

# Academic performance and subtypes of psychological traits in undergraduate nursing students: A latent class analysis

Rui Li

Shanghai University of Traditional Chinese Medicine

Wanqiong Zhou

Shanghai University of Traditional Chinese Medicine

Jing Wu (✉ [jingwuclose@126.com](mailto:jingwuclose@126.com))

Shanghai University of Traditional Chinese Medicine <https://orcid.org/0000-0002-2492-5118>

---

## Research article

**Keywords:** Latent class analysis, Learning burnout, Psychological capital, Rumination, Undergraduate nursing students

**Posted Date:** July 22nd, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-39742/v1>

**License:**   This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

# Abstract

**Background:** Undergraduate nursing students often encounter emotional problems due to academic stress. However, researchers have primarily focused on the impact of stressors, rather than understanding the subtypes of psychological state among students.

**Objectives:** To identify subgroups of psychological traits among undergraduate nursing students using latent class analysis (LCA), and to examine the relationship between subgroups and exam failure risk.

**Design and Methods:** A cross-sectional study was performed from May to July 2019. The Ruminative Responses Scale, Learning Burnout Questionnaire and Psychological Capital Scale were used to evaluate students' psychological traits. Subjects were categorized into subgroups by latent class analysis. Cross-sectional comparisons and longitudinal regression analyses were subsequently performed.

**Settings and Participants:** A total of 379 undergraduate nursing students from three medical colleges in Shanghai were investigated by cluster sampling method.

**Results:** A total of four latent classes were identified based on the mean scores of rumination, learning burnout and psychological capital: Class 1 – General group (N=181, 47.76%); Class 2 – Negative psychologically dominated group (N=54, 14.25%); Class 3 – Positive psychologically dominated group (N=65, 17.15%); and Class 4 – Ambivalence psychological group (N=79, 20.84%). Students belonging into Class 1 and 2 displayed a higher rate of exam failure compared with those in Class 3 and 4 ( $p < 0.05$ ). Regression analysis showed that Class 1 (OR=2.108, 95%CI 1.240-4.118,  $p = 0.006$ ) and Class 2 (OR=2.694, 95%CI 1.229-6.293,  $p = 0.016$ ) independently predicted exam failure among undergraduate nursing students after adjusting for age, gender, grade and other academic related factors.

**Conclusions:** Our findings provide practical implications for effective interventions that target each specific subgroup. Undergraduate nursing students with “Negative psychologically dominated group” were at a higher risk of exam failure. Urgent attention should be paid to address issues associated with psychological coping in students and their effect on learning outcomes.

## Background

Although the number of registered nurses in China has increased approximately 32% in the past ten years, rising demand for health care services has resulted in a shortage of qualified nurses in the healthcare system. Nursing schools across the country have been struggling to expand capacity, and concerns have also been raised about the psychological state of nursing students [1]. Reports have shown that 41.9% of nursing students experience significant levels of burnout, anxiety and stress during their undergraduate studies [2]. These psychological concerns are often brought about by future job anxiety, as well as intense academic burden, including regular clinical and educational assessments and frequently changing clinical environments.

Studies have documented that psychological state toward negative events are often associated with emotional exhaustion or burnout [3]. Negative events such as exam failure contribute to the worsening mental health of students and create challenges for effective nursing education [4]. Students who often feel overwhelmed by study burnout are more likely to fail in exams due. It is well known that psychological health has a positive impact on sustainable competitiveness, and is negatively correlated with study burnout [5]. Studies have also examined the effect of rumination on the psychological health of students [6]. However, most studies typically adopt qualitative approaches, which limit the generalizability of the findings. Conversely, existing quantitative studies tend to rely on variable-centered methods, which can obscure individual variation of students.

The current study examines the correlation between negative events such as exam failure and subtypes of psychological state among undergraduate nursing students via individually-oriented analyses[7], in order to identify “latent classes” or consistent patterns of psychological coping towards exam failure across individuals. This type of study is the first of its type that has been conducted in China, and provides a reference point for comparison with future international studies.

## Methods

### 2.1. Participants

From May to July 2019, a total of 379 undergraduate nursing students (341 females and 38 males) of Grade 1–4 from three medical colleges in Shanghai were enrolled in the current study via cluster sampling method.

### 2.2. Data collection

**General information.** A general information questionnaire was distributed by trained professionals via face-to-face interview to collect demographic data such as age, gender, place of birth, as well as academic information such as grade, working part-time, and student cadre.

**Rumination.** Ruminative Responses Scale (RRS) was used to assess rumination [8], a 22-item scale that included three categories: symptom rumination, brooding and reflective pondering. Each item was divided into four separate responses – almost never, sometimes, often, and almost always (1–4), and higher the scores, the more serious the degree of rumination. Previous studies had demonstrated that RRS had good reliability and validity with the overall Cronbach's  $\alpha$  between 0.86 and 0.90 [9, 10].

**Learning burnout.** Learning Burnout questionnaire was compiled by Lian [11] and designed to evaluate the degree of learning burnout. The scale consisted of 20 items based on a 5-point Likert scale, from 1 (completely inconsistent) to 5 (fully consistent); higher scores indicated higher levels of learning burnout. The items were separated into three categories: dejection, improper behavior, and reduced personal accomplishment. The questionnaire's Cronbach's  $\alpha$  was 0.865, and coefficient of each subscales was above 0.70 [12].

Psychological capital. The Psychological Capital Scale (PCS) [13] was used to measure the level of psychological capital. The scale consisted of 24 items based on a 5-point Likert scale that addressed four separate categories: self-efficacy, hope, optimism, and resiliency based on a scale from (1 = strongly disagree to 5 = strongly agree). Higher total scores indicated a greater level of psychological capital. The PCS had an overall Cronbach's  $\alpha$  of 0.93, with self-efficacy, hope, optimism, and resilience scores of 0.85, 0.84, 0.84, and 0.80, respectively [14].

## 2.3. Ethical considerations

This study was approved by a regional ethical review board in Shanghai, China. Written informed consent was obtained from all participants prior to taking part in the study.

## 2.4. Data analysis

We applied latent class analysis (LCA), a form of finite mixture modelling [15, 16] to identify methods of psychological coping among undergraduate nursing students. LCA is a model-based approach to clustering [17], that determines the optimal class number based on formal statistical procedures, and the results are interpreted in terms of probabilities.

A series of LCA models with an increasing number of latent classes were estimated. Each successive  $k$ -class model was compared with the previous  $(k-1)$ -class model using Akaike's information criterion (AIC), Bayesian information criterion (BIC), Adjusted BIC (aBIC), the Lo-Mendell-Rubin likelihood ratio (LMR LR) test, the adjusted LMR LR (ALMR LR) test and the bootstrap likelihood ratio test (BLRT). Once the optimal number of latent profiles was identified, students were classified into latent classes based on their most likely latent class membership. The quality of membership classification was assessed by examining classification probabilities and the entropy value. Next, the prevalence rates (i.e., unconditional probabilities) of the latent classes were assessed and the latent classes were defined based on the conditional-response probabilities of each latent.

The relationships between latent class membership and exam failure risk were examined using logistic regression analysis. A hypothesized model (Fig. 1) was implemented, which includes the effects of covariates such as age, gender, grade and academic factors, as well as the effects of covariates on distal outcome (exam failure risk) by latent class. Estimates of the odds ratio and 95% CIs were obtained based on the regression analysis. A value of  $p \leq 0.05$  was considered statistically significant.

## Results

The demographic characteristics of the study samples were shown in Table 1. A total of 379 subjects were enrolled in the study, with an average age of  $20.14 \pm 1.71$  years, including 341 females (90.0%) and 38 males. Subjects were classified into two groups according to whether or not they failed in exams. A total of 124 subjects (32.7%) reported failing in exams during their undergraduate period. Univariate analysis results for distributions of sociodemographic data between the groups showed that students in years 3 and 4 tended to have a higher exam failure rate ( $P < 0.05$ ).

Table 1  
Demographic characteristics and academic characteristics (N = 379).

Characteristics	All	Fail in exam	Not fail in exam	t/F	P- value
	(N = 379)	(N = 124)	(N = 255)		
Age(years)	20.14 ± 1.71	19.94 ± 2.15	20.23 ± 1.47	-1.525	0.128
Female(%)	341(90.0)	110(88.7)	231(90.6)	0.326	0.568
Grade					
College (1–2 years)	127(33.5)	30(24.2)	97(38.0)	7.718	0.007
College (3–4 years)	252(66.5)	94(75.8)	158(62.0)		
Working part-time					
No	218(57.5)	67(54.0)	151(59.2)	0.917	0.338
Yes	161(42.5)	57(46.0)	104(40.8)		
Student cadre					
No	245(64.6)	79(63.7)	166(65.1)	0.070	0.791
Yes	134(35.4)	45(36.3)	89(34.9)		
Place of birth					
City	235(62.0)	81(65.3)	154(60.4)	0.861	0.353
Countryside	144(38.0)	43(34.7)	101(39.6)		
Only child	234(61.7)	77(62.1)	157(61.6)	0.010	0.921
Single-parent family	41(10.8)	14(11.3)	27(10.6)	0.043	0.836

The mean scores of rumination among subjects were  $42.80 \pm 11.56$ , learning burnout were  $57.55 \pm 11.73$  and psychological capital were  $99.13 \pm 15.81$ , as shown in Table 2. Significant differences were found between the two test groups, including the scores of learning burnout, rumination, psychological capital and their dimension scores, except for the measure of reflective pondering.

**Table 2.** The mean scores of Rumination, learning burnout and psychological capital.

We performed LCA analysis to identify unique classes of students' psychological states based on the measures of learning burnout, rumination and psychological capital. The values for the AIC, BIC, and aBIC were smallest using a four-class solution, suggesting that a model with four classes had the best fit for the data. In addition, the VLMR and LMR results favored the four-class model over the three-class model ( $p < 0.001$ ). The five-class model did not provide a significantly better fit than the four-class model according to the VLMR and LMR tests ( $p = 0.75$ ), which supported the idea that the four-class model was

Scale and dimension scores	All(N=379)	Fail in exam(N=124)	Not fail in exam(N=255)	T-value	P-value
Rumination	42.80±11.56	44.61±11.47	41.92±11.52	2.332	0.022
Symptom rumination	22.42±6.38	23.54±6.23	21.87±6.39	2.425	0.016
Brooding	10.55±3.09	10.98±3.13	10.33±3.06	1.910	0.047
Reflective pondering	9.84 ±2.98	10.10± 2.91	9.72± 3.02	1.167	0.144
Learning burnout	57.55±11.73	60.90± 10.71	55.91± 11.88	3.982	0.000
Dejection	22.37±6.04	23.76± 5.97	21.68± 5.96	3.201	0.001
Improper behavior	17.76±4.20	18.76±3.71	17.27± 4.33	3.315	0.001
Reduced personal accomplishment	17.42±3.85	18.37 ±3.87	16.96 ±3.76	3.429	0.002
psychological capital	99.13±15.81	94.89 ±16.40	101.20 ±15.11	-3.734	0.000
Self-efficacy	25.54±5.18	24.39± 5.49	26.10± 4.94	-3.061	0.002
Hope	25.11±5.16	23.77± 5.45	25.76± 4.89	-3.604	0.001
Optimism	24.67±4.11	23.51± 4.09	25.23± 4.01	-3.931	0.000
Resiliency	23.78±3.30	23.22± 3.18	24.06± 3.32	-2.344	0.020

the optimal solution. Further, the four-class model also had a relatively high entropy value (i.e., close to 1;  $E = 0.93$ ), suggesting that the classes were clearly distinguishable from one another (Table 3)

Table 3  
Latent class model fit comparison (N= 379)

Model	AIC	BIC	ABIC	LMR LR P-value	ALMR LR P-value	BLRT P-value	Entropy
2-class LCA	29497.74	29655.24	29528.33	0.015	0.016	0.0000	0.897
3-class LCA	28919.63	29132.26	28960.92	0.368	0.371	0.0000	0.913
<b>4-class LCA</b>	<b>28548.69</b>	<b>28816.44</b>	<b>28600.70</b>	<b>0.024</b>	<b>0.024</b>	<b>0.0000</b>	<b>0.930</b>
5-class LCA	28226.84	28549.72	28289.55	0.759	0.759	0.0000	0.943
6-class LCA	27925.380	28303.38	27998.79	0.769	0.769	0.0000	0.936
Statistics for the selected LCA model are in bold type.							

Based on the LCA results, the four classes of nursing students' psychological states were shown in Table 4 and Fig. 2. Students in class 1 had a relatively normal psychological state, with 47.76% (n = 181) of all subjects belonging to this group. Students in class 1 tended to have average scores for all three psychological scales (learning burnout, rumination and psychological capital), without any anomalies in each of their psychological scores. We therefore classified students belonging to class 1 as the "General group".

Students in class 2 displayed high scores of learning burnout and rumination, but relatively lower scores for psychological capital measures. Thus, subjects belonging to class 2 were classified as "Negative psychologically dominated group", which comprised a total of 14.25% (n = 54) of all subjects. Students in this class were more likely to have negative psychological state or negative coping strategy.

Students in class 3 on the other hand, indicated positive psychological-related coping pattern, displaying the highest scores for measures of psychological capital but the lowest scores for measures of learning burnout and rumination. Thus, students belonging to class 3 were classified as "Positive psychological dominated group", and a total of 17.15% (n = 65) of all subjects belonged to this group.

Students in class 4 exhibited different patterns for psychological scales of response probability. These students received relatively high scores of psychological capital scale (higher than subjects from class 1 and class 2), and rumination scale (higher than subjects from class 1 and class 3), but significantly lower scores of learning burnout scale. Thus, students belonging to class 4 were classified as "Ambivalence psychological group", which comprised a total of 20.84% (n = 79) of all subjects.

Table 4  
The profiles of the classification.

Model	U1	U5	U9
Mean	(Rumination)	(Learning burnout)	(Psychological capital)
Class 1(N = 181,47.76%) General group	40.304	60.375	93.415
Class 2(N = 54,14.25%) Negative psychologically dominated group	59.286	70.091	78.304
Class 3(N = 65, 17.15%) Positive psychologically dominated group	30.679	44.454	116.308
Class 4(N = 79, 20.84%) Ambivalence psychological group	48.528	53.708	112.248

Class 1: General group = All kinds of psychological states are medium performance

Class 2: Negative psychologically dominated group = Negative mental state is serious

Class 3: Positive psychologically dominated group = Positive mental state is serious

Class 4: Ambivalence psychological group = Ambivalence mental state

The estimated probability of exam failure was shown in Table 5, according to latent class. Subjects in class 1 and 2 had higher probabilities of exam failure (37.57% and 40.74%), respectively. In comparison, subjects in class 3 and 4 had lower probabilities of exam failure (16.92% and 29.11%), respectively.

Table 5  
Estimated probability of exam failure by latent class.

Classes	Failure pro	Class 2		Class 3		Class 4	
		Chi-square	p-value	Chi-square	p-value	Chi-square	p-value
Class1(N = 181)	37.57%	0.177	0.674	9.351	0.002	1.728	0.189
Class2(N = 54)	40.74%			8.349	0.004	1.937	0.164
Class3(N = 65)	16.92%					2.938	0.087
Class4(N = 79)	29.11%	-	-	-	-	-	-

Class 1: General group = All kinds of psychological states are medium performance;

Class 2: Negative psychologically dominated group = Negative mental state is serious

Class 3: Positive psychologically dominated group = Positive mental state is serious;

Class 4: Ambivalence psychological group = Ambivalence mental state

Logistic regression modeling was used to examine the associations between class membership for the final four-class solution and probability of exam failure, as summarized in Table 6. Compared with the low psychological risk class 3, subjects from both class 1 (OR = 2.108, 95%CI: 1.240–4.118, P = 0.006) and class 2 (OR = 2.694, 95%CI: 1.229–6.293, P = 0.016) were associated with significantly higher risk of exam failure. In addition, exam failure was associated with students belonging to more senior grades, especially years 3 and 4.

Table 6  
Multi-adjusted Models for incident exam failure in association with latent classes and covariates.

<b>Covariates</b>	<b>OR</b>	<b>95% CI</b>	<b>P-value</b>
Age(years)	0.919	0.790–1.070	0.277
Gender(%)			
female	1.000	Reference	–
male	1.433	0.783–2.708	0.341
Grade			
College (1–2 years)	1.000	Reference	–
College (3–4 years)	2.017	1.194–3.335	0.012
Working part-time			
No	1.000	Reference	–
Yes	1.103	0.692–1.656	0.681
Student cadre			
No	1.000	Reference	–
Yes	0.874	0.572–1.476	0.726
Place of birth			
City	1.000	Reference	–
Countryside	0.784	0.488–1.260	0.315
Classes			
Class3	1.000	Reference	–
Class 4	1.487	0.873–3.118	0.175
Class 1	2.108	1.240–4.118	0.006
Class 2	2.694	1.229–6.293	0.016

OR, Odds ratio.95%CI, 95% Confidence interval.

Class 1: General group = All kinds of psychological states are medium performance;

Class 2: Negative psychologically dominated group = Negative mental state is serious

Class 3: Positive psychologically dominated group = Positive mental state is serious

## Discussion

The present study is the first study that explores the different psychological traits among Chinese undergraduate nursing students via numerous assessment scales including Ruminative Responses Scale, Learning Burnout Questionnaire and Psychological Capital Scale, as well as the association of different subgroups with the risk of exam failure. Latent class analysis results identified four latent subtypes, where the students belonging to the negative psychologically dominated group (class 2) displayed the highest probability of exam failure after adjusting for demographic and academic characteristics.

Recent studies demonstrated that undergraduate nursing students often encounter emotional problems due to academic stress [18, 5]. The underlying stressors include frequent academic assessment and disparity between academic studies and medical practice, which often will affect the outcome of nursing training. Yates et al. showed that nearly 70% of nursing students who performed poorly in exams subsequently failed a course [19]. In our present study, 32.7% of students reported at least one instance of exam failure during their undergraduate nursing curriculum. Notably, the ratio of exam failure increased in student from more senior grades (years 3 and 4), which is likely due to the collective academic burden and burnout.

A reasonable hypothesis is that nursing students during their internship in the hospital may be more vulnerable to mental exhaustion. However, it is still unclear whether the prevalence of burnout in nursing students is higher than the general population. Brazeau et al. [20] reported that medical students experience less burnout than age- and gender- matched general populations prior to embarking on their studies. Our present study showed that there was no evidence of burnout, which may be explained by the fact that subjects included both freshman and students from more senior grades.

Study proposed the Response Style Theory of Depression, which showed that people who are ruminating have the tendency to experience more negative emotions [21]. Hence, rumination scores should reflect the students' emotional state after failing the exam. In our current study, the scores of rumination in exam failure group were indeed significantly higher than the control group. These findings are consistent with the results of Kim et al [22].

Previous studies showed that nurse's psychological capital has a significant positive effects on their job performance and well-being [23]. According to the study by Liu et al., psychological capital plays a mediating role between negative life events and school adjustment among Chinese nursing students [24]. In our present study, nursing students who failed in exams received lower PCS scores, indicating that nursing students with higher levels of psychological capital are better able to adjust to academic pressures and events.

Furthermore, it is natural to consider that nursing students who failed in exams have more concrete reasons. Based on the results from numerous studies, there is conflicting evidence regarding the impact of psychological stress on the academic performance of students. Dendlea et al. found poor correlation between psychological stress and grade point average, which cannot be attributed to the students' intrinsic fear of poor performance [25]. In addition, there is limited data on the subtypes of students' mental state using different psychological scales. Our current study utilized the LCA method and identified four distinct classes of undergraduate nursing students via measures of learning burnout, rumination and psychological capital. Our results showed that the ratio of exam failure differed across subgroups, with students in class 2 characterized by relatively higher level of learning burnout and rumination, but lower level of psychological capital, displaying the highest probability of exam failure. This can be attributed to both high levels of psychological distress coupled with low levels of positive psychological qualities in these students. In contrast, students in class 3 who had the lowest rate of exam failure are traditionally regarded as the exceptional students. This is can be attributed to the optimistic characteristics and ability to overcome challenges in these students.

Our present study also found that age, gender, place of birth and part-time employment did not show significant correlation with exam failure. According to a system review by Pitt et al., there is conflicting information regarding to the impact of demographic characteristics on the academic performance of nursing students, possibly due to variations in study samples and covariates [26]. In our present study, after adjusting for demographic and academic factors, subjects in class 1 and 2 had a significantly higher probability of exam failure, which verified our hypothesis that students from different subgroups have varying degrees of impact on academic performance. Our study may help policy makers in nursing educational backgrounds to direct specific interventions for students from specific target groups, and help nursing students improve psychological coping abilities. It is worth noting that students who have failed in an exam are more likely to have repeat failures. Furthermore, students in class 1 and 2 may experience high levels of emotional distress given the possibility of exam failure. Thus, nursing educators should keep in mind that it is important to identify students who belong to separate subgroups have different psychological traits related to academic performance. Further studies are warranted in order to examine the differences between high- and poor-performing students in various aspects including behavior, coping and adaptability.

## 4.1. Limitations

There are several limitations with this current study. Firstly, data were collected in a cross-sectional manner, and thus causal relationships can be inconclusive. The relationships proposed by our hypotheses require further testing by longitudinal studies. Secondly, there may be possible bias due to the self-reporting nature of the test scales. Students may have different personal interpretations of the questionnaire items or contrasting feelings at the time they undertook the questionnaire, which may result in possible variations. Thirdly, the study samples were recruited via convenience sampling of Chinese nursing students exclusively, and thus additional research in other countries is required to determine whether our findings can be generalized worldwide.

# Conclusions

To the best of our knowledge, this is the first study that analyzed the different psychological traits in undergraduate nursing students and examined the associations of various subgroups with the risk of exam failure. Our results provide evidence that students with negative psychologically dominated coping states (class 2) have a higher risk of exam failure. Our findings may help identify nursing students who are at risk of poor academic performance. Tailored support programs for these particular students can help prevent them from ending up in a vicious circle of high perceived stress and poor academic performance, as well as help them break out of this circle. The LCA appears to be a useful method for assessing students' psychological traits.

# Declarations

## Ethics approval and consent to participate

This study was approved by Shanghai University of Traditional Chinese Medicine Research Ethics Committee.

## Consent for publication

Not applicable

## Availability of data and materials

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

## Competing interests

The authors declare that they have no competing interests.

## Funding

The authors received no financial support for the research.

## Authors' contributions

LR designed the study, collected data, and wrote the manuscript. ZW helped undertake statistical analysis and revised the manuscript. WJ participated in the design and coordination of the study. All authors contributed equally to this work and approved the final manuscript.

## Acknowledgements

We gratefully acknowledge the undergraduate nursing students who participated in this study.

# Abbreviations

**LCA:** Latent class analysis

**RRS:** Ruminative Responses Scale

**PCS:** Psychological Capital Scale

**AIC:** Akaike's information criterion

**BIC:** Bayesian information criterion

**aBIC:** Adjusted BIC

**LMR LR:** Lo-Mendell-Rubin likelihood ratio

**ALMR LR:** Adjusted LMR LR

**BLRT:** Bootstrap likelihood ratio test

## References

- [1] You, L. M., Ke, Y. Y., Zheng, J., & Wan, L. H. The development and issues of nursing education in China: a national data analysis. *Nurse Educ Today*.2015;35(2):310-314. <https://doi.org/10.1016/j.nedt.2014.10.004>.
- [2] Sun, L., Gao, Y., Yang, J., Zang, X. Y., & Wang, Y. G. The impact of professional identity on role stress in nursing students: A cross-sectional study. *Int J Nurs Stud*, 2016;63:1-8. <https://doi.org/10.1016/j.ijnurstu.2016.08.010>.
- [3] Armando, M., Sandini, C., Chambaz, M., Schaer, M., Schneider, M., & Eliez, S. Coping Strategies Mediate the Effect of Stressful Life Events on Schizotypal Traits and Psychotic Symptoms in 22q11.2 Deletion Syndrome. *Schizophr Bull*, 2018;44(suppl\_2):S525-s535. <https://doi.org/10.1093/schbul/sby025>.
- [4] Labrague, L. J., McEnroe-Petitte, D. M., Gloe, D., Thomas, L., Papathanasiou, I. V., & Tsaras, K. A literature review on stress and coping strategies in nursing students. *J Ment Health*, 2017;26(5): 471-480. <https://doi.org/10.1080/09638237.2016.1244721>.
- [5] Heim, E., Henderson, C., Kohrt, B. A., Koschorke, M., Milenova, M., & Thornicroft, G. Reducing mental health-related stigma among medical and nursing students in low- and middle-income countries: a systematic review. *Epidemiol Psychiatr Sci*, 2019;29:e28. <https://doi.org/10.1017/s2045796019000167>.
- [6] Thanoi, W., & Klainin-Yobas, P. Assessing rumination response style among undergraduate nursing students: A construct validation study. *Nurse Educ Today*, 2015;35(5):641-646. <https://doi.org/10.1016/j.nedt.2015.01.001>.

- [7] Ramirez, J. J., Fairlie, A. M., Olin, C. C., & Lindgren, K. P. Implicit and explicit drinking identity predict latent classes that differ on the basis of college students' drinking behaviors. *Drug Alcohol Depend*, 2017;178: 579-585. <https://doi.org/10.1016/j.drugalcdep.2017.06.010>.
- [8] Nolen-Hoeksema S. The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *J Abnorm Psychol*, 2000;109 (3) : 504-511. <https://doi.org/10.1037/0021-843x.109.3.504>
- [9] Moberly, N. J., & Watkins, E. R. Ruminative self-focus, negative life events, and negative affect. *Behav Res Ther*, 2008;46(9):1034-1039. <https://doi.org/10.1016/j.brat.2008.06.004>.
- [10] Özgür, E.-B., & Aslı, B. The short version of ruminative response scale: reliability, validity and its relation to psychological symptoms. *Procedia - Social and Behavioral Sciences*;2010,5:2178-2181. <https://doi.org/10.1016/j.sbspro.2010.07.433>.
- [11] Lian, R., Yang LX., & Wu LH. Relationship Between Professional Commitment and Learning Burnout of Undergraduates and Scales Developing. *Psychology*, 2005;37 (5):632-636. <http://journal.psych.ac.cn/xlxb/CN/Y2005/V37/I05/632>
- [12] Ling, L., Qin, S., & Shen, LF. An investigation about learning burnout in medical college students and its influencing factors. *International Journal of Nursing Sciences*, 2014;1(1):117-120. <https://doi.org/10.1016/j.ijnss.2014.02.005>.
- [13] Luthans, F. Positive organizational behavior: Developing and managing psychological Perspectives. *Academy of Management Executive*, 2002; 16(1):57-72. <https://doi.org/10.5465/ame.2002.6640181>.
- [14] Pan, X., Mao, T., Zhang, J., Wang, J., & Su, P. Psychological capital mediates the association between nurses' practice environment and work engagement among Chinese male nurses. *Int J Nurs Sci*, 2017;4(4):378-383. <https://doi.org/10.1016/j.ijnss.2017.09.009>.
- [15] Collins, L. M., & Lanza, S. T. Latent class and latent transition analysis: With applications in the social behavioral and health sciences. Hoboken, NJ: Wiley; 2010. <https://doi.org/10.1002/9780470567333.indsub>.
- [16] Muthén, B. O. Beyond SEM: General latent variable modelling. *Behaviormetrika*, 2002;29:81-117. <https://doi.org/10.2333/bhmk.29.81>
- [17] Campbell, S. B., Trachik, B., Goldberg, S., & Simpson, T. L. Identifying PTSD symptom typologies: A latent class analysis. *Psychiatry Res*, 2020; 285:112779. <https://doi.org/10.1016/j.psychres.2020.112779>.
- [18] Ackerman-Barger, K., Boatright, D., Gonzalez-Colaso, R., Orozco, R., & Latimore, D. Seeking Inclusion Excellence: Understanding Racial Microaggressions as Experienced by Underrepresented Medical and Nursing Students. *Academic medicine : journal of the Association of American Medical Colleges*, 2020;95(5):758-763. <https://doi.org/10.1097/ACM.0000000000003077>.

- [19]Yates, J. When did they leave, and why? A retrospective case study of attrition on the Nottingham undergraduate medical course. *BMC Med Educ*, 2012;12:43. <https://doi.org/10.1186/1472-6920-12-43>.
- [20]Brazeau, C. M., Shanafelt, T., Durning, S. J., Massie, F. S., Eacker, A., et al. Distress among matriculating medical students relative to the general population. *Acad Med*, 2014;89(11):1520-1525. <https://doi.org/10.1097/acm.0000000000000482>.
- [21]Halland, M., Pandolfino, J., & Barba, E. Diagnosis and Treatment of Rumination Syndrome. *Clin Gastroenterol Hepatol*, 2018;16(10):1549-1555. <https://doi.org/10.1016/j.cgh.2018.05.049>.
- [22]Kim, J. E., Park, J. H., & Park, S. H. Anger Suppression and Rumination Sequentially Mediates the Effect of Emotional Labor in Korean Nurses. *International journal of environmental research and public health*, 2019; 16(5):799. <https://doi.org/10.3390/ijerph16050799>.
- [23]Zhou, J., Yang, Y., Qiu, X., Yang, X., Pan, H., Ban, B., et al. Serial multiple mediation of organizational commitment and job burnout in the relationship between psychological capital and anxiety in Chinese female nurses: A cross-sectional questionnaire survey. *Int J Nurs Stud*, 2018;83:75-82. <https://doi.org/10.1016/j.ijnurstu.2018.03.016>.
- [24]Liu, C., Zhao, Y., Tian, X., Zou, G., & Li, P. Negative life events and school adjustment among Chinese nursing students: The mediating role of psychological capital. *Nurse Educ Today*, 2015;35(6):754-759. <https://doi.org/10.1016/j.nedt.2015.02.002>.
- [25]Dendle, C., Baulch, J., Pellicano, R., Hay, M., Lichtwark, I., Ayoub, S., et al. Medical student psychological distress and academic performance. *Med Teach*, 2018;40(12):1257-1263. <https://doi.org/10.1080/0142159x.2018.1427222>.
- [26]Pitt, V., Powis, D., Levett-Jones, T., & Hunter, S. Factors influencing nursing students' academic and clinical performance and attrition: an integrative literature review. *Nurse Educ Today*, 2012;32(8):903-913. <https://doi.org/10.1016/j.nedt.2012.04.011>.

## Figures

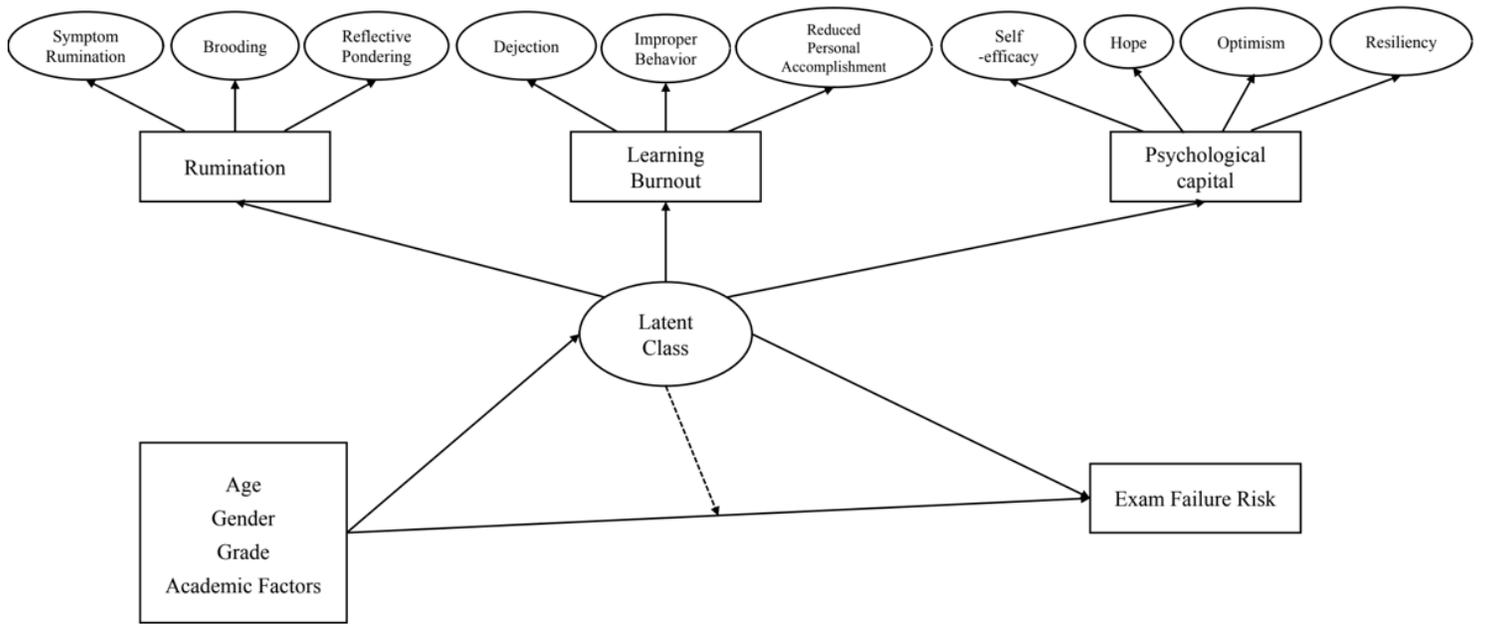
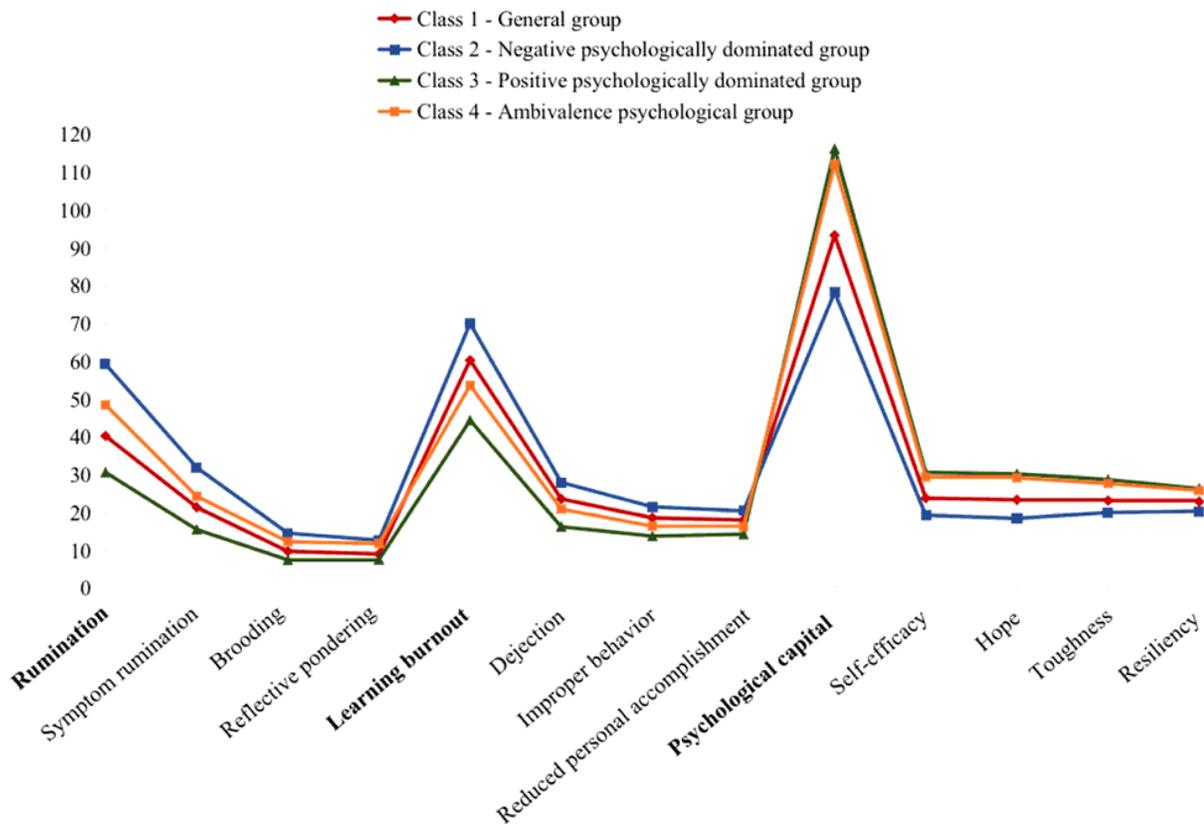


Figure 1

Multi-factor analysis model with latent class variable



## Figure 2

Four types of psychological traits of undergraduate nursing students based on the LCA results.