influence of macro-environmental changes on group mental health. Gender differences remained stable under the impact of the pandemic and did not significantly widen or narrow because of it, challenging the simple assertion that “the pandemic exacerbated existing inequalities.”

At the practical level, based on the “ecological-level intervention” concept derived from social ecological systems theory, this study offers the following implications for mental health work in universities: (1) the application of SCL-90 screening results should be upgraded from a binary judgment of “normal/abnormal” to trend monitoring based on dynamic changes in factor distributions; (2) the persistently high prevalence of obsessive-compulsive symptoms suggests that early identification of obsessive-compulsive tendencies and CBT interventions should be incorporated into routine screening systems (Hofmann et al., 2012); (3) the “incomplete recovery” pattern warns that universities should continue to allocate psychological service resources after the pandemic,

rather than being reduced immediately after the crisis has eased—because changes in cultural cognition at the macrosystem level require a longer time to recover in tandem; (4) the higher detection rate among female students calls for gender-sensitive mental health services.

6.2 Research Limitations

This study has the following limitations. First, limitations in data sources: the data came from a comprehensive university. Although the sample size was large ($N = 37871$), data from a single institution may be influenced by the culture of a specific region, disciplinary structure, and admission policies; the external validity of the conclusions awaits verification through multicenter studies. The mental health status of students at institutions of different tiers—Double First-Class universities, ordinary undergraduate institutions, and higher vocational/junior colleges—may differ systematically.

Second, limitations in research design: this study adopted a cross-sectional comparative design, with freshmen from different grades measured at different time points, rather than a longitudinal follow-up design tracking the same cohort of students continuously. Therefore, the observed “year differences” may conflate “grade differences” and “cohort differences”: freshman cohorts entering in different years may have had systematic differences in baseline characteristics before enrollment. For example, the 2020 cohort experienced special circumstances

such as home-based review and the postponement of the college entrance examination, and their psychological state before enrollment may already have differed from that of the 2018 cohort.

Third, limitations in measurement tools: as a self-report scale, the SCL-90 is subject to social desirability effects and recall bias. Studies have shown that university students may tend to underreport during freshman entrance screening (Liu Min, Zhang Wei, 2018). In addition, the SCL-90 uses a 1–5 scoring system, and the number of items contained in each factor differs (ranging from 6 to 13 items), so the reliability of factor mean scores may vary.

Fourth, limitations in variable control: this study included only three grouping variables—gender, urban/rural origin, and broad major category—and did not control for potential confounding variables such as family economic status, parents' educational level, only-child status, or prior history of mental health conditions.

Fifth, limitations in data analysis: this study used descriptive statistics and effect-size comparisons, but did not employ advanced statistical methods such as multifactor analysis of variance, multilevel linear modeling, or structural equation modeling to control for confounding factors and test moderating effects. Although the effect size (Cohen's d) provides a standardized index for comparison, confidence intervals were not reported.

6.3 Future Research Directions

On the basis of the above limitations, future research should proceed in the following directions. First, multicenter collaborative studies should be conducted, covering institutions in different regions, of different tiers, and of different types, in order to improve the external validity of the research conclusions. It is recommended that a shared platform for university mental health data be established, enabling cross-institutional horizontal comparisons and standardized data-collection procedures.

Second, longitudinal follow-up designs should be adopted, continuously tracking the same cohort of students from matriculation to graduation in order to distinguish year effects, cohort effects, and developmental effects. Particular attention should be paid to the phenomenon of the “high-incidence period” in the sophomore year (Dong Yuan, 2025)—whether it reflects a delayed maladaptive response after university entry or the cumulative result of academic pressure can be answered only with longitudinal data.

Third, multimodal assessment methods should be introduced. On the basis of SCL-90 self-assessment, behavioral indicators—such as actual consultation data from psychological counseling centers, trajectories of academic performance, and campus-card consumption records—and physiological indicators—such as heart-rate variability (HRV), skin conductance, and sleep monitoring—should be added, so as to overcome the limitations of relying on a single self-report

scale (Study on Gender Differences in College Students' Mental Health, 2025).

Fourth, targeted intervention studies should be carried out. On the basis of the findings of this study—the persistence of obsessive-compulsive symptoms and the “incomplete recovery” of anxiety—early intervention programs targeting obsessive-compulsive tendencies and anxiety symptoms should be designed and evaluated, such as online CBT, mindfulness training, and acceptance and commitment therapy; randomized controlled experimental designs should be used to test their effects.

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