Trajectories of Depression and Anxiety in Chinese High School Freshmen: Associations with Internet Addiction

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This is the accepted manuscript of Gao, T., Qin, Z., Hu, Y., Fei, J., Cao, R., Liang, L., Li, C., Mei, S., & Meng, X. (2021). Trajectories of depression and anxiety in Chinese high school freshmen: Associations with Internet addiction. Journal of affective disorders, 286, 180–186. https://doi.org/10.1016/j.jad.2021.02.074

Abstract

Background: Most previous studies focused on the associations of depression and anxiety with Internet addiction (IA) have used variable-centered approaches. This study aims to explore the distinct developmental trajectories of depression and anxiety, and their association with IA based on person-centered approaches.

Methods: A total of 437 Chinese high school freshmen at the baseline were followed across one year. Latent class growth analysis (LCGA) and growth mixture modeling (GMM) were used to identify the heterogeneity of individual trajectories of depression and anxiety.

Results: For depression, there were three distinct trajectories identified, namely, the escalating group (n=60, 13.7%), recovery group (n=31, 7.1%), and the low-stable group (n=346, 79.2%). For anxiety, the subgroups consisted of the escalating group (n=50, 11.4%), the recovery group (n=34, 7.8%), and the low-stable group (n=353, 80.8%). The probability of IA in the depression low-stable group was significantly smaller compared to those in either the recovery group (χ^2=10.794, P=0.001) or the escalating group (χ^2=19.314, $P < 0.001$). The probability of IA in the anxiety low-stable group was found to be significantly smaller than that in the recovery group (χ^2=17.359, P<0.001) and the escalating group (χ^2=7.752, P=0.005).

Limitations: The sample was limited to students from one specific high school and had a one-year follow-up.

Conclusions: The findings of the study suggest the necessity of early prevention and intervention strategies for those students with depression and anxiety, which are at elevated risk of developing IA.

Key Words: Depression; Anxiety; Internet addiction; Developmental trajectories; High school freshmen

1. Introduction

Anxiety and depression have been identified as the second (10.7%) and third (6.1%) most common psychiatric disorders in the age group ranging from 12 and 19 years old, respectively (Costello et al., 2011). A recent review for low- and middle-income countries indicated that the prevalence of depression and anxiety were 0%–28% and 8%–27% among the youth population, respectively (Yatham et al., 2018). According to the World Health Organization report (2014), depression and anxiety were the major causes of years lost due to disability among adolescents. Adolescents are at elevated risk of developing mental health and behavior problems (Wang et al., 2019). In China, high school students are facing a substantial academic stressor of attending a very competitive national university entrance examination. In particular, first-year students have to adapt to the transition from being junior-high-school students to being senior-high-school students. To adjust to their high school lives, students not only need to focus on their heavy academic tasks but also need to invest more time in social interactions. With the limited time available during a day, this tight schedule undoubtedly causes an increase in the level of daily stress. Therefore, it is crucial to explore the mental health state and behavioral problems of first-year high school students.

The 46th China statistical report on Internet development (China Internet Network Information Center, 2020) indicated that China had 940 million Internet users in June 2020. Students accounted for the largest proportion of all Internet users, with a percentage being of 23.7%. With regard to the age of Internet users, individuals aged 10 to 19 constituted 14.8% of the total number of users. Internet use in modern society is convenient and inevitable in several ways. Many applications, including social networking software, real-time video call, online shopping, videos, and games, are becoming more and more important in an individual's daily lives. However, excessive use of the Internet can result in Internet addiction (IA). IA is often characterized by failure to control Internet use, which leads to neglecting real-life relationships, work, and normal routines (Young, 2007). A recent systematic review and meta-analysis found that the pooled prevalence of generalized IA was 7.02% (Pan et al., 2020). Given the fact that the largest proportion of Internet users involves high-school students, it is sensible to make the assumption that adolescents are more vulnerable to IA compared with other aged groups.

Comorbidity among depression, anxiety, and IA has been identified in our previous study (Gao et al., 2020). Additionally, the impact of depression and anxiety on IA has been well documented in numerous cross-sectional studies (Elhai et al., 2020; Li et al., 2019b; Malak et al., 2017; Mamun et al.,

2019). Several longitudinal studies have also provided empirical evidence on the association between depression, anxiety, and IA over time. Ko et al. (2009) carried out a two-year prospective study and found that the presence of depression could be used to predict the occurrence of IA in adolescents. A three-year Chinese cohort study found that both depression and anxiety were causal factors of IA (Yao et al., 2013). The association between anxiety and IA was found to be relatively stable over time for adolescents aged between 16 to 18 years (Stavropoulos et al., 2017). A cognitive-behavioral model of pathological Internet use provides the theoretical framework for these studies, indicating that the underlying psychopathology (e.g., depression or social anxiety) is a predisposed vulnerability in Internet overuse (Davis, 2001). Most previous studies have been focused on the association of depression and anxiety with IA using variable-centered approaches. It is widely accepted that individuals with high levels of depression and anxiety are at great risk of developing IA. Considering the high prevalence of depression, anxiety, and IA, and the close relationship between them, conducting further research in this field is urgently needed.

The prevalence of depression and anxiety in the German university's 1st-year undergraduate students has been increased from 2016 to 2019 (Brailovskaia and Margraf, 2020). In contrast, the latent growth model of depressive symptoms in Chilean adolescents showed a decreasing trend over time (Stapinski et al., 2013). Other studies reported a V-shaped curve of depression trajectories in a middle-aged population (Lee, 2020). A three-year follow-up study found that the developmental trajectories of anxiety remained stable in non-clinical early adolescents (Voltas et al., 2016). All the above-mentioned studies were based on a single population and having the assumption that all individuals had the same or similar trajectories. However, from the perspective of dynamic development, it is more conducive to allow heterogeneity to explore variations over time. The latent class growth modeling approach has been designed to detect individual variability in developmental trajectories (Wickrama et al., 2008). The developmental trajectories of depression and anxiety exhibit clear heterogeneity and individual differences (Arizaga et al., 2020; Ellis et al., 2017; Nelemans et al., 2018; Shi et al., 2016).

When exploring within-person mental health variations over time, a person-centered approach is more informative and convincing than a variable-centered approach (Wickrama et al., 2008). Using a person-centered approach, the present study allows the heterogeneity in individual's trajectories of depression and anxiety. Based on these trajectories, the present study aims to explore the extent to which distinct patterns of depression and anxiety are associated with a high risk of IA. These findings will contribute to identifying the most vulnerable subgroups for depression and anxiety in senior-high-school

students, and provide a target to allow preventive efforts against IA. The presence of heterogeneity in the developmental trajectories of depression and anxiety was hypothesized when exploring the individual variability over time. Besides, the trajectories of depression and anxiety were associated with IA.

2. Methods

2.1. Participants

The data was taken from a longitudinal study, which consisted of three waves. Participants were collected via a random stratified sampling method from a senior high school located in Changchun, China. Each wave was spaced by approximately six months. At the baseline (Time 1, October 2017), the sample included 882 freshmen (grade 10) from one high school. At wave 2 (Time 2, April 2018), the sample dropped to 624 participants, since several students changed school campus and class composition. By the end of the third wave (Time 3, October 2018), a total of 437 students were included in the data analysis. Data collection was conducted based on a paper-and-pencil questionnaire in the classroom. The informed consent of all the participants was obtained before all data collections. Informed consent from the legal guardians or parents of any included minor was also obtained. The questionnaires took an average of 20 mins to complete, and participants were allowed to withdraw from the study at any time during the study. The study was approved by the research ethics board at Jilin University. The mean age was 15.05±0.64 years (range from 12 to 16 years) at the baseline.

2.2. Measures

2.2.1. Depression Anxiety Stress Scale

The Chinese version of the Depression Anxiety Stress Scale (DASS-21) (Gong et al., 2010), which was originally developed by Lovibond and Lovibond (1995), was used to assess the mental symptoms of the participants over time. The subscales of depression and anxiety were respectively used to measure the level of depression and anxiety. Each subscale contains seven items, which are rated on a four-point scale from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). A higher total score indicates a more severe symptom. As recommended by the DASS manual (Psychology Foundation of Australia, 2018), a cutoff of six points for the depression subscale indicates the occurrence of depression symptoms, whereas a five-point cutoff for the anxiety subscale indicates the presence of anxiety symptoms. In the present study, the Cronbach's α value in the three waves was found to be 0.79, 0.80, 0.90 for the depression subscales and 0.77, 0.86, 0.88 for the anxiety subscales, respectively.

2.2.2. Internet Addiction

The Young's diagnostic questionnaire (YDQ) for measuring IA is a widely used diagnostic tool (Young, 1998). This scale contains eight items. Response options include 0=no and 1=yes. A higher total score indicates a higher level of IA. As recommended, participants were categorized as suffering from IA if their overall score was greater than or equal to five. In the current study, the Cronbach's α value for this scale in the third wave was 0.82.

2.3. Statistical analyses

To identify heterogeneity in the patterns of the depression and anxiety subgroups among high school students, latent class growth analysis (LCGA) and growth mixture modeling (GMM) were conducted. Both LCGA and GMM are person-centered approaches, which mainly explore the relationships among individuals. This approach aims at categorizing individuals into more distinct groups according to individual response patterns so that individuals within a group are more similar than those between groups (Bergman and Trost, 2006). LCGA is an exceptional form of GMM, which sets all intercepts and slope variances to zero (Jung and Wickrama, 2008). This strategy not only describes the individuals' growth trajectory like the conventional latent growth curve model (LGCM), but also reveals inter-individual differences within a group over time. The optimal number for classes is based on the highest accuracy of the corresponding fit. Fit indices were used in the present study, including the Akaike information criterion (AIC), Bayesian information criterion (BIC), sample size adjusted BIC (aBIC), Vuong-Lo-Mendell-Rubin likelihood ratio test (VLMR), and bootstrapped likelihood ratio test (BLRT). The robust maximum likelihood estimation (MLR) was adopted to obtain a parameter estimate (Nylund et al., 2007). Smaller values of AIC, BIC, and aBIC represent a more accurate fitting model, whereas an entropy value closer to one indicates a more accurate classification. A significant *P*-value (<0.05) in VLMR and BLRT indicates that the *k* class model fits significantly better than the *k-1* class model. The final model of the posterior probability of trajectory membership must be bigger than 0.7. The final depression and anxiety model was selected by comparing the optimal fitting model indices between the LCGA and GMM approaches. After the numbers of the latent class for depression and anxiety were selected, the trajectories were plotted and interpreted, and each trajectory group membership was determined. Equality tests of means/probabilities across classes were used to investigate the influence of the trajectories of depression and anxiety on IA. The full information maximum likelihood (FIMI) approach was applied to handle the missing data. FIML is regarded as one of the most robust methods to

deal with missing, which allows the inclusion of participants with missing data in the analyses for unbiased inference (Raykov, 2005). All the statistical analyses were performed using the Mplus software with version 8.4.

3. Results

3.1. Baseline demographic characteristics of students

Appendix 1 shows the demographic characteristics of students collected at the baseline. The proportion of girls (64.1%) was higher than that of boys (35.9%). Over two-thirds of the students were from one-child families (72.3%). Regarding the education level of their parents, 44.4% of fathers and 38.7% of mothers had degrees of college or above. A little over half (51.0%) of the participants' fathers and less than half (46.7%) of the respondents' mothers had non-manual jobs. A total of 184 students reported that their average monthly family income was less than or equal to 6000 RMB, which accounted for 42.1% of the total sample.

3.2. Identifying depression trajectory groups

The fitting model indices of depression for the LCGA and GMM approaches are presented in Table 1. The LCGA model with two and three latent classes showed a significant *P*-value for the VLMR statistics. However, the three-class model was found to exhibit a higher entropy value (0.933) than the two-class model (0.905). Therefore, the optimal number of classes yielded a three-class model as the final LCGA model. Regarding the GMM model of depression, a two-class model was considered optimal. Comparing the optimal fitting model indices between the LCGA and GMM approaches, the LCGA depression model was found to be superior to the GMM model. Therefore, the three-class LCGA depression model was concluded to be the optimal model.

[Insert Table 1]

Fig. 1 displays the distinct trajectories of depression selected via the LCGA model. According to the characteristics of the developmental trajectories, the subgroups were named the escalating group, recovery group, and low-stable group. The escalating group included 60 (13.7%) participants, and the mean values of intercept and slope were 3.050 and 4.291 (P<0.001), respectively. Students from the escalating group showed a dramatically increased level of depression across time. The recovery group included 31 (7.1%) students, and the mean values of intercept and slope were 11.151 and -2.331

(P<0.001), respectively. Participants in the recovery group were found to be more likely to show higher levels of depression at Time 1, while the level of depression gradually decreased over time. Finally, the low-stable group included 346 (79.2%) students, and the mean values of intercept and slope were 1.525 (P<0.001) and -0.052 (P=0.581), respectively. According to the established six-point cutoff for depressive symptoms, students in the low-stable group showed a relatively low level of depression and were found to have no depressive symptoms during the follow-up study.

[Insert Fig. 1]

3.3. Identifying anxiety trajectory groups

Fitting model indices of anxiety for the LCGA and GMM approaches are presented in Table 2. For patterns of anxiety trajectories in the LCGA, only a two-class model was found to indicate a significant *P*-value for the VLMR statistics. Therefore, the two-class model for the LCGA was considered optimal. For the GMM model of anxiety, the GMM model with two, three, and four latent classes were found to indicate a significant *P*-value for the LMR-LRT statistics. However, both a three-class (0.885) and a four-class (0.913) model had higher entropy values than the two-class model (0.864). Besides, one of the classes in the four-class model had inadequate class size (i.e., only 0.7% of the total sample was in this group). Finally, the optimal number of classes was identified to be three for the GMM model based on the entropy value and class sizes. Comparing the optimal fitting model indices of the LCGA and GMM approaches, the latter was found to be superior to the former for dealing with anxiety. Therefore, the three-class GMM model was concluded to be the optimal model for anxiety.

[Insert Table 2]

Fig. 2. shows the three anxiety trajectories selected via the GMM model. The distinct trajectories were named the escalating group, recovery group, and low-stable group. The escalating group consisted of 50 (11.4%) participants, and the mean values of intercept and slope were 4.510 and 4.068 (P<0.001), respectively. Students in this group showed a dramatically increased level of anxiety over time. The recovery group included 34 (7.8%) respondents, and the mean values of intercept and slope were 12.955 (P<0.001) and -1.770 (P=0.005), respectively. Students in this group showed a higher initial level of anxiety and gradually decreased the level of anxiety over time. A total of 353 (80.8%) participants were included in the low-stable group, and the mean values of intercept and slope were 3.116 (P<0.001) and

-0.305 (P=0.014), respectively. According to the established five-point cutoff for anxious symptoms, students in the low-stable group showed a low level of anxiety and had no anxiety symptoms during the follow-up study.

[Insert Fig. 2]

3.4. Associations between depression developmental trajectories and IA

Based on the three-class depression model, IA at Time 3 (suffering from IA or not as a binary dependent variable) was included as a possible outcome of the LCGA model to explore the influence of depression trajectories on the probability of suffering from IA. The results of the equality tests of means/probabilities across classes are shown in Table 3. The probability of suffering from IA in the low-stable group was found to be significantly smaller than for the recovery group (χ^2=10.794, P=0.001) and the escalating group (χ^2=19.314, P<0.001). The probability of IA in the recovery group, the escalating group, and the low-stable group were 46.5%, 42.6%, and 12.8%, respectively.

[Insert Table 3]

3.5. Associations between anxiety developmental trajectories and IA

Based on the three distinct trajectories of the anxiety model, IA at Time 3 (suffering from IA or not as a binary dependent variable) was included as a possible outcome of the GMM to explore the influence of anxiety trajectories on the probability of suffering from IA. Equality tests of means/probabilities across classes indicated that the probability of suffering from IA in the low-stable group was significantly smaller than for the recovery group (χ^2=17.359, P<0.001) and the escalating group (χ^2=7.752, P=0.005). The probability of suffering from IA in the recovery group, the escalating group, and the low-stable group were 55.7%, 39.8%, and 12.9%, respectively (see Table 4).

[Insert Table 4]

4. Discussion

This present study identifies three distinct trajectories for depression, namely, the escalating group, the recovery group, and the low-stable group. Most students belonged to the low-stable group, which persistently displayed the lowest initial level of depression and remained comparatively stable. The mean value of depressive symptoms was found to be smaller than two during the follow-up. According to the six-point cutoff for depressive symptoms, the low-stable group rarely or never experienced depressive

symptoms during the study period. This result is consistent with a previous study, which reported that most people do not suffer from depression over time (Gunzler et al., 2016). A total of 13.7% of the study participants showed a lower initial level of depression but increased to a higher level of depressive symptoms over time (the escalating group). The mean score of depression in this group was higher than six at Time 2. For this group, intervention should occur during the early stages of depression, in order to prevent its rapid development. A small proportion of participants were included in the recovery group, presenting the highest initial level of depression but gradually decreased over time. However, the mean score of depression in this group remained over six during the follow-up study. Since students in this group were more likely to have more severe depressive symptoms, selective intervention measures should be adopted to alleviate depressive symptoms over time. The results of the present study support the ecological systems theory (Bronfenbrenner, 1979), which suggested the influence of the timing on depression. These findings are inconsistent with previous studies, which found that most depression patients would have a stable-low trajectory, followed by a recovery or an escalating trajectory (Arizaga et al., 2020; Wickrama et al., 2008).

In the present study, heterogeneity in the developmental trajectories of anxiety was also observed. Three distinct subgroups were identified by the GMM method, namely, the escalating group, the recovery group, and the low-stable group. The majority of participants were persistently found to exhibit the lowest level of anxiety across the study period. According to the five-point cutoff for anxious symptoms, students in the low-stable group did not develop anxiety symptoms over time. This finding supports previous research, where it was observed that most people did not suffer from anxiety over time (Shi et al., 2016). A small proportion of participants were included in the recovery group, with the highest initial level of anxiety (nearly 13 points) and followed by a gradually decreasing path. Students in this group clearly showed more severe anxiety symptoms, which means that immediate and direct interventions should be adopted at every stage and benefit from the advantages of relieving anxiety over time. About one in ten respondents were categorized as the escalating group. Their trajectory displayed a lower initial level of anxiety (nearly six points) and was followed by a gradually increasing trend. For this group, early-stage interventions are crucial in order to minimize anxiety symptoms. These findings are also in line with the ecological systems theory (Bronfenbrenner, 1979). The findings of the present study had some discrepancies with the findings of Letcher et al. (2012), where the proportion of the moderate group was found to be the largest one, followed by the low and high group.

In this study, the associations between the symptoms of depression and anxiety trajectories and IA were examined. We found that students in the depression recovery group and the escalating group had a higher risk of developing IA compared to those in the low-stable group. Likewise, the participants in the anxiety low-stable group had a lower probability of IA compared to the recovery group and escalating group. A recent short-term longitudinal study found that poor mental health at the baseline was associated with an increased probability of alcohol use over time (Lisa et al., 2019). The high proportions of anxiety and depression were found to be linked to heightened cardiovascular risks of subsequent CV events in patients with stable coronary heart diseases (Peter et al., 2020). Results from LGCM have indicated that depression could influence IA with a low/declining pattern, whereas the influence of anxiety on IA trajectory was found during the follow-up period for both subgroups with a low/declining trend of IA and a high/declining pattern of IA (Li et al., 2019a). Individuals who have difficulties in emotional regulation are more likely to adopt excessive Internet use as a compensatory strategy (Pettorruso et al., 2020). However, resorting to addictive behaviors has been reported to be an ineffective coping strategy for people to escape from the troublesome reality (Blasi et al., 2019). Internet use seems to be the most easily available method to rescue students temporarily from negative emotions and alleviate distressing feelings (Kardefelt-Winther, 2014). However, excessive Internet use would result in a greater probability of IA in the long run.

Practical implications

The findings of the present study provide empirical evidence to inform population mental health prevention strategies and mental health promotions for students in general and more importantly for those already suffering from mental health problems. For the prevention and intervention of depression and anxiety in high school freshmen, different methods of psychological counseling and intervention, based on the characteristics of each subgroup trajectory, can be adopted. Among these, students in the recovery and the escalating groups for both depression and anxiety are the most concerned. The ultimate goal is to promote mental health and reduce the possibility of excessive Internet use for trying to escape from negative emotions.

Strengths and limitations

Using a person-centered approach, the present study found the presence of heterogeneity for the individual trajectories of depression and anxiety. Distinct subgroups of depression and anxiety were found by using the LCGA and GMM methods, respectively. To the best of our knowledge, this is the first

study that focuses on the influence of membership in subgroup trajectories of depression and anxiety symptoms on IA. These results could provide practical advice for selective preventions and intervention purposes. However, there are several limitations to be noted. First, the sample was limited to students attending one specific high school, and the study only had a one-year follow-up. The representativeness and generalizability of the study findings may be limited. Future studies might benefit from exploring a more representative sample and investigating trajectories over a longer period. Secondly, self-reported measures were used in the study, which are prone to recall bias. However, it is difficult to obtain objective measures for these studied psychological constructs. Future studies should consider more validated and accurate measures to assess these variables. Finally, other unmeasured potential factors that might influence the results, such as smoking and the need for mental health care.

Conclusions

The present study investigated changes in depression and anxiety among high school freshmen over time and identified the differential impact of distinct trajectories of depression and anxiety on IA. The findings of the present study provide empirical data supporting the timing effect of the ecological systems theory (Bronfenbrenner, 1979) and suggest the necessity of early prevention and intervention strategies for those students with depression and anxiety, which are at elevated risk of developing IA.

Author Statement Contributors

SM and TG designed the study. TG, ZQ, YH, RC, LL and CL performed the study. TG analyzed the data and drafted the manuscript. XM, SM and JF participated in revising the manuscript. All authors approved the final manuscript.

Role of the Funding Source

This research received support from Planning Project for Humanities and Social Science Research of the Department of Education of Jilin Province (JJKH20190216SK), and International innovation team of Jilin University (2019GJTD06).

Acknowledgements

We want to thank all the participants in the present study.

Competing Declaration of Interest

The authors declare no conflict of interest.

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Appendix 1 A summary of demographic characteristics of the study cohort at baseline (n, %).

Variables	Girls	Boys	Total
Whether or not coming from a one-child family			
Yes	197 (70.4)	119 (75.8)	316 (72.3)
No	83 (29.6)	38 (24.2)	121 (27.7)
Father's highest education level			
Junior school or less	78 (27.9)	49 (31.2)	127 (29.1)
Senior high or technical secondary school	72 (25.7)	44 (28.0)	116 (26.5)
Junior college or above	130 (46.4)	64 (40.8)	194 (44.4)
Mother's highest education level			
Junior school or less	80 (28.6)	51 (32.5)	131 (30.0)
Senior high or technical secondary school	83 (29.6)	54 (34.4)	137 (31.3)
Junior college or above	117 (41.8)	52 (33.1)	169 (38.7)
Father's employment status			
Non-manual jobs	142 (50.7)	81 (51.6)	223 (51.0)
Manual jobs	130 (46.4)	73 (46.5)	203 (46.5)
Unemployed	8 (2.9)	3 (1.9)	11 (2.5)
Mother's employment status			
Non-manual jobs	137 (48.9)	67 (42.7)	204 (46.7)
Manual jobs	101 (36.1)	60 (38.2)	161 (36.8)
Unemployed	42 (15.0)	30 (19.1)	72 (16.5)
Average monthly family income			
≤6000 RMB	115 (41.1)	69 (43.9)	184 (42.1)
6001-9000 RMB	93 (33.2)	43 (27.4)	136 (31.1)
>9000 RMB	72 (25.7)	45 (28.7)	117 (26.8)

Table 1 Fitting model indices for the depression latent class growth analysis (LCGA) and growth mixture modeling (GMM).

Model		AIC	BIC	aBIC	Entropy	VLMR (*P*-value)	BLRT (*P*-value)
LCGM							
	1-class	7249.037	7269.436	7253.569	–	–	–
	2-class	6876.411	6909.050	6883.663	0.905	<0.001	<0.001
	3-class	**6705.846**	**6750.725**	**6715.817**	**0.933**	**0.023**	**<0.001**
	4-class	6617.451	6674.570	6630.141	0.916	0.077	<0.001
	5-class	6545.972	6615.331	6561.381	0.935	0.189	<0.001
GMM							
	1-class	7007.091	7039.731	7014.343	–	–	–
	2-class	**6801.388**	**6846.267**	**6811.359**	**0.926**	**<0.001**	**<0.001**
	3-class	6657.310	6714.429	6670.000	0.930	0.086	<0.001
	4-class	6600.449	6669.808	6615.858	0.915	0.187	<0.001
	5-class	6526.296	6607.895	6544.425	0.931	0.232	<0.001

Note: AIC=Akaike information criterion; BIC=Bayesian information criterion; aBIC=sample size adjusted BIC; VLMR=Vuong-Lo-Mendell-Rubin likelihood ratio test; BLRT=bootstrapped likelihood ratio test.

The optimal model is highlighted in bold.

Table 2 Fitting model indices for the anxiety latent class growth analysis (LCGA) and growth mixture modeling (GMM).

Model		AIC	BIC	aBIC	Entropy	VLMR (*P*-value)	BLRT (*P*-value)
LCGM							
	1-class	7535.330	7555.729	7539.862	–	–	–
	2-class	**7157.438**	**7190.078**	**7164.690**	**0.873**	**<0.001**	**<0.001**
	3-class	7058.971	7103.850	7068.942	0.890	0.110	<0.001
	4-class	7011.228	7068.347	7023.918	0.891	0.065	<0.001
	5-class	6953.543	7022.902	6968.952	0.903	0.486	<0.001
GMM							
	1-class	7193.526	7226.166	7200.778	–	–	–
	2-class	7072.472	7117.351	7082.443	0.864	0.001	<0.001
	3-class	**7011.006**	**7068.125**	**7023.696**	**0.885**	**0.043**	**<0.001**
	4-class	6975.251	7044.609	6990.660	0.913	0.030	<0.001
	5-class	6912.675	6994.274	6930.804	0.917	0.461	<0.001

Note: AIC=Akaike information criterion; BIC=Bayesian information criterion; aBIC=sample size adjusted BIC; VLMR=Vuong-Lo-Mendell-Rubin likelihood ratio test; BLRT=bootstrapped likelihood ratio test.

The optimal model is highlighted in bold.

Table 3 Regression model of depression including Internet addiction at Time 3 as the outcome.

Groups	Prob	SE	OR	SE	2.5%CI	97.5%CI
Recovery group						
Non-IA	0.535	0.100	1.000	0.000	1.000	1.000
IA	0.465	0.100	1.172	0.571	0.451	3.045
Escalating group						
Non-IA	0.574	0.063	1.000	0.000	1.000	1.000
IA	0.426	0.063	1.000	0.000	1.000	1.000
Low-stable group						
Non-IA	0.872	0.019	1.000	0.000	1.000	1.000
IA	0.128	0.019	0.197	0.064	0.104	0.373

Comparisons	χ^2	*P*	*df*
Overall test	28.873	<0.001	2
Recovery group vs. Escalating group	0.106	0.745	1
Recovery group vs. Low-stable group	10.794	0.001	1
Escalating group vs. Low-stable group	19.314	<0.001	1

Table 4 Regression model of anxiety including Internet addiction at Time 3 as the outcome.

Groups	Prob	SE	OR	SE	2.5%CI	97.5%CI
Recovery group						
Non-IA	0.443	0.102	1.000	0.000	1.000	1.000
IA	0.557	0.102	8.465	3.759	3.545	20.213
Escalating group						
Non-IA	0.602	0.088	1.000	0.000	1.000	1.000
IA	0.398	0.088	4.453	2.054	1.804	10.996
Low-stable group						
Non-IA	0.871	0.022	1.000	0.000	1.000	1.000
IA	0.129	0.022	1.000	0.000	1.000	1.000

Comparisons	χ^2	*P*	*df*
Overall test	28.386	<0.001	2
Recovery group vs. Escalating group	1.132	0.287	1
Recovery group vs. Low-stable group	17.359	<0.001	1
Escalating group vs. Low-stable group	7.752	0.005	1

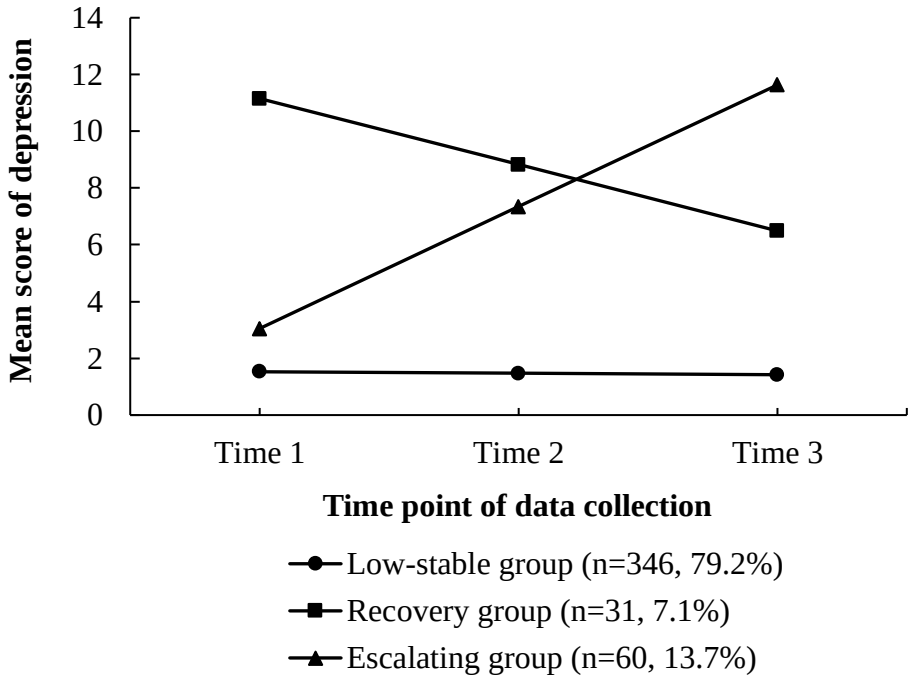

Fig. 1 Developmental trajectories of depression among the study cohort based on the 3-class model (n = 437).

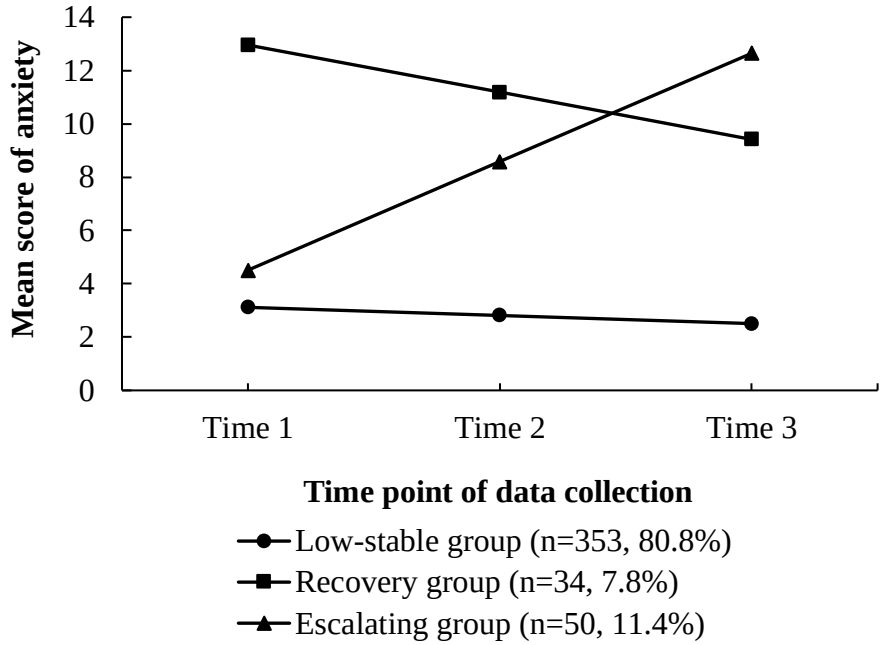

Fig. 2 Developmental trajectories of anxiety among the study cohort based on the 3-class model (n = 437).