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Original Research

Self-compassion may reduce anxiety and depression in nursing students: a pathway through perceived stress

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ARTICLE INFO

Article history:
Received 10 December 2018
Received in revised form
11 April 2019
Accepted 14 May 2019
Available online 29 June 2019

Keywords:
Self-compassion
Anxiety
Depression
Perceived stress
Mental health
Nursing students

ABSTRACT

Objectives: Nursing students report high levels of anxiety and depression, which requires urgent attention. A growing amount of evidence indicates that self-compassion may indirectly (through perceived stress) and directly influence anxiety and depression, yet the research to date has not fully examined the reasons for this association. The present study examines the effects of self-compassion on anxiety and depression through perceived stress and may thus provide an innovative starting point for developing effective interventions for affected nursing students.

Study design: This is a cross-sectional study.

Methods: Using structural equation modelling (SEM), we estimated the strength of the pathways between self-compassion, perceived stress and anxiety and depression among 1453 nursing students in Ningbo, China. The measurements included demographics, the Self-Compassion Scale–Short Form, the Chinese version of the Perceived Stress Questionnaire and the Goldberg Anxiety and Depression Scale.

Results: Nursing students had an average score of 4.50 ± 2.44 on the Goldberg Anxiety Scale (GAS) and 3.58 ± 2.34 on the Goldberg Depression Scale (GDS), indicating high levels of anxiety and depression. The GAS and GDS scores were significantly different by the academic year, part-time employment and career prospects. The average scores for self-compassion and perceived stress were 38.99 ± 4.55 and 0.40 ± 0.14, respectively. The SEM results suggested that self-compassion was negatively associated with anxiety and depression (−0.44, $P < 0.001$). Perceived stress was positively associated with anxiety and depression (0.64, $P < 0.001$). Self-compassion was negatively associated with perceived stress (−0.65, $P < 0.001$). Self-compassion had no significant correlation with anxiety and depression in the effect of perceived stress (−0.14, $P = 0.127$). Thus, self-compassion indirectly influences anxiety and depression through perceived stress.

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https://doi.org/10.1016/j.puhe.2019.05.015
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Conclusions: Self-compassion might reduce nursing students' anxiety and depression through perceived stress. Interventionists can consider using self-compassion training to alleviate perceived stress, anxiety and depression in nursing students.
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Introduction

Nursing is widely recognized as a challenging occupation; nursing students, who receive rigorous training to prepare themselves for this occupation, report high levels of anxiety and depression.[1,2] For instance, a 2018 meta-analysis reported that worldwide, 34% of nursing students experienced depressive symptoms. Among students aged younger than 25 years, this prevalence ranged from 39.4% to 41.0%. This prevalence was particularly high among nursing students in Asia, especially in China, where 43.0% of the nursing students had depression.[3] However, across the globe, there are few effective intervention strategies tackling this mental health challenge among nursing students,[4] including in countries with the most serious nurse shortages, such as China.[5–7] Taken together, high levels of adverse mental health outcomes in nursing professionals require urgent attention and effective intervention.

To develop effective intervention among nursing students, research on the key factors that lead to their adverse mental health outcomes is called for. Perceived stress is a critical psychosocial factor that influences mental health outcomes among nursing students. The concept of perceived stress highlights how people feel about stress, not just stress itself. It is an individual's evaluation of a situation and events beyond his or her self-ability, that is, a cognitive evaluation of stressful events and situations. Nursing students have significantly higher levels of stress than students in other fields.[8] Work-related stressors, such as intensive working environments, heavy workload, interactions with dying patients, night shifts and conflicts with patients or doctors all contribute to excessive stress and feelings of depression and anxiety among nursing practitioners.[9] Perceived stress can influence nursing students' performance at school and general health and happiness;[10–12] it can also increase their levels of anxiety and depression[13,14] and, worse, can lead to mental dysregulation, systemic physiological disorders[15] or even suicidal thoughts.[16]

Compassion is the capacity of health professionals to understand and respond to patients' physical and emotional experiences of illness. While anxiety and depression among nurses might be related to too much and disproportional compassion dedicated to patients (i.e., compassion fatigue), compassion dedicated to oneself, or self-compassion, is found to be able to alleviate the negative emotions experienced by individuals.[17]

Specifically, self-compassion is a positive self-attitude or emotion regulation strategy and an emotional awakening state. An individual shows self-compassion when he or she does not evade his or her own pain or failure but feels open and tolerant; in light of this unbiased understanding, one considers his or her personal experience as part of the collective experience of all humanity, thereby relieving one's suffering.[17] In recent years, self-compassion has been widely used to predict senses of well-being among a wide range of people, including college students.[18–20]

Empirical studies have found that high levels of self-compassion can prevent or reduce the onset of anxiety and depression,[21–23] and it is a better predictor of mixed anxiety and depression.[21] In addition, a recent study showed that self-compassion could be attributed to lower perceived stress.[24] After completing a conscious self-sympathy programme, participants reported reduced perceived stress, which also indicated that high levels of self-compassion in nursing students may also reduce perceived stress.[25]

Although growing evidence indicates that self-compassion is associated with lower perceived stress and decreased anxiety and depression, the causal pathways that mediate this relationship are not well understood. Based on the current literature, we hypothesize that self-compassion will reduce anxiety and depression, but mainly indirectly through perceived stress. That is, a high level of self-compassion will reduce nursing students' perceived stress, which in turn will reduce their anxiety and depression. To verify this hypothesis, we collected cross-sectional survey data from a group of Chinese nursing students. The ultimate goal of this study was to provide evidence for effective interventions among nursing students in China. As mindfulness is a prerequisite for self-compassion, if our hypothesis is supported, we can try to implement measures such as mindfulness training to reduce nursing students' anxiety and depression.[26]

Methods

Study design and sample

We used a stratified random sampling strategy, stratifying students by their academic years. The detailed sampling procedures were reported elsewhere.[27] Briefly, we aimed to randomly sample 50% of the students from each academic year of nursing students to obtain large, representative samples. Specifically, we randomly selected 616 first-year nursing students from a pool of 1232 first-year students. Similarly, we randomly selected 581 second-year nursing students from a pool of 1162 second-year students and 322 third-year (final-year) nursing students from a pool of 644 third-year students. Overall, a total of 1519 students were randomly selected. The survey was anonymous to fully respect and protect the

participants' privacy. Students were invited to a specific classroom during class recess to complete the survey. Investigators explained the purpose of the study and the precautions for completing the form before the investigation. Each participant was given a small incentive as compensation for his or her time: a piece of chocolate worth five Chinese RMB (equal to 0.8 US dollars). After excluding incomplete questionnaires, a total of 1453 completed questionnaires were collected. The response rate was 95.66% (1453 of 1519) (Fig. 1).

Measurement

Sociodemographics

General information questionnaires include gender (male and female), age (in years), home location (urban, rural, suburban), academic year (first year, second year, third year/final year), being an only child (yes, no), part-time employment (yes, no), frequency of home visits (every week, every two weeks, every month, every 3 months, every semester) and self-assessed employment prospects (excellent, good, average, poor, extremely poor).

Latent variables

Anxiety and depression were assessed using the Goldberg Anxiety and Depression Scale (GADS).[28] The GADS has two 9-item subscales (i.e., the Goldberg Anxiety Scale [GAS] and the Goldberg Depression Scale [GDS]). The GAS was used to measure anxiety, and the GDS was used to measure depression. Each item has two answers: 'yes' or 'no'; a 'yes' response has a value of 1, while a 'no' response has a value of 0. The total score ranges from 0 to 18, with each subscale ranging

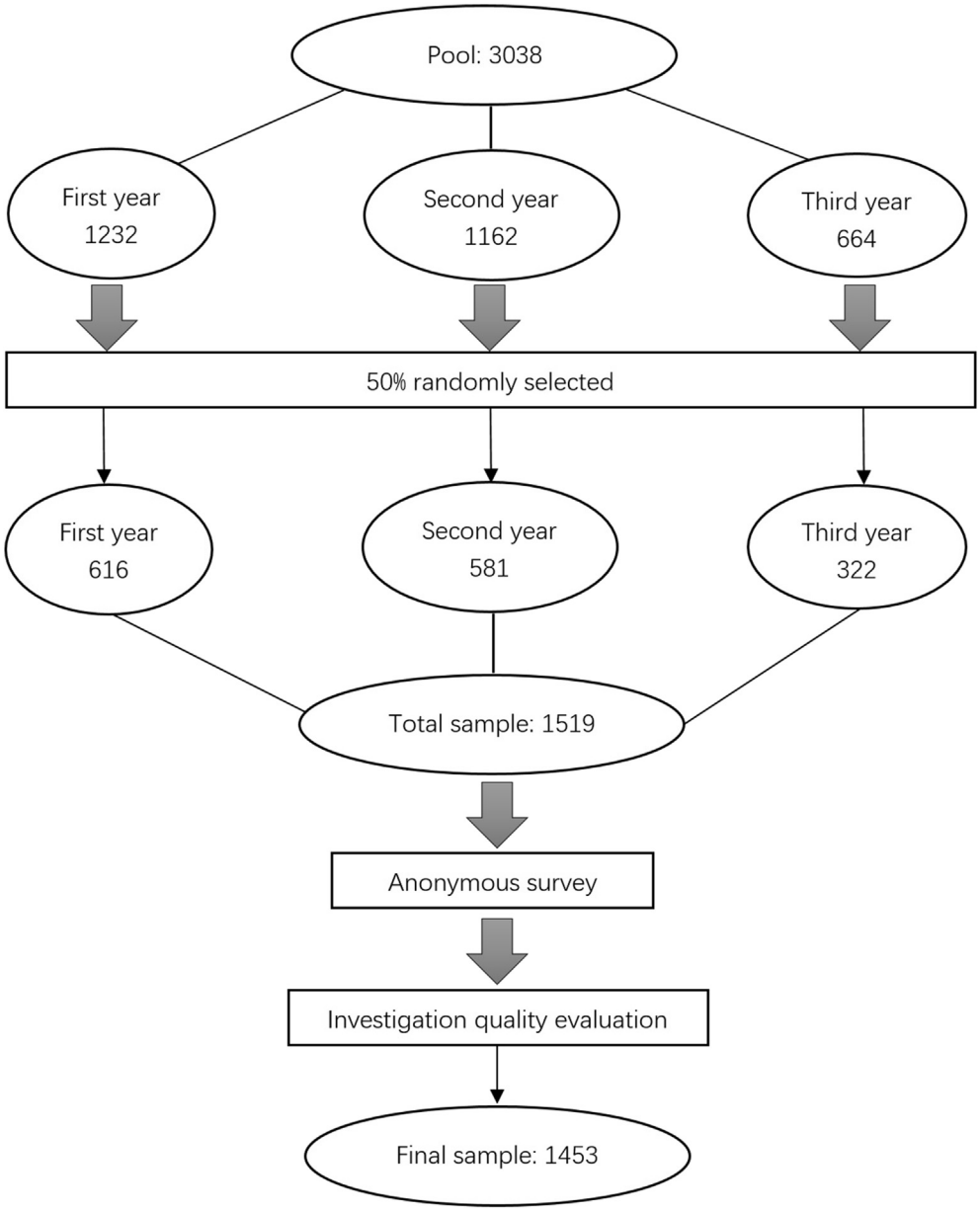

Fig. 1 – Flowchart of the sampling strategy.

from 0 to 9. Generally, GAS scores >five or GDS scores >2 indicate that survey respondents may have anxiety or depressive symptoms.[28] In our study, we used the total GADS score to represent an overall level of anxiety and depression. The higher the GADS score is, the greater the probability of having clinical symptoms.[28]

We used the Self-Compassion Scale–Short Form (SCS–SF)[29] to assess self-compassion. The SCS–SF is an efficient alternative to the long form, as it has the same factor structure, good internal consistency and a near-perfect correlation with the long SCS.[29] It has been widely used in surveys in many countries around the world. The SCS–SF is applicable to various groups of people and has been used with college students.[20,30] Items on the SCS–SF use a five-point Likert scale to measure conformity (1, 'almost never' to 5, 'almost always'). The final SCS–SF score ranges from 12 to 70. A higher score indicates a higher level of self-compassion.

We translated both the GADS and SCS–SF scales from English into Chinese using forward- and back-translation techniques based on the integrated method[31] and Brislin's translation model.[32,33] Forward translation was conducted independently by two English–Chinese translators whose first language was Chinese. Back translation was conducted by two English scholars. After several rounds of comparing, contrasting and combining the translations, we finalized the Chinese versions of the GADS and SCS–SF.

Perceived stress was assessed using the Chinese version of the Perceived Stress Questionnaire (C-PSQ).[27] The PSQ Index = (original value −30)/90, and the final score ranges from 0 to 1. The higher the score, the greater the perceived stress.

Statistical analyses

A database was built by EpiData (version 3.1; Jens M. Lauritsen & Michael Bruus, Odense, Denmark) software. SPSS (version 18.0; SPSS Inc., Chicago, IL, USA) and AMOS (version 18.0; SPSS Inc., Chicago, IL, USA) were adopted to analyse the data. Descriptive statistics were used to describe the demographic characteristics. The (mean ± SD) represents the mean value; analysis of variances were used to compare values among three or more groups. The relationship between latent variables was presented through structural equation modelling (SEM). In SEM, we randomly divided the data into four groups, of which three were used to analyse the aforementioned three measurement models (the SCS–SF, C-PSQ and GADS) and the fourth was used as a structural model to validate the hypotheses. Correlational analysis (Cronbach's alpha or Guttman's lambda-2 coefficients), exploratory factor analyses (EFAs) and confirmatory factor analyses were used to assess the psychometric characteristics of the C-PSQ, SCS–SF and GADS. In data reduction, we utilized principal components to analyse the extraction factor and varimax method to obtain rotation.

Several commonly used goodness-of-fit indexes were examined to assess the data-model fit: the root mean square error of approximation; confidence interval; standardized root mean residual; goodness of fit index; normed Chi-square; the ratio of the Chi-square to its degrees of freedom; Tucker–Lewis index; comparative fit index; adjusted goodness of fit index; and parsimony normed fit index.[34–39]

Ethic statement

This study was reviewed and approved by the Ethics Committee of Wuhan University School of Medicine, China. This study meets the relevant requirements of the Declaration of Helsinki and its revised version. Informed consent was obtained from the relevant administrative department at the study site and from the students enrolled. The survey was conducted anonymously to ensure full respect and protection of individual privacy rights before, during and after the data collection process.

Results

Descriptive analyses

Sociodemographic characteristics

Characteristics of the respondents are described in Table 1; 1.4% of respondents were male and 98.6% were female. Participants were between 17 and 23 years of age, with an average age of 19.58 ± 1.09. Of the respondents, 13.4% lived in urban areas, 59.8% lived in rural areas and 26.8% lived in suburban

Table 1 – Demographic characteristics (n = 1453).

Characteristic		N (%)
Gender		
	Male	20 (1.4)
	Female	1433 (98.6)
Age in years		
	17	8 (0.6)
	18	239 (16.4)
	19	457 (31.5)
	20	469 (32.3)
	21	209 (14.4)
	22	69 (4.7)
	23	2 (0.1)
Home location		
	Urban	194 (13.4)
	Rural	869 (59.8)
	Suburban	390 (26.8)
Academic year		
	First year	603 (41.5)
	Second year	566 (39.0)
	Third year/final year	284 (19.5)
Only child		
	Yes	473 (32.6)
	No	980 (67.4)
Part-time employment		
	Yes	570 (39.2)
	No	883 (60.8)
Frequency of home visits		
	Every week	160 (11.0)
	Every two weeks	151 (10.4)
	Every month	465 (32.0)
	Every three months	305 (21.0)
	Every semester	372 (25.6)
Employment prospects		
	Excellent	106 (7.3)
	Good	682 (46.9)
	Average	609 (41.9)
	Poor	48 (3.3)
	Extremely poor	8 (0.6)

areas. A total of 41.5% of the participants surveyed were first-year nursing students, 39.0% were second-year nursing students and 19.5% were third-year (final year) nursing students. Among all participants, 32.6% were the only child in their families and 39.2% reported having part-time jobs and 11.0% went home once every week, 10.4% went home once every two weeks, 32.0% went home once every month, 21.0% went home once every three months and 25.6% went home once every semester. Participants reported a range of career prospects, including excellent (7.3%), good (46.9%), average (41.9%), poor (3.3%) and extremely poor (0.6%).

Outcome characteristics—anxiety and depression

Given that the GADS uses dichotomous (yes vs. no) items, we reported the Guttman's lambda-2 coefficient instead of Cronbach's, which is recommended by Sijtsma and Emons.[40] The Guttman's lambda-2 of the GAS was 0.749 and that of the GDS was 0.756, indicating acceptable internal consistency. The average GAS score was 4.50 ± 2.44. The GAS score was significantly different by academic year ($F = 25.22$, $P < 0.001$), part-time employment ($F = 35.14$, $P < 0.001$) and employment prospects ($F = 14.81$, $P < 0.001$). No significant difference was found by gender, age, home location, being an only child or frequency of home visits (all $P > 0.01$). The average GDS score was 3.58 ± 2.34. The GDS score was significantly different by academic year ($F = 10.71$, $P < 0.001$), part-time employment ($F = 18.00$, $P < 0.001$) and employment prospects ($F = 29.14$, $P < 0.001$), while no significant differences were found by gender, age, home location, being an only child or frequency of home visits (all $P > 0.01$) (Table 2).

Predictor characteristics

Self-compassion

The Cronbach's alpha of the Chinese version of the SCS–SF was 0.634. According to Kaiser,[41] a Kaiser–Meyer–Olkin (KMO) index greater than 0.6 indicates a good factor analysis. The KMO index of the Chinese version of the SCS–SF was 0.75. Therefore, we performed EFAs and obtained three dimensions. The three extracted factors explained 51.36% of the total variance (>50%), which was at an acceptable level.[34]

The average self-compassion score was 38.99 ± 4.55. Table 3 presents the item responses for the SCS–SF. The scores of the reverse items (1, 4, 8, 9, 11 and 12) were 3.35 ± 0.93, 3.29 ± 0.96, 3.11 ± 0.95, 3.53 ± 0.86, 2.90 ± 0.88 and 2.63 ± 0.90, respectively, while the scores of the other items (2, 3, 5, 6, 7 and 10) were 3.56 ± 0.79, 3.68 ± 0.74, 3.69 ± 0.73, 3.92 ± 0.70, 3.78 ± 0.73 and 3.16 ± 0.89, respectively.

Perceived stress

The Cronbach's alpha of the C-PSQ was 0.920. The average perceived stress score among the surveyed students was 0.40 ± 0.14. Table 4 presents the scores for each dimension of the C-PSQ, which were 25.37 ± 5.92 (worries/tension), 16.45 ± 4.00 (joy), 9.85 ± 2.20 (overload), 9.14 ± 2.23 (conflict) and 5.08 ± 1.32 (self-realization).

Structural equation modelling

Self-compassion was negatively associated with anxiety and depression (−0.44, $P < 0.001$) (Fig. 2). According to our assumptions for building a model and based on the results of the relationship between sociodemographics and anxiety and depression, several sociodemographic data were included, i.e., the influence of demographic variables on the model was excluded. Perceived stress was positively associated with anxiety and depression (0.64, $P < 0.001$), self-compassion was negatively associated with perceived stress (−0.65, $P < 0.001$), self-compassion had no significant correlation with anxiety and depression in the effect of perceived stress (−0.14, $P = 0.127$) and other path coefficients in the model had $P < 0.001$. The results are shown in Fig. 3. All path coefficients in the

Table 2 – Bivariate relationship between sociodemographics and anxiety and depression (n = 1453).

Characteristic	GAS			GDS		
	Mean ± SD	F	P	Mean ± SD	F	P
Gender		1.21	0.27		0.10	0.81
Age		2.37	0.03		2.17	0.04
Home location		0.36	0.70		1.70	0.18
Academic year		25.22	<0.001		10.71	<0.001
First year	4.06 ± 2.39			3.26 ± 2.23		
Second year	5.05 ± 2.38			3.89 ± 2.32		
Third year/final year	4.36 ± 2.46			3.64 ± 2.54		
Only child		1.59	0.21		3.77	0.05
Part-time employment		35.14	<0.001		18.00	<0.001
Yes	4.94 ± 2.38			3.90 ± 2.37		
No	4.20 ± 2.43			3.37 ± 2.30		
Frequency of home visits		2.69	0.03		2.47	0.04
Employment prospects		14.81	<0.001		29.14	<0.001
Excellent	3.71 ± 2.47			2.18 ± 1.20		
Good	4.12 ± 2.36			3.18 ± 2.23		
Average	4.99 ± 2.44			4.16 ± 2.34		
Poor	5.29 ± 2.21			4.77 ± 2.03		
Extremely poor	5.37 ± 1.60			4.38 ± 1.92		

GAS, Goldberg Anxiety Scale; GDS, Goldberg Depression Scale; SD, standard deviation.

Table 3 – Item responses of the SCS–SF (n = 1453).

Items	N (%)					Mean ± SD
	1	2	3	4	5	
1. When I fail at something important to me, I become consumed by feelings of inadequacy.	77 (5.3)	171 (11.8)	436 (30.0)	710 (48.9)	59 (4.1)	3.35 ± 0.93
2. I try to be understanding and patient towards those aspects of my personality I don't like.	20 (1.4)	143 (9.8)	356 (24.5)	869 (59.8)	65 (4.5)	3.56 ± 0.79
3. When something painful happens, I try to take a balanced view of the situation.	10 (0.7)	109 (7.5)	311 (21.4)	928 (63.9)	95 (6.5)	3.68 ± 0.74
4. When I'm feeling down, I tend to feel like most other people are probably happier than I am.	58 (4.0)	269 (18.5)	405 (27.9)	642 (44.2)	79 (5.4)	3.29 ± 0.96
5. I try to see my failings as part of the human condition.	14 (1.0)	81 (5.6)	357 (24.6)	895 (61.6)	106 (7.3)	3.69 ± 0.73
6. When I'm going through a very hard time, I give myself the caring and tenderness I need.	4 (0.3)	51 (3.5)	243 (16.7)	917 (63.1)	238 (16.4)	3.92 ± 0.70
7. When something upsets me, I try to keep my emotions in balance.	13 (0.9)	66 (4.5)	302 (20.8)	913 (62.8)	159 (10.9)	3.78 ± 0.73
8. When I fail at something that's important to me, I tend to feel alone in my failure.	58 (4.0)	339 (23.3)	501 (34.5)	491 (33.8)	64 (4.4)	3.11 ± 0.95
9. When I'm feeling down, I tend to obsess and fixate on everything that's wrong.	35 (2.4)	157 (10.8)	368 (25.3)	794 (54.6)	99 (6.8)	3.53 ± 0.86
10. When I feel inadequate in some way, I try to remind myself that feelings of inadequacy are shared by most people.	41 (2.8)	307 (21.1)	529 (36.4)	530 (36.5)	46 (3.2)	3.16 ± 0.89
11. I'm disapproving and judgemental about my own flaws and inadequacies.	73 (5.0)	393 (27.0)	616 (42.4)	346 (23.8)	25 (1.7)	2.90 ± 0.88
12. I'm intolerant and impatient towards those aspects of my personality I don't like.	111 (7.6)	600 (41.3)	486 (33.4)	229 (15.8)	27 (1.9)	2.63 ± 0.90

SCS–SF, Self-Compassion Scale–Short Form; SD, standard deviation.
These items (1, 4, 8, 9, 11, and 12) are the reverse items, and the score is the original score that was not reversed; items are rated on a 5-point Likert scale ranging from 1 (almost never) to 5 (almost always).

Table 4 – Dimension score estimation of the C-PSQ (n = 1453).

Dimension	Items	Mean ± SD	Min	Max
Worries/tension	9, 12, 14, 15, 18, 19, 20, 22, 26, 27, 28, 30	25.37 ± 5.92	12	48
Joy	1, 10, 13, 17, 21, 25, 29	16.45 ± 4.00	7	28
Overload	4, 8, 11, 16	9.85 ± 2.20	4	16
Conflict	2, 3, 5, 6, 24	9.14 ± 2.23	5	19
Self-realization	7, 23	5.08 ± 1.32	2	8

C-PSQ, Chinese version of the Perceived Stress Questionnaire; SD, standard deviation.
The reverse items (1, 7, 10, 13, 17, 21, 25 and 29) are reversed in the statistics presented in the table.

model had $P < 0.001$. The results of the tests and the model's goodness-of-fit are shown in Table 5.

Discussion

Our study showed that nursing students in China experienced high levels of perceived stress, anxiety and depression. Our SEM results indicated that self-compassion could directly influence perceived stress and that perceived stress was a significant mediator between self-compassion and anxiety and depression. Grounded in Judd and Kenny's[42] intermediary test theory, it can be inferred that self-compassion might indirectly influence nursing students' anxiety and depression through perceived stress. We did not find a significant relationship between self-compassion and anxiety and depression.

The high GADS scores among nursing students in this study were similar to the high levels of anxiety and depression documented by other studies focussing on nursing students globally.[2,43] In addition, our survey results showed that nursing students in more senior years reported higher levels

Fig. 2 – Relationship between self-compassion and anxiety and depression. ***P < 0.001.

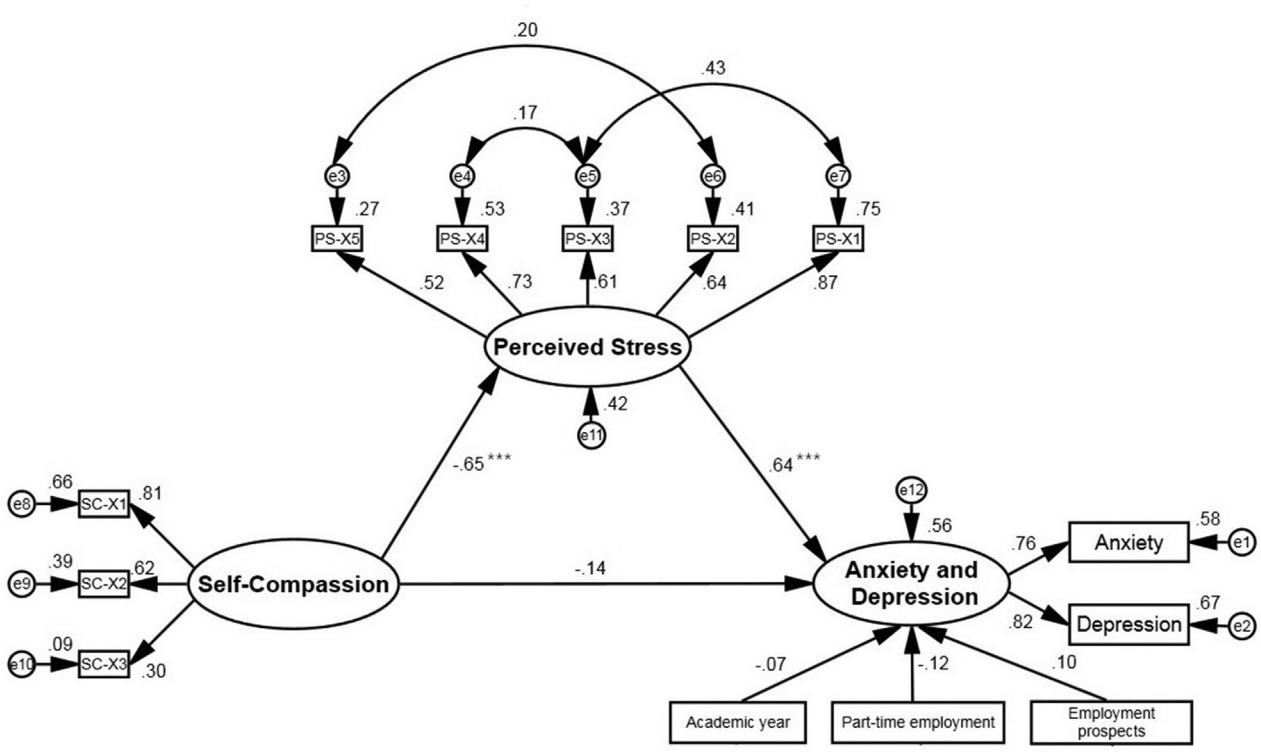

Fig. 3 – Final structural model (n = 363). SC, self-compassion; PS, perceived stress; e, measurement errors; X, dimension. Factor loadings are standardized, ***P < 0.001.

of anxiety and depression than first-year students. Medical students also showed this trend in their levels of depression and anxiety.[44] These higher levels of anxiety and depression may contribute to the growing profession-related pressure for students in medical fields when moving into higher academic years. Unlike students in other majors, nursing students in their final year begin clinical practice or internships. During this process, they might have to witness and handle extremely stressful events, such as fatal disease, pain and death, all of which can lead to excessive stress and perceived stress, anxiety and depression.

Nursing students who were employed part-time were more likely to have high levels of anxiety and depression, which could be attributable to their workload and competing priorities between school and work. Studies have shown that students who work part-time are more likely to drink alcohol, smoke and use marijuana.[45] The stress response model for drug abuse suggests that people often drink alcohol as a response to stress. Alcohol consumption can temporarily alleviate daily stress factors, thereby strengthening certain unhealthy strategies.[46] While part-time job experience may be useful for future career development, educators should also be aware of its potential psychological burden on students.

The final SEM model in this study provides us with evidence that improving the level of self-compassion could help reduce perceived stress, thereby reducing anxiety and depression among nursing students. A previous study found that a three-week self-compassion training resulted in a significant increase in mindfulness, optimism and self-efficacy among female college students and a greater reduction in rumination compared with the time management control group.[20] Another intervention study found that participants who wrote compassionate reflections about their painful experiences once a day for a week reported a significant reduction in depression for three months and a significant increase in happiness for up to six months compared with the control group.[47] Other intervention strategies, such as biofeedback,[48] exercise,[49] standardized patients and mindfulness

Table 5 – Evaluation of the goodness-of-fit of the model (n = 363).

GOF index	Test result	Cut-off value	Model fit
Absolute measures			
RMSEA (90% CI)	0.070 (0.058, 0.083)	<0.05 or 0.08	Yes
SRMR	0.074	<0.08	Yes
GFI	0.938	>0.90	Yes
Normed Chi-square	2.790	<2.0–3.0	Yes
Incremental fit measures			
TLI	0.903	>0.90	Yes
CFI	0.928	>0.90	Yes
Parsimony measures			
AGFI	0.904	>0.90	Yes
PNFI	0.664	>0.50	Yes

GOF, goodness-of-fit; RMSEA, root mean square error of approximation; CI, confidence interval; SRMR, standardized root mean residual; GFI, goodness-of-fit index; Chi-square/df, the ratio of the Chi-square to its degrees of freedom; TLI, Tucker–Lewis index; CFI, comparative fit index; AGFI, adjusted goodness-of-fit index; PNFI, parsimony normed fit index.

meditation, were also found to be effective in reducing perceived stress, anxiety and depression.[50]

The public health implication of our study is that these findings provide evidence and support to utilize psychological means to develop effective interventions to tackle mental health challenges faced by nursing students in China. Nursing educators or intervention practitioners can consider integrating self-compassion training in their existing mental health programmes targeting at nursing students. These programmes can help nursing students to develop the core skills of Mindful self-compassion training, which is designed to cultivate self-compassion using meditation, daily life practices, lecture, group exercises and discussion, managing thoughts and emotions, incorporating mindfulness into learning and life, and unconditional love for oneself and for others.[51]

More importantly, parents and early childhood educators should cultivate their children's self-compassion at an early age so that mindfulness can become a healthy habit in daily life; in this way, students will be better prepared and treat themselves kindly and compassionately when they suffer, fail or feel inadequate. Thus, it can address the anxiety and depression of the wider population.

Limitations and prospects

This study aimed to explore the pathway between several hypothesized psychosocial variables and anxiety and depression. Despite the fact that the present study has the ability to provide an innovative solution, some limitations still need to be considered. First, owing to various limitations, mainly the research scope, the sample size and time, the results might not be overgeneralized. As such, this study was confined to one college, and thus, the representativeness of the sample may be lacking. One of the biggest study challenges is to find an adequate sample size and fairly representative population. For future research, we plan to conduct multicentre surveys. Second, the cross-sectional design also limits the ability for causal inferences based on the findings. No baseline data were found to be related to the prognosis. Because of the short time of observation, the long-term effect should be followed up. To fully understand the dynamic pathway between self-compassion, perceived stress and depression, longitudinal studies are needed. Finally, there was potential for selection bias and confounding in such observational study. Providing students with incentives could have led to sample selection bias that might have influenced the selection of participants and even their motivation to respond. Moreover, measurement bias existed too. Revisions, item revising, would be needed if these questionnaires were used in nurses from other clinical settings. We should minimise potential sources of bias, thus increasing the instrument's psychometric properties for clinical psychological treatment practice and future research.

Conclusions

Self-compassion might reduce nursing students' anxiety and depression through perceived stress. Consequently, improving college students' self-compassion through various feasible methods can reduce their perceived pressure and thus reduce anxiety and depression. Interventionists should consider self-compassion as an approach to alleviate perceived stress and thereby reduce anxiety and depression in nursing students, such as through implementing training to incorporate mindfulness into daily life. In this way, students can manage academic pressure and challenges with a positive attitude and avoid adverse mental health outcomes while transitioning from school to clinical professions.

Further, with the increasing severity of mental health problems in nursing students and limited resources to resolve this problem, further exploration of the possible pathways between psychosocial factors and depression and/or stress resilience is urgently needed to develop more effective intervention strategies to address adverse mental health outcomes among nursing students.

Author statements

Acknowledgements

Special thanks to Dr. Susan Levenstein, Dr. David Goldberg and Dr. Kristin Neff for providing their research instruments. Thanks to Zongman Qiu (Master candidate in applied psychology) from South China Normal University for his guidance regarding SEM. Additionally, the authors are grateful to all respondents who took part in the present study and the teachers of Ningbo College of Health Sciences for their valued assistance in collecting data. All authors appreciated the anonymous reviewers and the academic editor who provided constructive comments and suggestions to improve the quality of the manuscript.

Ethical approval

This study was reviewed and approved by the Ethics Committee of Wuhan University School of Medicine, China.

Funding

This project was supported by the Ningbo College of Health Sciences scientific research project (grant no. 2018Z02), the Ideological and Political Education Research Association of Ningbo's Colleges and Universities research topic (grant no. SGXSZ18012) and the Key Research Center for Humanities and Social Sciences in Hubei Province (Hubei University of Medicine) (grant no. 2016YB006).

Competing interests

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Author roles

Runtang Meng (the PI of the project), Bing Liu and Yi Luo conceived and designed the study. Yi Luo collected, analysed and interpreted the data as well as compiled the initial draft of

the manuscript. Jingjing Li and Runtang Meng contributed to the statistical analysis and interpretation of the data. Yi Luo, Runtang Meng and Jingjing Li jointly edited the final manuscript. Xiaoping Cao and Wei Ge supported in collecting the data. Runtang Meng directed all facets of the study. All authors were involved in critical revision and approval of the final content before submission.

REFERENCES

1. Papazisis G, Nicolaou P, Tsiga E, Christoforou T, Sapountzi–Krepia D. Religious and spiritual beliefs, self–esteem, anxiety, and depression among nursing students. *Nurs Health Sci* 2014;**16**:232–8.
2. Cheung T, Wong SY, Wong KY, Law LY, Ng K, Tong MT, et al. Depression, anxiety and symptoms of stress among baccalaureate nursing students in Hong Kong: a cross-sectional study. *Int J Environ Res Public Health* 2016;**13**:779.
3. Tung Y-J, Lo KK, Ho RC, Tam WSW. Prevalence of depression among nursing students: a systematic review and meta-analysis. *Nurse Educ Today* 2018;**63**:119–29.
4. Wu Q, Zhao L, Ye X-C. Shortage of healthcare professionals in China. *BMJ* 2016;**354**:i4860.
5. Lambert VA, Lambert CE, Petrini M, Li XM, Zhang YJ. Workplace and personal factors associated with physical and mental health in hospital nurses in China. *Nurs Health Sci* 2007;**9**:120–6.
6. Gao Y-Q, Pan B-C, Sun W, Wu H, Wang J-N, Wang L. Anxiety symptoms among Chinese nurses and the associated factors: a cross sectional study. *BMC Psychiatry* 2012;**12**:141.
7. Melincavage SM. Student nurses' experiences of anxiety in the clinical setting. *Nurse Educ Today* 2011;**31**:785–9.
8. McGrath A, Reid N, Boore J. Occupational stress in nursing. *Int J Nurs Stud* 2003;**40**:555–65.
9. Tyler PA, Ellison RN. Sources of stress and psychological well-being in high-dependency nursing. *J Adv Nurs* 1994;**19**:469–76.
10. Song Y, Lindquist R. Effects of mindfulness-based stress reduction on depression, anxiety, stress and mindfulness in Korean nursing students. *Nurse Educ Today* 2015;**35**:86–90.
11. Urquijo I, Extremera N, Villa A. Emotional intelligence, life satisfaction, and psychological well-being in graduates: the mediating effect of perceived stress. *Appl Res Qual Life* 2016;**11**:1241–52.
12. Sribanditmongkol V, Neal JL, Patrick TE, Szalacha LA, McCarthy DO. Effect of perceived stress on cytokine production in healthy college students. *West J Nurs Res* 2015;**37**:481–93.
13. Kulsoom B, Afsar NA. Stress, anxiety, and depression among medical students in a multiethnic setting. *Neuropsychiatric Dis Treat* 2015;**11**:1713.
14. van der Riet P, Rossiter R, Kirby D, Dluzewska T, Harmon C. Piloting a stress management and mindfulness program for undergraduate nursing students: student feedback and lessons learned. *Nurse Educ Today* 2015;**35**:44–9.
15. Deckro GR, Ballinger KM, Hoyt M, Wilcher M, Dusek J, Myers P, et al. The evaluation of a mind/body intervention to reduce psychological distress and perceived stress in college students. *J Am Coll Health* 2002;**50**:281–7.
16. Houston K, Hawton K, Shepperd R. Suicide in young people aged 15–24: a psychological autopsy study. *J Affect Disord* 2001;**63**:159–70.
17. Neff K. Self-compassion: an alternative conceptualization of a healthy attitude toward oneself. *Self Ident* 2003;**2**:85–101.
18. Neely ME, Schallert DL, Mohammed SS, Roberts RM, Chen Y-J. Self-kindness when facing stress: the role of self-compassion, goal regulation, and support in college students' well-being. *Motiv Emot* 2009;**33**:88–97.
19. Wei M, Liao KYH, Ku TY, Shaffer PA. Attachment, self-compassion, empathy, and subjective well-being among college students and community adults. *J Personal* 2011;**79**:191–221.
20. Smeets E, Neff K, Alberts H, Peters M. Meeting suffering with kindness: effects of a brief self-compassion intervention for female college students. *J Clin Psychol* 2014;**70**:794–807.
21. Van Dam NT, Sheppard SC, Forsyth JP, Earleywine M. Self-compassion is a better predictor than mindfulness of symptom severity and quality of life in mixed anxiety and depression. *J Anxiety Disord* 2011;**25**:123–30.
22. MacBeth A, Gumley A. Exploring compassion: a meta-analysis of the association between self-compassion and psychopathology. *Clin Psychol Rev* 2012;**32**:545–52.
23. Proeve M, Anton R, Kenny M. Effects of mindfulness-based cognitive therapy on shame, self-compassion and psychological distress in anxious and depressed patients: a pilot study. *Psychol Psychother Theor Res Pract* 2018;**91**:434–49.
24. Sirois FM, Hirsch JK. Self-compassion and adherence in five medical samples: the role of stress. *Mindfulness* 2019;**10**:46–54.
25. Neff KD, Germer CK. A pilot study and randomized controlled trial of the mindful self-compassion program. *J Clin Psychol* 2013;**69**:28–44.
26. Snaith N, Schultz T, Proeve M, Rasmussen P. Mindfulness, self-compassion, anxiety and depression measures in South Australian yoga participants: implications for designing a yoga intervention. *Complement Ther Clin Pract* 2018;**32**:92–9.
27. Luo Y, Gong B, Meng R, Cao X, Tang S, Fang H, et al. Validation and application of the Chinese version of the Perceived Stress Questionnaire (C-PSQ) in nursing students. *PeerJ* 2018;**6**:e4503.
28. Goldberg D, Bridges K, Duncan-Jones P, Grayson D. Detecting anxiety and depression in general medical settings. *BMJ* 1988;**297**:897–9.
29. Raes F, Pommier E, Neff KD, Van Gucht D. Construction and factorial validation of a short form of the Self-Compassion Scale. *Clin Psychol Psychother* 2011;**18**:250–5.
30. Lockard AJ, Hayes JA, Neff K, Locke BD. Self-compassion among college counseling center clients: an examination of clinical norms and group differences. *J Coll Couns* 2014;**17**:249–59.
31. Sidani S, Guruge S, Miranda J, Ford-Gilboe M, Varcoe C. Cultural adaptation and translation of measures: an integrated method. *Res Nurs Health* 2010;**33**:133–43.
32. Doris S, Lee DT, Woo J. Translation of the chronic heart failure questionnaire. *Appl Nurs Res* 2003;**16**:278–83.
33. Brislin RW. Back-translation for cross-cultural research. *J Cross Cult Psychol* 1970;**1**:185–216.
34. Kline RB. *Principles and practice of structural equation modeling*. 4th ed. New York: Guilford publications; 2015.
35. Bentler PM. Comparative fit indexes in structural models. *Psychol Bull* 1990;**107**:238.
36. Browne MW, Cudeck R. Alternative ways of assessing model fit. *Socio Methods Res* 1992;**21**:230–58.
37. Hair JF, Black WC, Babin BJ, Anderson RE. *Multivariate data analysis: pearson new international edition*. 7th ed. London: Pearson Higher Education; 2014.
38. Hu Lt, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Model: a multidisciplinary journal* 1999;**6**:1–55.
39. Wu M. *Structural equation modeling: operation and application of AMOS*. 2nd ed. Chongqing: Chongqing University Press; 2010.
40. Sijtsma K, Emons WH. Advice on total-score reliability issues in psychosomatic measurement. *J Psychosom Res* 2011;**70**:565–72.

41. Kaiser HF, Rice J, Little jiffy, mark IV. *Educ Psychol Meas* 1974;**34**:111–7.
42. Judd CM, Kenny DA. Process analysis: estimating mediation in treatment evaluations. *Eval Rev* 1981;**5**:602–19.
43. Papazisis G, Tsiga E, Papanikolaou N, Vlasiadis I, Sapountzi-Krepia D. Psychological distress, anxiety and depression among nursing students in Greece. *Int J Caring Sci* 2008;**1**:42.
44. Iqbal S, Gupta S, Venkatarao E. Stress, anxiety & depression among medical undergraduate students & their socio-demographic correlates. *Indian J Med Res* 2015;**141**:354.
45. Leeman RF, Hoff RA, Krishnan-Sarin S, Patock-Peckham JA, Potenza MN. Impulsivity, sensation-seeking, and part-time job status in relation to substance use and gambling in adolescents. *J Adolesc Health* 2014;**54**:460–6.
46. Tavolacci M-P, Boerg E, Richard L, Meyrignac G, Dechelotte P, Ladner J. Prevalence of binge drinking and associated behaviours among 3286 college students in France. *BMC Public Health* 2016;**16**:178.
47. Shapira LB, Mongrain M. The benefits of self-compassion and optimism exercises for individuals vulnerable to depression. *J Posit Psychol* 2010;**5**:377–89.
48. Ratanasiripong P, Kaewboonchoo O, Ratanasiripong N, Hanklang S, Chumchai P. Biofeedback intervention for stress, anxiety, and depression among graduate students in public health nursing. *Nurs Res Pract* 2015;**2015**:1–5.
49. Stubbs B, Vancampfort D, Rosenbaum S, Firth J, Cosco T, Veronese N, et al. An examination of the anxiolytic effects of exercise for people with anxiety and stress-related disorders: a meta-analysis. *Psychiatr Res* 2017;**249**:102–8.
50. Ratanasiripong P, Park JF, Ratanasiripong N, Kathalae D. Stress and anxiety management in nursing students: biofeedback and mindfulness meditation. *J Nurs Educ* 2015;**54**:520–4.
51. Perula-de Torres LA, Atalaya JCV, Garcia-Campayo J, Roldan-Villalobos A, Magallon-Botaya R, Bartolome-Moreno C, et al. Controlled clinical trial comparing the effectiveness of a mindfulness and self-compassion 4-session programme versus an 8-session programme to reduce work stress and burnout in family and community medicine physicians and nurses: MINDUUDD study protocol. *BMC Fam Pract* 2019;**20**:24.