Validation and application of the Chinese version of the Perceived Stress Questionnaire (C-PSQ) in nursing students

Yi Luo [1] , Boxiong Gong [2] , Runtang Meng [Corresp., 3] , Xiaoping Cao [1] , Shuang Tang [4] , Hongzhi Fang [5] , Xing Zhao [6] , Bing Liu [7]

1 School of Nursing, Ningbo College of Health Sciences, Ningbo, People's Republic of China

2 Department of Oncology, Taihe hospital, Hubei University of Medicine, Shiyan, People's Republic of China

3 Department of Preventive Medicine, School of Health Sciences, Wuhan University, Wuhan, People's Republic of China

4 Department of Nursing, Renmin hospital, Hubei University of Medicine, Shiyan, People's Republic of China

5 Department of Anaesthesiology, ShanDong Provincial Western Hospital, Jinan, People's Republic of China

6 Department of orthopaedics, Taihe hospital, Hubei University of Medicine, Shiyan, People's Republic of China

7 Centre of Health Administration and Development Studies, Hubei University of Medicine, Shiyan, People's Republic of China

Corresponding Author: Runtang Meng
Email address: mengruntang@whu.edu.cn

Objective. To translate the Perceived Stress Questionnaire (PSQ) into Chinese, validate its reliability and validity in nursing students and investigate the perceived stress level of nursing students. **Method.** Forward- and back-translation combined with expert assessment and cross-cultural adaptations were used to construct the Chinese version of the Perceived Stress Questionnaire (C-PSQ). This research adopted a stratifiedsampling method among 1519 nursing students in 30 classes of Ningbo College of Health Sciences to assess the reliability and validity of the C-PSQ. Among them, we used the Recent C-PSQ (only the last month). **Results.** The C-PSQ retained all 30 items of the original scale. Principal component analysis extracted five factors that explained 52.136% of the total variance. The S-CVI/Ave was 0.913. Concurrent validity was 0.525 and 0.567 for anxiety and depression respectively. The results of the confirmatory factor analysis were as follows: χ^2/df=4.376, RMR=.023, GFI=.921, AGFI=.907, CFI=.916, RMSEA=.048, PNFI=.832, PGFI=.782, CN=342 and AIC/CAIC=.809 . The scale's Cronbach's alpha was 0.922, and Cronbach's α of each dimension was 0.899 (worries/tension), 0.821 (joy), 0.688 (overload), 0.703 (conflict), 0.523 (self- realization) . The correlation coefficient between the first and second test, the first and third test, and the second and third test was 0.725, 0.787, and 0.731, respectively. Mean values and distribution of overall PSQ index in nursing students was 0.399±0.138. Different demographic factors were significantly associated with the perceived stress of nursing students. **Conclusion.** The C-PSQ has an appropriate reliability and validity, which means that the scale can be used as a universal tool for psychosomatic studies. The perceived stress of nursing students was relatively high. Further studies are needed.

1 **Validation and application of the Chinese version of the Perceived Stress Questionnaire (C-**
2 **PSQ) in nursing students**
3 Yi Luo [1, †], Boxiong Gong [2, †], Runtang Meng [3, †, *], Xiaoping Cao [1], Shuang Tang [4], Hongzhi Fang
4 [5], Xing Zhao [6] and Bing Liu [7]

5 1 School of Nursing, Ningbo College of Health Sciences, Ningbo, People's Republic of China
6 2 Department of Oncology, Taihe hospital, Hubei University of Medicine, Shiyan, People's
7   Republic of China
8 3 Department of Preventive Medicine, School of Health Sciences, Wuhan University, Wuhan,
9   People's Republic of China
10 4 Department of Nursing, Renmin hospital, Hubei University of Medicine, Shiyan, People's
11   Republic of China
12 5 Department of Anaesthesiology, Shandong Provincial Western Hospital, Jinan, People's
13   Republic of China
14 6 Department of orthopaedics, Taihe hospital, Hubei University of Medicine, Shiyan, People's
15   Republic of China
16 7 Centre of Health Administration and Development Studies, Hubei University of Medicine,
17   Shiyan, People's Republic of China

18 * Corresponding author: Runtang Meng, mengruntang@163.com or mengruntang@whu.edu.cn
19 † These authors contributed equally to this work.

20 **Abstract**

21   **Objective.** To translate the Perceived Stress Questionnaire (PSQ) into Chinese, validate its
22 reliability and validity in nursing students and investigate the perceived stress level of nursing
23 students. **Method.** Forward- and back-translation combined with expert assessment and cross-
24 cultural adaptations were used to construct the Chinese version of the Perceived Stress
25 Questionnaire (C-PSQ). This research adopted a stratified sampling method among 1519 nursing
26 students in 30 classes of Ningbo College of Health Sciences to assess the reliability and validity
27 of the C-PSQ. Among them, we used the Recent C-PSQ (only the last month). **Results.** The C-
28 PSQ retained all 30 items of the original scale. Principal component analysis extracted five
29 factors that explained 52.136% of the total variance. The S-CVI/Ave was 0.913. Concurrent
30 validity was 0.525 and 0.567 for anxiety and depression respectively. The results of the
31 confirmatory factor analysis were as follows: χ^2/df=4.376, RMR=.023, GFI=.921, AGFI=.907,
32 CFI=.916, RMSEA=.048, PNFI=.832, PGFI=.782, CN=342 and AIC/CAIC=.809. The scale's
33 Cronbach's alpha was 0.922, and Cronbach's α of each dimension was 0.899 (worries/tension),
34 0.821 (joy), 0.688 (overload), 0.703 (conflict), 0.523 (self- realization). The correlation
35 coefficient between the first and second test, the first and third test, and the second and third test
36 was 0.725, 0.787, and 0.731, respectively. Mean values and distribution of overall PSQ index in
37 nursing students was 0.399±0.138. Different demographic factors were significantly associated
38 with the perceived stress of nursing students. **Conclusion.** The C-PSQ has an appropriate
39 reliability and validity, which means that the scale can be used as a universal tool for
40 psychosomatic studies. The perceived stress of nursing students was relatively high. Further

41 studies are needed.

1. Introduction

Nursing students experience a substantial amount of stress (Al-Zayyat & Al-Gamal 2014; Patterson 2016). These perceived stresses increases in the process of learning professional nursing knowledge (Lamaurt et al. 2011; Levesque 2015). Their stress originates from daily life events, the rigorous study of theories, and nursing clinical practice. On the one hand, nursing students must spend plenty of time and energy learning complicated professional topics, which makes them feel isolated, helpless and nervous (Yearwood & Riley 2010). On the other hand, clinical practice is performed in the hospital, which has a complicated environment (heavy workload, quick tempo, highly concentrated and intense competition) and depressed atmosphere (birth, senility, illness and death); nursing staff is a high-risk occupation in China. Nursing students can feel anxious, as they are constantly exposed to the sad emotions of the patients and their family members as well as fear of the risk of needle stick injuries (Moscaritolo 2009; Shearer & Davidhizar 1998). Moreover, nursing practice requires nursing students to possess a high medical and humanistic quality; nursing students can experience great stress while studying to meet these requirements because of their fear of lacking professional knowledge and skills (Moridi et al. 2014; Sheu et al. 2002).

For most Chinese students, stress also results from characteristics of the Chinese education system. Inequality exists in the allocation of educational resources, and the educational resource-utilization-rate is low (Rong & Shi 2001). In addition, as a result of the rapid expansion of the Chinese educational system, graduates' employment rate has become lower than before, which is uncommon in the development of higher education worldwide (Wen 2005). Nursing students in China experience substantial stress. They not only tolerate the stress from academic studies and clinical practice but also from the risk of failing to find a job.

Excessive stress has negative effects on nursing students, including psychological disorders, physiological diseases and social maladjustments. Research indicates that stress can significantly predict depressive symptoms, the prevalence of depression has reached 32.6% among college nursing students (Chen et al. 2015). Another study shows that nursing students have a much higher probability of committing suicide than other students (Goetz 1998). Excessive stress can therefore seriously affect nursing students' mental health and can cause physical injury. Moreover, it has been shown that stress increases the incidence of ulcerative colitis, sleeping difficulties and fatigue syndrome, which means that stress has a negative influence on students' health (Asencio-López et al. 2015; Levenstein et al. 2000; Levenstein et al. 2015; Waqas et al. 2015). Poor mental and general health may not only lead to a low capacity to study and cope in students (Beddoe & Murphy 2004) but also change students' determination to engage in nursing practice, which may have poor physic-psycho-social responses (Chen & Hung 2014; Watson et al. 2009).

The problems mentioned above present many challenges to nursing students as well as nursing educators. Nursing educators can gradually relieve students' stress and negative emotions through effective measures when they detect the students' perceived stress and recognize their nervousness and anxiety (Hamaideh et al. 2016). The current study adopted the Perceived Stress Questionnaire (PSQ) to investigate nursing students' perceived stress level. In 1993, Susan

83 Levenstein developed the PSQ and published it in English and Italian; it has shown good
84 reliability and validity. The PSQ has two forms - the General PSQ and Recent PSQ. The General
85 form measures the perceived stress based on the subjects' feeling in the long run ("in general,
86 during the last two years"), while the Recent form evaluates according to events that happened in
87 only the last month ("during the last month") (Levenstein et al. 1993). Two forms of the PSQ
88 differ only in the defined time range, and other content are identical. The scale has 30 items that
89 cover seven dimensions including harassment, overload, irritability, lack of joy, fatigue, worries
90 and tension. In addition to the English and Italian versions, the scale has been translated into
91 other languages including German (Fliege et al. 2001; Fliege et al. 2005; Kocalevent et al. 2007;
92 Kocalevent et al. 2011a; Kocalevent et al. 2011b), French (Consoli et al. 1996), Spanish
93 (Montero-Marin et al. 2014; Sanz-Carrillo et al. 2002), Swedish (Bergdahl & Bergdahl 2002;
94 Rönnlund et al. 2015), Norwegian (Østerås et al. 2015), Greek (Karatza et al. 2014) and Thai
95 (Ross et al. 2005; Wachirawat et al. 2003). We preliminarily focus on versions that provide
96 relatively complete psychometric characteristics.
97 The PSQ belongs to a universal scale (Kocalevent et al. 2007) which is commonly used to
98 measure perceived stress, it can be applied to the medical field and other fields (Levenstein et al.
99 1994). It provided an effective scale for the current study, as it has been used previously to
100 measure perceived stress in medical students (Montero-Marin et al. 2014). Universal as the scale
101 is, it can be used to measure the perceived stress of not only nursing students, medical students
102 and inpatients (Fliege et al. 2005) but also that of the entire medical staff, such as doctors, nurses
103 and managers. Moreover cannot but raise, the Perceived Stress Scale (PSS) is another earlier
104 universal scale for measuring stress perception and is currently translated into near 30 language
105 versions (2017), including the Chinese PSS, other than English on the basis of Laboratory for the
106 Study of Stress, Immunity and Disease. Indeed, the major difference between the PSS and the
107 PSQ lies solely with measurement dimensions, dimensions of the latter are more focused on
108 individuals appraise situations in their lives as stressful to report whether there seem to be
109 unpredictable, uncontrollable or overloaded during the previous month (Lee 2012; Levenstein et
110 al. 1993). According to items, there are three versions of the PSS (PSS-14, PSS-10 and PSS-4).
111 However, no Chinese version of the PSQ had been published until we introduced the Chinese
112 version of the PSQ (C-PSQ). The C-PSQ was validated in a large sample of Chinese nursing
113 students to measure their level of perceived stress, thus proving the scale had an appropriate
114 reliability and validity. Once the PSQ has been introduced to China, people will be able to use it
115 to measure the perceived stress level of nursing students and other medical students as well as
116 that of medical workers and other groups of people whose level of perceived stress needs to be
117 studied. We believed that the development of the C-PSQ would provide a firm foundation for
118 related studies in China.

119 **2. Method**
120 2.1. Introducing the scale
121 The PSQ was translated using forward and back translation based on the integrated method
122 (Sidani et al. 2010) and Brislin's translation model (Brislin 1970; Doris et al. 2003) after
123 receiving permission from the original author—Susan Levenstein. Firstly, forward translation
124 was independently carried out by two bilingual translators whose first language was Chinese.

125 One translator had abundant psychological knowledge and knew the scale, while the other
126 translator was sensitive to expressions of language. Secondly, the translator with abundant
127 psychological knowledge and an English scholar compared and examined the two scales together
128 to finalize a draft. Thirdly, two English language scholars who knew nothing about the English
129 version of the PSQ back-translated the draft to an English version. Fourthly, the two back-
130 translated scales were compared, and the back-translated version was finalized. Fifthly, the
131 researcher compared and judged the differences between the back-translated manuscript and the
132 original scale, forward- and back-translated different items again and finalized the questionnaire.
133 Additionally, we consulted 10 scholars who are experts in the development and validation of
134 scales from Wuhan University, Yunnan University and Ningbo College of Health Sciences.
135 Taking the experts' suggestions and the results of the forward and backward translation into
136 consideration, we developed the C-PSQ after several rounds of discussion. For the specific
137 processes, refer to Figure 1.

138 [Figure 1 near here.]
139 **Figure 1** Flow chart of introducing the C-PSQ.

140 The C-PSQ maintains the item order and scoring method of the original English version of the
141 PSQ, using a four-point Likert Scale and asking how often (on a scale from 1, 'almost never', to
142 4, 'usually') each item occurred. The lowest score on the original scale is 30, and the highest
143 score is 120. The final score, PSQ index, is (raw score-30)/90 and ranges from 0-1, with higher
144 scores indicating greater stress. Several items (1, 7, 10, 13, 17, 21, 25, 29) were reverse scored
145 (Levenstein et al. 1993). There are presently two ways to cut off score concerning PSQ index
146 evaluation. Two cut-off scores of the PSQ index were yielded in recent research by using the PSQ
147 index mean score (M) and standard deviation (SD) of the population studied in order to divide the
148 subjects into three groups, low level ($\leq$M$\pm$SD), moderate level (>M$\pm$SD and $\leq$M$\pm$2SD) and high
149 level (>M$\pm$2SD) of perceived stress(Bergdahl & Bergdahl 2002; Kocalevent et al. 2007). Three
150 cut-off scores of the PSQ index is divided according to quartile in earlier research (Levenstein et
151 al. 1993; Sanz-Carrillo et al. 2002).

152 2.2. Ethics statement
153 The medical ethics committee of Wuhan University School of Medicine (WUSM) approved
154 this study. The current study adhered to the rules of the Declaration of Helsinki and its revised
155 version as well as the rules of bio-medical journals. Additionally, this study was approved by the
156 surveyed school and students in Ningbo College of Health Sciences.

157 2.3. Research
158 The current study includes general information on and the perceived stress of nursing students.
159 The newly developed C-PSQ was used to measure perceived stress. Among them, we used the
160 Recent C-PSQ (only the last month). We interviewed 9 students prior to conducting the survey
161 formally to assess whether the general information form and language of the C-PSQ were
162 suitable and reasonable in line with the Chinese context. We then revised the general information
163 form based on the results of the interview and adjusted the text font, size and line spacing to

164 make it easier to read to avoid information bias (Althubaiti 2016).
165 The final general information form included the following information: sex, age, home
166 location (city, town, village), single-child status, admission time (2015, 2014, 2013), initial
167 educational degree (secondary school, high school), clinical practice experience, part-time job
168 status, frequency of going back home, physical health, mental health, attitude towards nursing job
169 prospects, greatest source of stress in college life (studies, employment, interpersonal
170 relationships, love life, financial state, family), and the most often used coping skill (adjusting
171 psychology, solving problems, escaping). Meanwhile, to test for criterion (concurrent) validity of
172 the C-PSQ, the Goldberg Anxiety and Depression Scale (GADS, individually referred to as the
173 GAS and GDS) was selected as a comparator scale, which shall be composed of a 9-item
174 subscale that assesses symptoms of anxiety and a 9-item subscale that assesses symptoms of
175 depression over the past month (Goldberg et al. 1988). All items can be answered with a simple
176 "yes" or "no", with one or zero point respectively scored for each response. The final score is
177 acquired by accumulating the response to each of the items, with higher values representing
178 greater levels of symptomatology. The GADS has not only revealed good criterion validity for
179 depressive disorders and generalised anxiety disorder but also displayed adequate values of
180 sensitivity and specificity (Kiely & Butterworth 2015; Mulhall et al. 2018; Pachana et al. 2007).
181 Our team used this brief and friendly scale because it has been widely adopted as a standard to
182 screen of anxiety and depression in large sample studies of the general population (Goldberg et
183 al. 1988).
184 The formal investigation occurred from November 18, 2015, to January 6, 2016. We adopted
185 the stratified sampling method to identify the sample of nursing students in Ningbo College of
186 Health Science. In total, 1519 nursing students from 30 classes were surveyed. Among
187 respondents, students in Grade 1 had studied nursing courses for more than 3 months, and
188 students in Grade 3 had taken part in clinical practice in the hospital for more than 2 months.
189 Simultaneously, we randomly chose a class to test the test-retest reliability of the C-PSQ. A total
190 of 50 students in the class were tested three times including the formal survey, once per week; the
191 final response rate was 100%. To fully respect and protect the subjects' privacy, subjects'
192 responses to our study were considered anonymous and confidential. The objective of the survey
193 and the instructions for filling out the form were explained to the nursing students before the
194 survey was conducted. All questionnaires were written and were collected once the subject
195 finished writing. After excluding the unfinished and nonstandard questionnaires, a total of 1453
196 complete questionnaires were collected, for a response rate of 95.66%.

197 2.4. Statistical method
198 A database was built by Epidata (version 3.1, Lauritsen JM &Bruus M, Odense, Denmark)
199 software. SPSS (version 18.0, SPSS Inc., Chicago, IL, USA), AMOS (version 18.0, SPSS Inc.,
200 Chicago, IL, USA) and Excel (version 2010, Microsoft, Redmond, USA) were adopted to analyse
201 the data. Descriptive statistics were used to describe the demographic characteristics. Construct
202 validity was tested by factor analysis, which was performed using principle components analysis
203 with varimax transformation. Criterion (concurrent) validity and convergence values were
204 evaluated by Spearman's correlations. Ten experts evaluated the content validity of the scale and
205 found it acceptable (Lynn 1986). We chose Cronbach's coefficient to test the internal consistency

206   of the scale and Spearman's correlations to assess the test-retest reliability. The (mean ± SD)
207   represents the mean value; T-test or ANOVAs were used to compare the test or factor scores
208   between two or more groups. The significance level was set at or below 5%.

209   **3. Results**
210   Characteristics of the subjects are described in Table 1. Nursing students' age ranged from 17-
211   23 years, with an average age of 19.58±1.09. Their length of clinical practice experienced was 2-
212   12 months, and the average length was 8.58±1.32 months.

213   **Table 1** Nursing students' demographic data (N=1453).
214   [Table 1 near here.]

215   The Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was 0.951, which means that
216   the factor analysis was suitable (Kaiser & Rice 1974). The common factors and component
217   matrix of the principal component analysis are summarized in Table 2. The five extracted factors
218   explained 52.136% of the total variance (>50%), which was an acceptable level (Wu 2010).
219   Factor 1 (Worries/Tension) includes 12 items (9, 12, 14, 15, 18, 19, 20, 22, 26, 27, 28, 30), factor
220   2 (Joy) includes 7 items (1, 10, 13, 17, 21, 25, 29), factor 3 (Overload) includes 4 items (4, 8, 11,
221   16), factor 4 (Conflict) includes 5 items (2, 3, 5, 6, 24), and factor 5 (Self- realization) includes 2
222   items (7, 23). The 5 factors described below formed the 5 dimensions of the scale.

223   **Table 2** Communalities and rotated component matrix.
224   [Table 2 near here.]

225   Of the five extracted factors of the C-PSQ, items 2, 3, 5, 6 and 24 represented conflict, as they
226   mainly revealed the socially acceptable degree of stress and psychological contradictions
227   (Rönnlund et al. 2015; Sanz-Carrillo et al. 2002). Items 4, 8, 11 and 16 were named overload, as
228   they mainly illustrated the stress caused by excess loads (Levenstein et al. 1993). Items 1, 10, 13,
229   17, 21, 25 and 29 were named joy, as they mainly presented a state that was joyful and energetic
230   (Sanz-Carrillo et al. 2002); items on this dimension were reversely scored. Items 9, 12, 14, 15,
231   18, 19, 20, 22, 26, 27, 28 and 30 revealed the worry and strain of the subjective; as it combined
232   the dimensions of worries and tension in the original scale, we named it worries/tension
233   (Levenstein et al. 1993). Items 7 and 23 represented self-realization, and thus we called it self-
234   realization (Sanz-Carrillo et al. 2002). We compared the scale's items clustering in the factors and
235   factorial structure between the C-PSQ, English/Italian version of the PSQ and other versions of
236   the PSQ. The results are shown in Table 3.

237   **Table 3** Comparison of factorial structure among different versions of the PSQ.

238   [Table 3 near here.]

239   The average Content Validity Index of the PSQ (S-CVI/Ave) was 0.913 (> 0.90), which means

240   that the scale has good content validity (Polit & Beck 2006). Taking the GADS as criterion,

241   concurrent validity of the PSQ was 0.525 and 0.567 for anxiety and depression respectively. The

242   results of construct validity of the PSQ displays in Table 4.

243   **Table 4** Convergence values for the C-PSQ hierarchical factors structure.

244   [Table 4 near here.]

245   Based on the results of the factor analysis above, we conducted a confirmatory factor analysis

246   to modify the model and formed Figure 2. In addition, the uncorrelated base model demonstrates

247   in Figure 3. The results of the tests and the model's goodness of fit are shown in Table 5.

248   [Figure 2 near here.]

249   **Figure 2** Confirmatory factor analysis the modified model model (n=1453).

250   [Figure 3 near here.]

251   **Figure 3** Confirmatory factor analysis the uncorrelated base model (n=1453).

252   **Table 5** Evaluation of the goodness of fit of the confirmatory factor analysis.

253   [Table 5 near here.]

254   From Table 5, we could see that the model's chi-square degree of freedom was 4.376;

255   comprehensive assessments were made by referring to the goodness-fit index, as the result could

256   be influenced by sample size (Kline 2016; Wheaton 1987). Indices that were within the standard

257   range included RMR=.023, GFI=.921, AGFI=.907, CFI=.916, RMSEA=.048, PNFI=.832,

258   PGFI=.782, CN=342 and AIC/CAIC=.809. The critical values for each of the fit indices (Byrne

259   2016) are RMR <.05, GFI> .9 (Hu & Bentler 1999), AGFI> .9, CFI> .9 (Bentler 1990; Hu et al.

260   1995), RMSEA <.05 (good fit) or <.08 (reasonable) (Browne & Cudeck 1993), PNFI> .5, PGFI

261   > .5, CN > 200 (Hu et al. 1995), lower is better concerning AIC/CAIC value(Wu 2010),

262   respectively.

263   Cronbach's alpha of the C-PSQ was 0.922 CI (0.916, 0.928), which means that this scale has

264   good internal consistency (Antonius 2003). Moreover, Cronbach's α values of the other 5

265   dimensions were all acceptable (Wu 2010), including 0.899 CI (0.891, 0.907), 0.821 CI (0.807,

266   0.835), 0.688 CI (0.661, 0.713), 0.703 CI (0.678, 0.726) and 0.523 CI (0.472, 0.570); namely

267   0.899 (worries/tension), 0.821 (joy), 0.688 (overload), 0.703 (conflict), 0.523 (self- realization).

268   The scale has shown acceptable test-retest reliability. The correlation between the first and second

269   test was 0.725 CI (0.514, 0.878), the correlation between the first and third test was 0.787 CI

270   (0.607, 0.890), and the correlation between the second and third test was 0.731 CI (0.506, 0.897).

271   These results at one-week intervals proved that the scale has an appropriate level of both stability
272   and responsiveness to change over time. Reliability and validity of the PSQ in different nations
273   show that in Table 6.

274   **Table 6** Description on different validity and reliability of the PSQ reported in original as well as
275   different translated versions.
276   [Table 6 near here.]

277   Mean values and distribution of overall perceived stress score (PSQ index) in the surveyed
278   students was (0.399±0.138, range 0.02-0.90). By using the two cut-off scores described below,
279   the prevalence of perceived stress at a moderate level was estimated to be 10.3%. The prevalence
280   of perceived stress at high levels was 2.8%. Of the responding students, 647 (44.5%) thought that
281   the greatest stress came from employment, and 543 (37.4%) considered studying to be the
282   greatest stress in college. Additionally, 49 students (3.4%) attributed the greatest stress to love
283   affairs, while 50 students (3.4%) reported their financial situations. Eleven students (0.8%)
284   ascribed stress to other categories. We compared the perceived stress of nursing students with
285   different characteristics (Table 7).

286   **Table 7** Comparison of perceived stress in nursing students.
287   [Table 7 near here.]

288   **4. Discussion**
289   In the present study, the PSQ was translated and validated as well as applied in a large sample
290   of nursing students. During the test-retest trial, the surveyed students reported engagement in
291   different activities, including taking courses, skills training, sectional examinations and internship
292   assignments. In particular, students were stressed during examinations and obtaining an
293   internship, which we thought could influence their perceived stress and affect the final results.
294   However, the results of the test-retest reliability were above .70, which meant that the scale are
295   acceptable for research tools (Keszei et al. 2010) and had certain stability. The concurrent validity
296   and Construct validity of the PSQ is not bad. Nonetheless, this result did not study using the same
297   criterion as a reference. Therefore, the C-PSQ has an appropriate reliability and validity, which
298   guarantees it as a suitable tool to measure the perceived stress of people in China.
299   χ^2/df can be influenced by sample size, which was large in the current study. As a result, the
300   χ^2/df did not reach the appropriate standard (Hayduk 1987), but the results were acceptable, as
301   they matched the flexible range ($<$5) (Wu 2009). Moreover, other goodness-of-fit indexes of the
302   model were all within the acceptable range, demonstrating that the scale's structure was stable.
303   As shown in Table 3, visible difference in the structure and items clustering in the factors are
304   present among different versions of the PSQ but on some level several items of the PSQ (24, 4,
305   21, 14 and 27) were happened to the cluster on a stability factor. In spite of this, the PSQ could be
306   still translated into different languages and applied globally. Most of the fit statistics of the
307   modified model is greater than the critical value and around half of fit statistics of the
308   uncorrelated base model are not satisfactory in this study. We must admit that no matter which
309   model's fitting effect is not great satisfactory, the modified model we reluctantly accept. Multi-

310   country study showed that the results of exploratory factor analysis (EFA) are inconsistent after
311   the PSQ was translated into local languages. There is reason to believe that the structural
312   equation model may need to be further simplified. We will consider removing items (item
313   reduction) (Fliege et al. 2005; Rönnlund et al. 2015) to optimize the structure of factors in future
314   studies.

315   Furthermore, based on appropriate reliability and validity, we retained all 30 items of the
316   original scale (Levenstein et al. 1993), thereby maintaining the high integrity of the original scale
317   in obtaining an objective result. Moreover, the original English and Italian scales had advanced
318   after twenty years of development, and items of the C-PSQ kept the same items as the original
319   scale as well as the item order (Asencio-López et al. 2015; Levenstein et al. 2000; Levenstein et
320   al. 1994; Levenstein et al. 1993). Including reversed scores for some of the items can detect false
321   information. For example, when a subject chose "usually" as the answer for both "you feel
322   rested" and "you feel tired", we judged the response as ineffective. In word, we need to extend
323   the sample further research concerning reliability and validity of the PSQ.

324   Mean values and distribution of overall PSQ index in nursing students was 0.399±0.138. This
325   index was lower than that of ulcerative colitis patients in Susan Levenstein's research (Levenstein
326   et al. 1994). Independent t-tests revealed that the differences were not statistical significant, t=-
327   1.659, P=0.097. This index was higher than that of the general population (Sanz-Carrillo et al.
328   2002), t=4.024, P=0.000, and this difference was statistically significant. In the current study,
329   nursing students' perceived stress levels were relatively high, which was consistent with the
330   results of other studies (Lee & Noh 2016; Ross et al. 2005). Appropriate stress can motivate
331   students' enthusiasm to study and practice and can cultivate their confidence and optimism.
332   However, students are forced to cope with stress when it becomes excessive (Findik et al. 2015).
333   Whether the stress results in unhealthy physical and psychological change or abnormal behaviour
334   depends on factors such as social support (school, family, friends and community) (Metzger et al.
335   2016) and self-adjustment (Saoji 2016). Therefore, it is necessary for nursing educators to
336   recognize nursing students' stress and communicate with students to gradually build a support
337   system for them. Leading and encouraging the students to develop mechanisms that facilitate
338   optimism can help students manage stress and stay in a good mood.

339   Students whose initial educational degree was secondary school had lower perceived stress
340   levels than students whose initial educational degree was high school. This could be explained by
341   the previous nursing experience gained by secondary school graduates during their schooling.
342   They became accustomed to the nursing field earlier than students who directly graduated from
343   high school, and as students who directly graduated from high school were unfamiliar with the
344   study of nursing, they became stressed. Moreover, students who participated in clinical practice
345   had a lower perceived stress than those who did not; this result differed from other studies (Al-
346   Zayyat & Al-Gamal 2014; Moridi et al. 2014). Traditionally, people think that clinical practice is
347   the greatest source of stress for nursing students. We speculated that students' perceived stress
348   originated most from their fear of the many uncertain events that could happen during their
349   internship, rather than their involvement in clinical practice. Students who are about to participate
350   in their internship had a higher perceived stress, as they were worried and feared the difficulties
351   they might face, whereas students who had participated in the internship had a lower perceived
352   stress, as they were able to accomplish their work.

353   Part-time jobs influenced nursing students in many ways (Lee et al. 1999). Students who
354 worked part-time were under greater stress than those who did not. This might be because
355 students who take part-time positions have a heavier economic burden than those who do not;
356 they have to make a living through this work (Well et al. 2015). Moreover, role conflicts occur
357 when students play many roles in their life, including student, worker, and friend (Yamada et al.
358 2011). Studies show that time spent on part-time position is inversely proportional to students'
359 scores. Working 16 or more hours per week has a negative influence on students' academic
360 achievements (Salamonson & Andrew 2006). Working students' learning schedules could be
361 occupied by their part-time job, thus leading to high levels of stress in studies and daily life.
362   Students who visited their home frequently had a lower perceived stress level than those who
363 did not. Going back home can comfort nursing students through the provision of family support.
364 One study showed that family support played an important role in medical students' life,
365 especially when they were faced with a challenge. Family support encouraged students to face
366 that challenge head-on and full of confidence (Klink et al. 2008). Furthermore, it can affect
367 students' anxiety and depression (Wodka & Barakat 2007), lower the incidence of depression
368 (Harris & Molock 2000) and positively affect the psychological health of students.
369   Students who were optimistic about their employment had a lower perceived stress than those
370 who were not. Employment stress is determined by both inward and outward influencing factors
371 and is closely related to the environment, physiology, psychology and behaviour (Hwang 2012;
372 Yun & Kim 2012). For instance, stress in academics and daily life can cause students to lack
373 confidence and determination when needing to find employment. Additionally, in recent years,
374 the job market has been stressful, which presents a challenge to Chinese nursing students.
375   Furthermore, students who could manage their emotions and were good at solving problems
376 had a lower perceived stress than those who tended to avoid stress. One of the keys to success is
377 knowing how to cope with stress and difficulties (Brady et al. 2016). Positive psychological
378 interventions can be useful in reducing stress and improving confidence (Greeson et al. 2015;
379 Heinen et al. 2017). One strategy to improve health status is promoting stress management
380 capacity through training (Li et al. 2016). One study showed that rational coping strategies were
381 inversely proportional to perceived stress (Crego et al. 2016). Moreover, the students who were
382 psychologically and physiological healthy had lower perceived stress levels than those who were
383 not. Students' perceived stress can both influence and be influenced by their psychological and
384 physiological health. Further studies should be conducted on the process of how stress influences
385 psychological and physiological health.

386 **Conclusion**
387   The C-PSQ has an appropriate reliability and validity, which means that the scale can be used
388 as a universal tool for psychosomatic studies. The perceived stress of nursing students was
389 relatively high. In future research, it is necessary to further expand the sample to test different
390 groups. Further studies are needed.

391 ***Relevance for clinical practice***
392   The current study has translated the Perceived Stress Questionnaire (PSQ) into Chinese and
393 applied it to nursing students. Results showed that nursing students' perceived stress level was

394 relatively high which remind nursing educators to focus on students' stress. High level of stress
395 makes students give up nursing study, educators should avoid this phenomenon which may cause
396 the loss of clinical nurse and influence the nursing service quality. Further more, the PSQ could
397 also be applied to clinical nurses by which the nursing managers could know the perceived stress
398 of nurses. Nursing managers would relieve the stress of nurses which can ensure the smooth
399 development of nursing work. We suggested that future studies should continuously monitor the
400 dynamic stress level of nurses throughout their nursing career, specific interventions would be
401 made in some special time of nodes at which the stress level is high. Such interventions would
402 promote the development of nurses and improve the stability of the nursing team.

403 ***Limitations and suggestions for future research***
404 Despite our efforts to completely explore validation and application of the CPSQ, we firmly
405 believe that additional psychometrics indicators and influencing factors should be incorporated
406 into further research done in the future.
407 1. Validation should include construct validity, criterion validity and content validity tests. There
408 will be critical need also for action to find more evidence to prove that validity of the C-PSQ has
409 stable and good validity. There are no adequate comparator scales to establish criterion validity
410 and construct validity of the scale being assessed. The PSS may be a suitable criterion for testing
411 in future studies.
412 2. The cross-sectional design of this study only tested nursing students, resulting in limited the
413 inference of application range. As the PSQ is a universal scale, we need to measure different
414 samples of more locations to confirm the C-PSQ applicability in China.
415 3. The PSQ belongs to a subjective measurement scale with respect to stress perception, which is
416 easily affected by various factors, such as participants' cultural level and participation attitude. If
417 further studies can be combined with objective indicators (physiological and biochemical index)
418 as a criterion, thereby obtaining a more comprehensive criterion-related validity.

419 **Acknowledgement:**
420 Special thanks to Susan Levenstein MD from Aventino Medical group in Italy and Chua
421 Yeewen from Department of Psychology, HELP University for their great help in the process of
422 introducing the scale to China. We really appreciate that Susan Levenstein MD has taken time out
423 of her schedule to comment on this paper. Meanwhile, we would like to acknowledge our friends
424 Jingjing Li PhD Candidate from Rollins School of Public Health (RSPH), Emory University;
425 Zhenkun Wang PhD from Tongji Hospital, Tongji Medical College, Huazhong University of
426 Science and Technology; Yucong Ma who is a MTI of Southeast University-Monash University
427 Joint Graduate School (Suzhou) and Di zhang who is a master student from School of Health
428 Sciences, Wuhan University for their valuable assist in forward and back-translation. Also, we are
429 grateful to all subjects taking part in the present study and teachers in Ningbo College of Health
430 Sciences for their necessary assistance in collecting data. All authors appreciated the reviewers
431 for constructive comments and suggestions to improve the quality of manuscript.

432 **References**
433 Al-Zayyat AS, and Al-Gamal E. 2014. Perceived stress and coping strategies among Jordanian nursing students during

434 clinical practice in psychiatric/mental health courses. *International journal of mental health nursing* 23:326-
435 335.

436 Althubaiti A. 2016. Information bias in health research: definition, pitfalls, and adjustment methods. *Journal of*
437 *multidisciplinary healthcare* 9:211.

438 Antonius R. 2003. *Interpreting quantitative data with SPSS*: Sage.

439 Asencio-López L, Almaraz-Celis G, Carrillo MV, Huerta VP, Silva GL, Muñoz TM, Monroy CF, Regalado TJ, Dipp MK,
440 and López MD. 2015. Burnout syndrome in first to sixth-year medical students at a private university in the
441 north of Mexico: descriptive cross-sectional study. *Medwave* 16:e6432-e6432.

442 Beddoe AE, and Murphy SO. 2004. Does mindfulness decrease stress and foster empathy among nursing students?
443 *Journal of nursing education* 43:305-312.

444 Bentler PM. 1990. Comparative fit indexes in structural models. *Psychological bulletin* 107:238.

445 Bergdahl J, and Bergdahl M. 2002. Perceived stress in adults: prevalence and association of depression, anxiety and
446 medication in a Swedish population. *Stress and Health* 18:235-241.

447 Brady ST, Reeves SL, Garcia J, Purdie-Vaughns V, Cook JE, Taborsky-Barba S, Tomasetti S, Davis EM, and Cohen GL.
448 2016. The psychology of the affirmed learner: Spontaneous self-affirmation in the face of stress. *Journal of*
449 *Educational Psychology* 108:353.

450 Brislin RW. 1970. Back-translation for cross-cultural research. *Journal of cross-cultural psychology* 1:185-216.

451 Browne MW, and Cudeck R. 1993. *Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), Testing*
452 *structural equation models*. Newbury Park, CA: Sage.

453 Byrne BM. 2016. *Structural equation modeling with AMOS: Basic concepts, applications, and programming*:
454 Routledge.

455 Chen CJ, Chen YC, Sung HC, Hsieh TC, Lee MS, and Chang CY. 2015. The prevalence and related factors of depressive
456 symptoms among junior college nursing students: a cross-sectional study. *Journal of psychiatric and*
457 *mental health nursing* 22:590-598.

458 Chen Y-W, and Hung C-H. 2014. Predictors of Taiwanese baccalaureate nursing students' physio–psycho-social
459 responses during clinical practicum. *Nurse Education Today* 34:73-77.

460 Consoli S, Taine P, Szabason F, Lacour C, and Metra P. 1996. Development and validation of a perceived stress
461 questionnaire recommended as a follow-up indicator in occupational medicine. *L'Encephale* 23:184-193.

462 Crego A, Carrillo-Diaz M, Armfield JM, and Romero M. 2016. Stress and Academic Performance in Dental Students:
463 The Role of Coping Strategies and Examination-Related Self-Efficacy. *Journal of dental education* 80:165-
464 172.

465 Doris S, Lee DT, and Woo J. 2003. Translation of the chronic heart failure questionnaire. *Applied Nursing Research*
466 16:278-283.

467 Findik UY, Ozbas A, Cavdar I, Topcu SY, and Onler E. 2015. Assessment of nursing students' stress levels and coping
468 strategies in operating room practice. *Nurse education in practice* 15:192-195.

469 Fliege H, Rose M, Arck P, Levenstein S, and Klapp B. 2001. Validierung des "perceived stress questionnaire"(PSQ) an
470 einer deutschen stichprobe. *Diagnostica* 47:142-152.

471 Fliege H, Rose M, Arck P, Walter OB, Kocalevent R-D, Weber C, and Klapp BF. 2005. The Perceived Stress
472 Questionnaire (PSQ) reconsidered: validation and reference values from different clinical and healthy adult
473 samples. *Psychosomatic medicine* 67:78-88.

474 Goetz CS. 1998. Are you prepared to SAVE your nursing student from suicide? *Journal of nursing education* 37:92-
475 95.

476 Goldberg D, Bridges K, Duncan-Jones P, and Grayson D. 1988. Detecting anxiety and depression in general medical

477   settings. *Bmj* 297:897-899.

478   Greeson JM, Toohey MJ, and Pearce MJ. 2015. An Adapted, Four-Week Mind–Body Skills Group for Medical
479   Students: Reducing Stress, Increasing Mindfulness, and Enhancing Self-Care. *Explore: The Journal of*
480   *Science and Healing* 11:186-192.

481   Hamaideh SH, Al-Omari H, and Al-Modallal H. 2016. Nursing students' perceived stress and coping behaviors in
482   clinical training in Saudi Arabia. *Journal of Mental Health*:1-7.

483   Harris TL, and Molock SD. 2000. Cultural orientation, family cohesion, and family support in suicide ideation and
484   depression among African American college students. *Suicide and Life-Threatening Behavior* 30:341-353.

485   Hayduk LA. 1987. *Structural equation modeling with LISREL: Essentials and advances*: Jhu Press.

486   Heinen I, Bullinger M, and Kocalevent R-D. 2017. Perceived stress in first year medical students-associations with
487   personal resources and emotional distress. *BMC medical education* 17:4.

488   Hu L-T, Bentler PM, and Hoyle RH. 1995. *Evaluating model fit. In R. H. Hoyle (Ed.), Structural equation modeling:*
489   *Concepts, issues, and applications*. Thousand Oaks, CA: Sage.

490   Hu Lt, and Bentler PM. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria
491   versus new alternatives. *Structural equation modeling: a multidisciplinary journal* 6:1-55.

492   Hwang R-I. 2012. Factors affecting employment stress among college nursing students. *Journal of Korean Public*
493   *Health Nursing* 26:215-226.

494   Kaiser HF, and Rice J. 1974. Little Jiffy, Mark IV. *Educational and psychological measurement*.

495   Karatza E, Kourou D, Galanakis M, Varvogli L, and Darviri C. 2014. Validation of the greek version of perceived stress
496   questionnaire: Psychometric properties and factor structure in a population-based survey. *Psychology*
497   5:1268-1284.

498   Keszei AP, Novak M, and Streiner DL. 2010. Introduction to health measurement scales. *Journal of psychosomatic*
499   *research* 68:319-323.

500   Kiely KM, and Butterworth P. 2015. Validation of four measures of mental health against depression and generalized
501   anxiety in a community based sample. *Psychiatry research* 225:291-298.

502   Kline RB. 2016. *Principles and practice of structural equation modeling*. New York, NY: THE GUILFORD PRESS.

503   Klink JL, Byars-Winston A, and Bakken LL. 2008. Coping efficacy and perceived family support: potential factors for
504   reducing stress in premedical students. *Medical Education* 42:572-579.

505   Kocalevent R-D, Levenstein S, Fliege H, Schmid G, Hinz A, Brähler E, and Klapp BF. 2007. Contribution to the
506   construct validity of the Perceived Stress Questionnaire from a population-based survey. *Journal of*
507   *psychosomatic research* 63:71-81.

508   Kocalevent RD, Hinz A, Brähler E, and Klapp BF. 2011a. Determinants of fatigue and stress. *BMC research notes*
509   4:238.

510   Kocalevent RD, Hinz A, Brahler E, and Klapp BF. 2011b. Regional and individual factors of stress experience in
511   Germany: results of a representative survey with the perceived stress questionnaire (PSQ).
512   *Gesundheitswesen* 73:829-834.

513   Lamaurt F, Estryn-Behar M, Le Moel R, Chrétien T, and Mathieu B. 2011. Survey on the satisfaction regarding their
514   studies and the health habits of nursing students in France. *Recherche en soins infirmiers*:44-59.

515   Lee E-H. 2012. Review of the psychometric evidence of the perceived stress scale. *Asian nursing research* 6:121-127.

516   Lee E, and Noh HK. 2016. The Effects of a Web-Based Nursing Process Documentation Program on Stress and
517   Anxiety of Nursing Students in South Korea. *International journal of nursing knowledge* 27:35-42.

518   Lee T, Mawdsley JM, and Rangeley H. 1999. Students' part-time work: towards an understanding of the implications
519   for nurse education. *Nurse education today* 19:443-451.

520   Levenstein S, Prantera C, Varvo V, Scribano ML, Andreoli A, Luzi C, Arca M, Berto E, Milite G, and Marcheggiano A.
521   2000. Stress and exacerbation in ulcerative colitis: a prospective study of patients enrolled in remission.
522   *The American journal of gastroenterology* 95:1213-1220.

523   Levenstein S, Prantera C, Varvo V, Scribano ML, Berto E, Andreoli A, and Luzi C. 1994. Psychological stress and
524   disease activity in ulcerative colitis: a multidimensional cross-sectional study. *American Journal of*
525   *Gastroenterology* 89:1219-1225.

526   Levenstein S, Prantera C, Varvo V, Scribano ML, Berto E, Luzi C, and Andreoli A. 1993. Development of the Perceived
527   Stress Questionnaire: a new tool for psychosomatic research. *Journal of psychosomatic research* 37:19-32.

528   Levenstein S, Rosenstock S, Jacobsen RK, and Jorgensen T. 2015. Psychological stress increases risk for peptic ulcer,
529   regardless of Helicobacter pylori infection or use of nonsteroidal anti-inflammatory drugs. *Clinical*
530   *Gastroenterology and Hepatology* 13:498-506. e491.

531   Levesque P. 2015. Meeting the Needs of the Transgender Nursing Student. *Nurse educator* 40:244-248.

532   Li F, Chen J, Yu L, Jing Y, Jiang P, Fu X, Wu S, Sun X, Luo R, and Kwan H. 2016. The Role of Stress Management in the
533   Relationship between Purpose in Life and Self-Rated Health in Teachers: A Mediation Analysis.
534   *International Journal of Environmental Research and Public Health* 13:719.

535   Lynn MR. 1986. Determination and quantification of content validity. *Nursing research* 35:382-386.

536   Metzger IW, Cooper SM, Ritchwood TD, Onyeuku C, and Griffin CB. 2016. Profiles of African American College
537   Students' Alcohol Use and Sexual Behaviors: Associations With Stress, Racial Discrimination, and Social
538   Support. *The Journal of Sex Research*:1-12.

539   Montero-Marin J, Demarzo MMP, Pereira JP, Olea M, and García-Campayo J. 2014. Reassessment of the
540   psychometric characteristics and factor structure of the 'Perceived Stress Questionnaire'(PSQ): analysis in a
541   sample of dental students. *PloS one* 9:e87071.

542   Moridi G, Khaledi S, and Valiee S. 2014. Clinical training stress-inducing factors from the students' viewpoint: A
543   questionnaire-based study. *Nurse education in practice* 14:160-163.

544   Moscaritolo LM. 2009. Interventional strategies to decrease nursing student anxiety in the clinical learning
545   environment. *Journal of nursing education* 48:17-23.

546   Mulhall S, Andel R, and Anstey KJ. 2018. Variation in symptoms of depression and anxiety in midlife women by
547   menopausal status. *Maturitas* 108:7-12.

548   Østerås B, Sigmundsson H, and Haga M. 2015. Perceived stress and musculoskeletal pain are prevalent and
549   significantly associated in adolescents: an epidemiological cross-sectional study. *BMC public health*
550   15:1081.

551   Pachana NA, Byrne GJ, Siddle H, Koloski N, Harley E, and Arnold E. 2007. Development and validation of the
552   Geriatric Anxiety Inventory. *International psychogeriatrics* 19:103-114.

553   Patterson SL. 2016. The effect of emotional freedom technique on stress and anxiety in nursing students: A pilot
554   study. *Nurse education today* 40:104-110.

555   Polit DF, and Beck CT. 2006. The content validity index: are you sure you know what's being reported? Critique and
556   recommendations. *Research in nursing & health* 29:489-497.

557   Rönnlund M, Vestergren P, Stenling A, Nilsson LG, Bergdahl M, and Bergdahl J. 2015. Dimensionality of stress
558   experiences: Factorial structure of the Perceived Stress Questionnaire (PSQ) in a population-based Swedish
559   sample. *Scandinavian journal of psychology* 56:592-598.

560   Rong XL, and Shi T. 2001. Inequality in Chinese education. *Journal of Contemporary China* 10:107-124.

561   Ross R, Zeller R, Srisaeng P, Yimmee S, Somchid S, and Sawatphanit W. 2005. Depression, stress, emotional support,
562   and self-esteem among baccalaureate nursing students in Thailand. *International Journal of Nursing*

563   *Education Scholarship* 2:Article25.

564   Salamonson Y, and Andrew S. 2006. Academic performance in nursing students: influence of part-time
565   employment, age and ethnicity. *Journal of advanced nursing* 55:342-349.

566   Sanz-Carrillo C, Garcıa-Campayo J, Rubio A, Santed M, and Montoro M. 2002. Validation of the Spanish version of
567   the Perceived Stress Questionnaire. *Journal of psychosomatic research* 52:167-172.

568   Saoji AA. 2016. Yoga: A strategy to cope up stress and enhance wellbeing among medical students. *North American*
569   *journal of medical sciences* 8:200.

570   Shearer RA, and Davidhizar RE. 1998. Recognizing a post-traumatic stress disorder in a nursing student. *Journal of*
571   *nursing education* 37:222-224.

572   Sheu S, Lin H-S, and Hwang S-L. 2002. Perceived stress and physio-psycho-social status of nursing students during
573   their initial period of clinical practice: the effect of coping behaviors. *International Journal of Nursing*
574   *Studies* 39:165-175.

575   Sidani S, Guruge S, Miranda J, Ford-Gilboe M, and Varcoe C. 2010. Cultural adaptation and translation of measures:
576   an integrated method. *Research in nursing & health* 33:133-143.

577   Wachirawat W, Hanucharurnkul S, Suriyawongpaisal P, Boonyapisit S, Levenstein S, Jearanaisilavong J, Atisook K,
578   Boontong T, and Theerabutr C. 2003. Stress, but not Helicobacter pylori, is associated with peptic ulcer
579   disease in a Thai population. *Journal of the Medical Association of Thailand= Chotmaihet thangphaet*
580   86:672-685.

581   Waqas A, Khan S, Sharif W, Khalid U, and Ali A. 2015. Association of academic stress with sleeping difficulties in
582   medical students of a Pakistani medical school: a cross sectional survey. *PeerJ* 3:e840.

583   Watson R, Gardiner E, Hogston R, Gibson H, Stimpson A, Wrate R, and Deary I. 2009. A longitudinal study of stress
584   and psychological distress in nurses and nursing students. *Journal of Clinical Nursing* 18:270-278.

585   Well E, First F, it Out W, and Training CB. 2015. Warning over nursing students who resort to part-time jobs just to
586   get by. *Nursing Standard* 29:8.

587   Wen D-m. 2005. The impacts of Chinese higher education expansion on graduate employment: an empirical
588   analysis. *Journal of Higher Education* 26:25-30.

589   Wheaton B. 1987. Assessment of fit in overidentified models with latent variables. *Sociological Methods & Research*
590   16:118-154.

591   Wodka EL, and Barakat LP. 2007. An exploratory study of the relationship of family support and coping with
592   adjustment: Implications for college students with a chronic illness. *Journal of adolescence* 30:365-376.

593   Wu M-L. 2009. *Structural Equation Model: the operation and application of AMOS*: Chongqing University Press.

594   Wu M-L. 2010. *Statistical analysis of the questionnaire: SPSS operation and Application*. Chongqing: Chongqing
595   University Press.

596   Yamada Y, Mizuno M, Ebara T, and Hirosawa M. 2011. Merits and demerits of engaging in athletic, academic and
597   part-time job roles among university student-athletes in Japan. *Journal of human ergology* 40:141-150.

598   Yearwood E, and Riley JB. 2010. Curriculum infusion to promote nursing student well-being. *Journal of advanced*
599   *nursing* 66:1356-1364.

600   Yun S-W, and Kim K-S. 2012. The Influence of University Students' Locus of Control on Stress towards Employment.
601   *Journal of the Korea Academia-Industrial cooperation Society* 13:606-614.

Figure 1

Flow chart of introducing the C-PSQ.

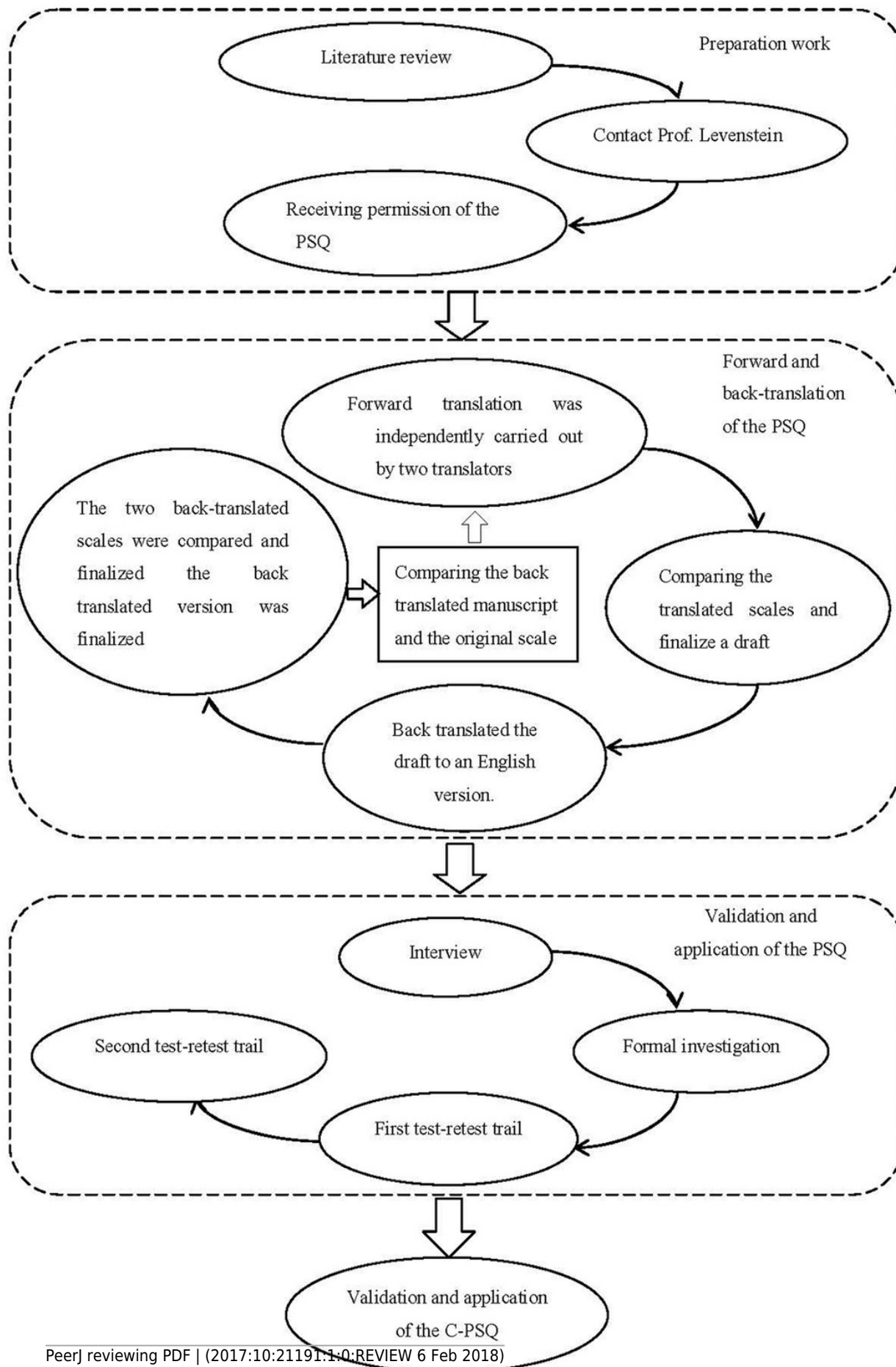



Figure 2

Confirmatory factor analysis the modified model model (n=1453).

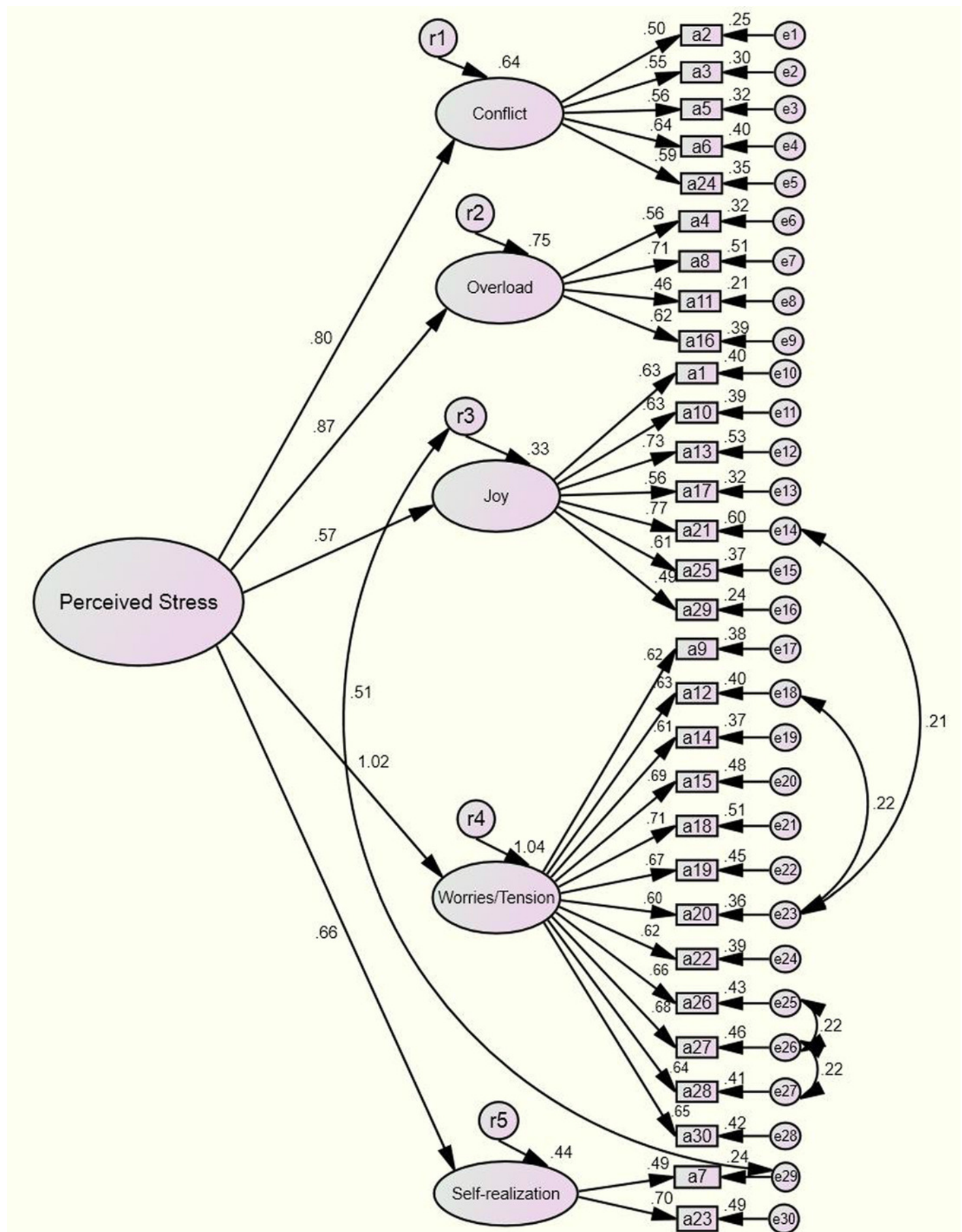



Figure 3

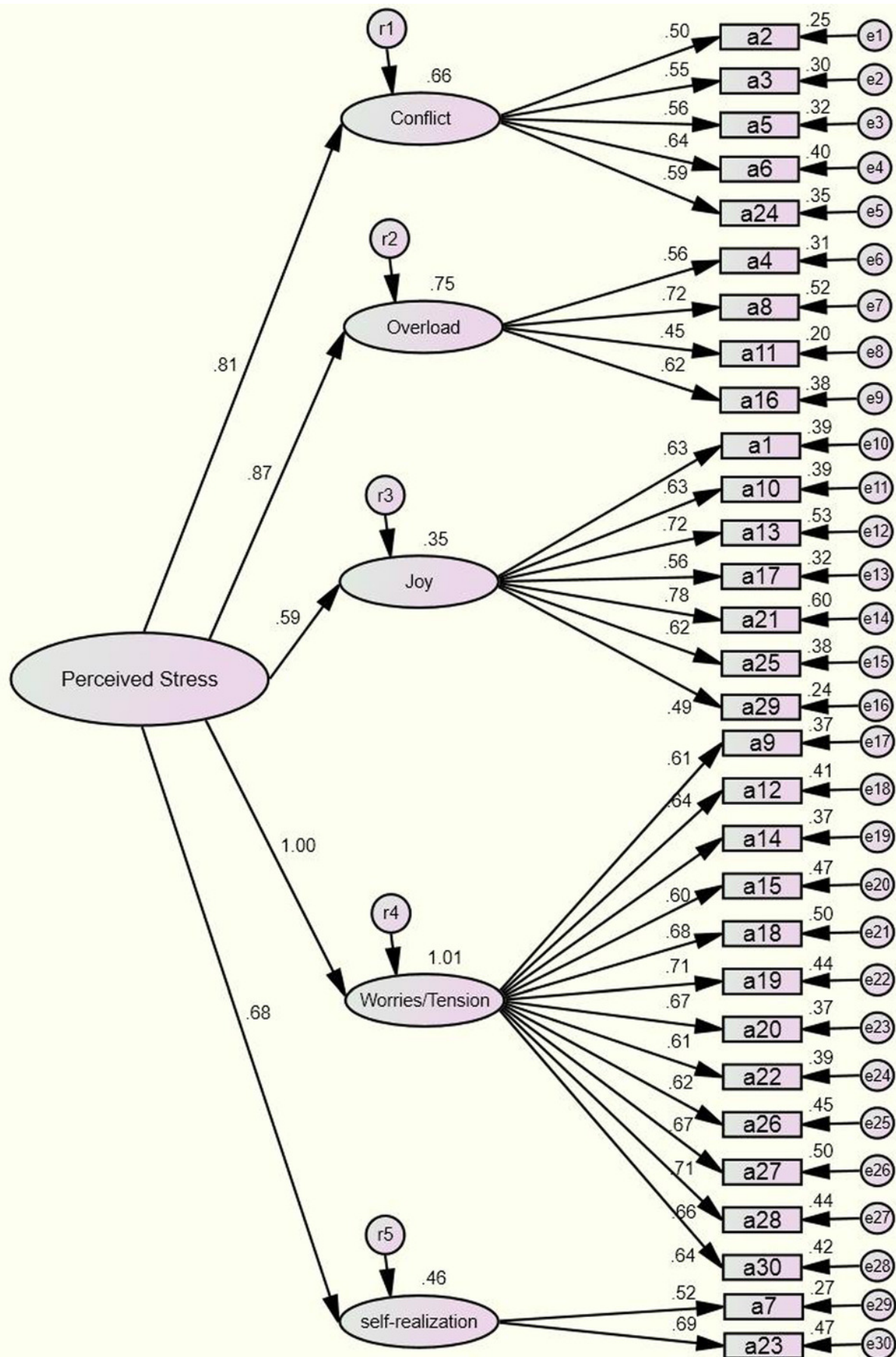
Confirmatory factor analysis the uncorrelated base model (n=1453).

Nursing students' demographic data (N=1453).

Table 1 Nursing students' demographic data (N=1453).

	n (%)
Sex	
Male	20(1.38)
Female	1433(98.62)
Age	
17	8(0.55)
18	239(16.45)
19	457(31.45)
20	469(32.28)
21	209(14.38)
22	69(4.75)
23	2(0.14)
Home location	
City	194(13.35)
Town	869(59.81)
Village	390(26.84)
Single-child status	
Yes	473(32.55)
No	980(67.45)
Admission year	
2015	603(41.50)
2014	566(38.95)
2013	284(19.55)
Clinical practice status	
Yes	653(44.94)
No	800(55.06)

Communalities and rotated component matrix.

Table 2 Communalities and rotated component matrix.

	Communalities	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
			Component			
a20	.554	.645	.199	-.010	.307	.062
a22	.532	.634	.130	.068	.190	.268
a28	.558	.620	.249	.244	.198	-.109
a12	.551	.611	.187	.050	.317	.198
a27	.571	.602	.281	.346	.093	-.005
a19	.522	.593	.120	.371	.136	.020
a14	.427	.551	.131	.302	.087	.083
a18	.543	.543	.217	.399	.122	.160
a30	.533	.531	.094	.440	-.007	.218
a26	.515	.531	.283	.373	.030	.115
a15	.527	.456	.176	.398	.193	.305
a9	.439	.420	.135	.382	.138	.283
a21	.654	.233	.756	-.043	.142	.080
a13	.583	.189	.702	.009	.092	.215
a25	.485	.201	.647	.151	-.049	.012
a10	.480	.135	.647	.093	.173	.071
a1	.459	.124	.635	.117	.069	.150
a29	.513	.071	.628	.230	-.018	-.245
a17	.419	.108	.615	-.033	.137	.095
a4	.572	.064	.094	.729	.149	.070
a11	.427	.238	-.115	.592	.063	-.052
a8	.564	.279	.295	.563	.144	.248
a16	.433	.345	.067	.538	.104	.099
a5	.554	.276	.113	.010	.682	.007
a3	.502	.088	.144	.342	.571	.175
a2	.524	.095	.115	.402	.565	-.146
a6	.520	.294	.090	.162	.541	.327
a24	.520	.489	.089	-.018	.522	-.033
a23	.553	.267	.114	.222	.030	.647
a7	.608	.051	.523	.001	.079	.571

Note.

"a" represent item.

Comparison of factorial structure among different versions of the PSQ.

Original version	Spanish version	German version	Greece Version	Swedish version	Chinese version
Harrassment (2, 6, 19, 24)	Harrassment- social acceptance (5, 6, 12, 17, 19, 20, 24)	-	Harrassment (6, 19, 24)	Conflict (6, 20, 24)	Conflict (2, 3, 5, 6, 24)
Overload (4, 11, 28, 29)	Overload (2, 4, 11, 18)	Demands (2, 4, 16, 29, 30)	Overload (2, 4, 11, 16, 18, 25, 28, 30)	Demand (2, 4, 11, 16, 29, 30)	Overload (4, 8, 11, 16)
Irritability (3, 10)	Irritability- tension- fatigue (1, 3, 8, 10, 14, 15, 16, 26, 27, 30)	-		-	-
Lack of joy (5, 7, 16, 17, 21, 23, 25)	Energy- joy (1, 13, 21, 25, 29)	Joy (7, 13, 17, 21, 25)	Joy (1, 7, 13, 17, 21, 29)	Lack of joy (10, 17, 21, 25)	Joy (1, 10, 13, 17, 21, 25, 29)
Fatigue (1, 8, 13, 15)	-	-	Tension– Fatigue (3, 5, 8, 10, 14, 26, 27)	Fatigue (1, 8, 13)	-
Worries (9, 18, 20, 22, 30)	Fear- anxiety (22, 28)	Worries (9, 12, 15, 18, 22)	Worries (9, 12, 15, 20, 22, 23)	Worries/tension	Worries/Tension
Tension (12, 14, 26, 27)	-	Tension (1, 10, 14, 26, 27)		(9, 14, 22, 27)	(9, 12, 14, 15, 18, 19, 20, 22, 26, 27, 28, 30)
-	Self- realisation- satisfaction (7, 9, 23)	-		-	Self- realization (7, 23)

Table 3 Comparison of factorial structure among different versions of the PSQ.

Note: C-PSQ (2017), the Greece version (2014) and the Spanish version (2002) keeps all the 30 items of the original version (1993) while the German version (2005) keeps 20 items and the Swedish version (2015) keeps 21 items of the original scale.

Convergence values for the C-PSQ hierarchical factors structure.

Table 4 Convergence values for the C-PSQ hierarchical factors structure.

	rg	Mean	SD	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Perceived Stress	0-1	0.399	0.138	0.913	0.735	0.678	0.715	0.563
Anxiety	0-9	4.503	2.441	0.499	0.396	0.347	0.386	0.268
Depression	0-9	3.577	2.343	0.549	0.435	0.343	0.390	0.316

Note. rg, range; SD, standard deviation; Anxiety and Depression from GADS; Convergence values are Spearman's R correlations; All P values are less than 0.01; Correlation is significant at the 0.01 level (2-tailed).

Evaluation of the goodness of fit of the confirmatory factor analysis.

Table 5 Evaluation of the goodness of fit of the confirmatory factor analysis.

Index	Test result$^\triangle$	Model fit judgement$^\triangle$	Test result$^\blacktriangle$	Model fit judgement$^\blacktriangle$	Standard and critical value
χ^2/df	4.376	No (Probably caused by the large sample)	5.668	No (Probably caused by the large sample)	<3
RMR	.023	Yes	.030	Yes	$<.05$
GFI	.921	Yes	.896	No	$>.9$
AGFI	.907	Yes	.879	No	$>.9$
CFI	.916	Yes	.882	No	$>.9$
RMSEA	.048	good fit	.057	reasonable	$<.05$ (good fit) $<.08$ (reasonable)
PNFI	.832	Yes	.791	Yes	$>.5$
PGFI	.782	Yes	.771	Yes	$>.5$
CN	342	Yes	287	Yes	>200
AIC/CAIC	.809	relatively small	.854	relatively large	relatively small

Notes:

χ^2/df, differences in chi-square by df (all $p <$ .001); RMR, root mean square residual; GFI, goodness-of-fit index; AGFI, adjusted goodness-of-fit index; CFI, comparative fit index; RMSEA, root mean square error of approximation; PNFI, parsimony-adjusted NFI; PGFI, parsimony goodness-of-fit index; CN, Critical N; AIC= Akaike information criterion; CAIC= consistent Akaike information criterion; $\triangle$ the modified model; $\blacktriangle$ the uncorrelated base model.

Description on different validity and reliability of the PSQ reported in original as well as different translated versions.

Table 6 Description on different validity and reliability of the PSQ reported in original as well as different translated versions.

		Original version	Spanish version	German version	Greece Version	Swedish version	Chinese version
Validity							
	Criterion validity	1. Trait Anxiety (STAI) (N=24): r=.69^G; r=.75^R 2. PSS(N=89): r=.56^G; r=.73^R 3. CES-D(N=24) : r=0.49^G; r=0.56^R 4.self-rated stress(N=52): r=.40^G; r=.56^R 5. Somatic comllaints (from Kellner's SQ) (N=73): r=.50^G; r=.58^R	1. Trait Anxiety (STAI) (N= 80): r=.65^G; r=.69^R 2. Depression (BDI) (N= 80): r=.46^G; r=.49^R 3. Psychological disturbance (GHQ-28) (N= 80): r=.51^G; r=.55^R 4. Somatic symptoms (SPPI somatic section) (N= 31): r=.62^G; r=.67^R	1. Quality of life (WHOQoL): r=-.58^G 2. Social support (F-SOZU): r=-.61^G 3. Higher perceived stress scores are associated with some of the relevant indicators of a supposed immunological imbalance(tryptase$^+$ mast cells (TMC$^+$), CD8$^+$ T-cells, and TNF-α$^+$ cells) in women who have had a miscarriage.	1. DASS-21 (N=451): r=.597^R 2. PSS(N=453): r=.737^R	1. BDI (N=1275): r=.354^G 2. State Anxiety (STAI) (N=1275): r=.400^G 3. Trait Anxiety (STAI) (N=1275): r=.539^G	1. GAS (N=1453): r=0.525^R 2. GDS (N=1453): r=0.567^R
	Content validity	null	null	null	0.2-0.5(inter—correlations between the items)	null	0.913 (S-CVI/Ave)
	Construct validity	Seven factors	Six factors	Four factors	Five factors	Five factors	Five factors

		60%	58.01%	58%	54.28%	55.5%	52.136%
Reliability							
	Coefficient alpha	.90^G; .92^R	.90^G; .87^R	at least .85^G (reliability at least .80)	.90^R	.90^G	0.922^R
	Test-retest	.82^G 8.03±l.64 days, N=101	.80^G 13.12±2.05 days, N=176	null	.86^R one month, N=212	null	0.725^R one week, N=50

Note.

1. STAI = the State-Trait Anxiety Inventory, PSS = the Perceived Stress Scale, CES-D = the Center for Epidemiologic Studies Depression, BDI = the Beck Depression Inventory, GHQ-28 = the General Health Questionnaire-28 items, DASS-21 = the Depression Anxiety Stress Scale(a short version); GADS = GAS + GDS= the Goldberg Anxiety and Depression Scale;

2. G represents the General PSQ; R means the Recent PSQ.

Comparison of perceived stress in nursing students.

Table 7 Comparison of perceived stress in nursing students.

	n	Mean±SD	*t*/F	*P*
Initial educational degree			-9.749	0.000
Secondary school	319	0.334±0.123		
High school	1134	0.417±0.136		
Clinical practice			-8.823	0.000
Yes	653	0.364±0.127		
No	800	0.427±0.140		
Part time job			4.816	0.000
Yes	570	0.420±0.140		
No	883	0.385±0.135		
Frequency of going home			5.348	0.001
<1/2 month	311	0.380±0.130		
<1 month	465	0.390±0.139		
<1 season	305	0.410±0.134		
<1 semester	372	0.417±0.143		
Physical health			69.537	0.000
Very good	334	0.336±0.126		
Good	779	0.393±0.126		
Average	316	0.469±0.137		
Bad	24	0.551±0.156		
Mental health			134.761	0.000
Very good	391	0.324±0.124		
Good	737	0.394±0.118		
Average	300	0.489±0.128		
Bad	25	0.631±0.134		
Prospect of employment			45.702	0.000
Very good	106	0.325±0.139		
Good	683	0.373±0.127		
Average	608	0.431±0.136		
Bad	56	0.512±0.133		
Coping skill			48.516	0.000
Adjusting psychology	968	0.388±0.131		
Solving problems	369	0.390±0.138		
Escaping	116	0.516±0.138		

Note.

Secondary school and high school represent the educational degree before college degree. *t*/F, we chose "*t*" to compare the differences between the two groups; we used "F" to compare differences between more than two groups.