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Cross-cultural validation of the Student Nurse Stress Index Scale

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1 **Cross-cultural validation of the Student Nurse Stress Index Scale: A**
2 **descriptive survey targeting student nurses in China**

3 **Abstract**

4 **Background:** Currently, relatively little is known regarding the sources and levels of
5 stress experienced by nursing students in China. This is largely because there is no
6 reliable and valid, culturally appropriate measure of student nurse' stress. A
7 culturally acceptable, Chinese Version of the Student Nurse Stress Index Scale
8 (SNSI-CHI), with established reliability and validity, is needed to identify sources of
9 stress in Chinese nursing students.

10 **Methods:** This validation study used a cross-sectional descriptive survey design.
11 Stratified cluster random sampling was used to collect data from August 2017 to
12 January, 2018 from 1100 nursing students in Henan Province, China. A demographic
13 questionnaire, SNSI-CHI and Perceived Stress Scale (PSS-14) were administered.
14 Exploratory and confirmatory factor analysis was carried out on two randomly
15 selected samples (each N=538) from the overall return. The content, construct,
16 predictive and concurrent validity of the translated SNSI-CHI were examined.

17 **Results:** 1076 nursing students returned the survey (97.82% response rate). The
18 average total score of SNSI-CHI was 58.455 ± 13.903 . The internal consistency,
19 test-retest reliability and content validity of the SNSI-CHI was excellent with a
20 content validity index of 0.954. A four factor simple structure was revealed and
21 confirmed using exploratory (explaining 75% of the variance) and confirmatory factor
22 analysis ($\chi^2/df=1.347$, GFI=0.956, AGFI=0.945, RMR=0.032, RMSEA=0.025,
23 NFI=0.974, IFI=0.993, TLI=0.992, CFI=0.993). This structure, i.e. academic load,
24 clinical concerns, interface worries and personal problems compared well with the
25 original SNSI. The SNSI-CHI totals and subscales showed good concurrent and
26 predictive validity with the PSS-14 as comparator or criterion. A score of higher than
27 65 on the SNSI-CHI indicates high levels of perceived stress symptoms. Some 10.5%
28 of respondents experience high levels of stressful demand. Sensitivity and specificity
29 values of 71.7% and 75.1% respectively, demonstrated good predictive validity.

30 **Limitations:** This study sample was confined to the Henan Province, which may limit
31 its generalizability. A larger and more diverse sample is needed in the future research.

32 **Conclusions:** The SNSI-CHI is both reliable and valid and culturally appropriate for
33 use in China and its structure enables cross-cultural comparison.

34 **Keywords:** Nursing student, stress, reliability, validity, cross-cultural comparison

35 **1. Introduction**

36 Stress has been described as a negative emotional experience which occurs when
37 individuals perceive themselves to be subject to excessive demands, or demands with
38 which they cannot cope (Cox and Griffiths, 2010). Stress results from a dynamic
39 interaction between the person and their environment resulting in the potential for
40 both positive and negative reactions to perceptions of demand (Sinha et al., 2016).
41 Positive effect, or eustress, may improve energy and alertness levels (Selye, 1965),
42 whereas negative affect or distress, is more likely to result in more problematic
43 physical (headache, fatigue, etc.), psychological (anxiety, anger, etc) and behavioral
44 consequences for the person (such as smoking, drinking, etc.) (Song and Lindquist,
45 2015).

46 Many students experience high levels of stress at the onset of their university
47 education due to the many wide-ranging challenges they face when adapting to the
48 demands in this new environment (Ranjbar, 2016). This is especially true in nursing
49 students. The volume, extent and complexity of the required theoretical knowledge
50 combined with worries regarding difficulty of homework and exams, fear of failure,
51 peer competition, and developing sufficient competence in both academic study and
52 nursing skills are all key demands that create stress and concern for the students
53 (Alzayyat and Al-Gamal, 2014).

54 Nursing is an applied science which requires the nursing student to integrate
55 theory and practice, i.e. to assimilate wide-ranging theory and apply this critical
56 understanding in their practice. Student nurses experience considerable academic
57 demand combined with real clinical concerns regarding the well-being of their
58 patients as they develop their practical skills (Sarikoc et al., 2017). Nursing students

59 often experience high levels of stress during their first clinical experiences, as they
60 realize that they are responsible for the safety of their patients. Perhaps as a result,
61 they worry about making mistakes, and often report feelings of distress, despite the
62 support from their academic and clinical supervisors (Sarikoc et al., 2017).

63 Developing relationships with patients, their relatives, clinical instructors, other
64 healthcare professions are essential elements of the student nurses' emergent role set
65 and are also perceived as a source of demand. Student nurses report that concerns
66 regarding insufficient professional training and a lack of practical knowledge, leads
67 them to feel vulnerable and unprepared (Sercekus and Baskale, 2016). The lack of
68 free time and reduced opportunity for entertainment or engaging with family members
69 may also cause stress in student nurses (Pulido-Martos et al., 2012).

70 The sources of stress facing student nurses have been categorised in several
71 different, yet complementary ways. The 43-item Beck and Srivastava Stress Inventory
72 (BSSI) scale identifies that the sources of stress of nursing students include academic
73 stress, death of patients; lack of understanding, college-home interface, and course
74 organization and resources (Beck and Srivastava, 1991). Deary and his collaborators
75 (2003) identify four broad concerns including: clinical, confidence, education and
76 finance, moreover, they developed a 43-item scale to evaluate the stressors faced by
77 nursing students (the Stressors in Nursing Students Scale, SINS). Costa and Polak
78 (2009) suggest that six factors or categories capture the stressors facing student nurses:
79 environment, performance of practical activities, professional communication, time
80 management, professional education, and theoretical activity. They developed a
81 30-item Instrument for Assessing Stress among Nursing Students (ASNS). Gibbons
82 (2009) classified stress factors into three areas: learning and teaching;
83 placement-related and course organization, with a 29-item questionnaire Index of
84 Sources of Stress in Nursing Students (ISSN).

85 However, while a number of questionnaires to measure stress exist, many of the
86 scales used to assess the sources of stress faced nursing students have not been
87 developed and evaluated with sufficient psychometric rigor (Jones and Johnston 1999;
88 Pulido-Martos et al., 2012). The Student Nurse Stress Index Scale (SNSI) (Jones and

89 Johnston) is a 22-item self-reported instrument designed to measure the sources and
90 levels of stress in students nurses, with a stable, simple structure, with clear content,
91 and excellent reliability and validity established in several international settings. For
92 example, in United Kingdom (Jones and Johnston, 1999), scale reliabilities indicated
93 by Cronbach's α exceeded 0.70 for all four factors and construct validity was
94 acceptable with CFI=0.87 GFI=0.86. In America, an average Cronbach's α for the 4
95 factors of 0.89 (Baker, 2012) was reported. In Turkey, a content validity index of 0.97
96 was reported, along with excellent construct validity CFI=0.94, GFI=0.89 (Sarikoc et
97 al., 2017). Accordingly, student nurse stress has a robust, repeatable four factor
98 structure including academic load, clinical concerns, interface worries and personal
99 problems. This structure aligns well with findings from a recent systematic review
100 which provides a critical analysis of the field and concludes that three broad areas of
101 stressors face student nurses i.e. academic stressors, clinical stressors and
102 personal/social stressors (Pulido-Martos et al., 2012).

103 Currently, Perceived Stress Scale (PSS-14) is designed for use in the general
104 adult population to measure stress outcomes and is widely used in China following its
105 translation and validation (Guo et al., 2018). This measure is a culturally appropriate,
106 reliable and valid measure of stress outcome (emotion, sense of control) against which
107 it is possible to validate a Chinese version of the SNSI.

108 Currently, there is no generally accepted, culturally appropriate scale to
109 accurately measure the sources of stress experienced by the nursing students in China.
110 Therefore, it is important to identify such a tool and demonstrate its reliability and
111 validity and to enable cross-cultural comparison (Mirzaei et al., 2012) to accurately
112 assess the stressors facing nursing students in China. Thus, this study aims to translate
113 and adapt the SNSI scale into the Chinese context and to verify its validation for the
114 future usage in Chinese nursing students.

115 **2. Aim and Objective**

116 The aims of this study were 1) to test the reliability of SNSI-CHI including
117 internal consistency, item-to-total correlation, inter-item correlation and intra-class

118 correlation; 2) to verify its content validity and construct validity; 3) and then assess
119 concurrent validity and predictive validity from comparing the use Perceived Stress
120 Scale (PSS-14) among Chinese nursing students.

121 **3. Methods**

122 **3.1. Design and Setting**

123 This cross-sectional descriptive validation study was conducted from August
124 2017 to January 2018, in Henan Province, which is located in the central part of
125 People's Republic of China. There are five medical colleges or universities each of
126 which have Schools of Nursing and which offer a four-year bachelor degree nursing
127 program. A total of 2500 nursing graduates emerge every year. In China and also in
128 Henan, the nursing Bachelor degree is taught over four years. The curriculum
129 comprises School-based nursing theory and research methodology, alongside hospital
130 placements and direct patient interactions. For the first three years, students undertake
131 clinical practice for a month in every summer and winter vacation, ahead of an
132 extended period of clinical practice in the full last year. Entry is highly competitive,
133 and requires high grades in the standardised National College Entrance Examination
134 (NCEE). Fewer than 10% of candidates can achieve the lowest admission score for
135 Schools of Nursing with baccalaureate program.

136 **3.2. Participates Inclusion**

137 Inclusion criteria included: (1) Participant were ≥ 18 years old; (2) currently
138 enrolled in a baccalaureate science of nursing program; (3) literate; (4) had
139 experienced clinical practice time ≥ 1 month and (5) provided consent to participate.
140 Exclusion criteria included students who were absent during the survey period.

141 **3.3. Instruments**

142 The questionnaire captured three parts: demographic variables, the SNSI-CHI
143 and Perceived Stress Scale (PSS-14).

144 Demographic variables: included contact information, homeplace, household
145 income, number of sibling, age, gender, height, weight, body mass index (BMI), grade,
146 student leaders status, marital status, amount of sleep on average per night, physical

147 health condition, and total clinical practice time. Biological, psychological and
148 sociocultural factors were measured as they are likely to be correlated with stress (Sun
149 et al., 2016; McCarthy et al., 2018; Smith et al.,2017). BMI may also closely relate to
150 stress, as an individual may lose appetite, or overeat following exposure to stressors
151 Lu et al., 2016).

152 The Student Nurse Stress Index Scale (SNSI) (Jones and Johnston, 1999) was
153 developed to provide a robust measure of nursing student stress with excellent
154 reliability and validity. It consists of 22 items clustered into four factors: academic
155 load (items 1, 2, 3, 8, 14, 18, and 20), clinical concerns (items 13,14,16,17,18,19,20),
156 interface worries (items 4, 5, 6, 7, 15, 21, and 22) and personal problems (items 9, 10,
157 11, and 12). SNSI uses a five-point Likert scale ranging from 1 (not stressful) to 5
158 (extremely stressful). The total score ranges from 22 to 110, and the higher scores
159 demonstrate a higher level of perceived demand or sources of stress.

160 The Perceived Stress Scale (PSS-14) investigates stress as an outcome and the
161 extent to which respondents perceived that their stress is unpredictable, uncontrollable
162 and overwhelming (Liu et al., 2017). The PSS-14 showed an excellent reliability and
163 validity in China (Yang and Huang, 2003). This measure comprises 14 items and two
164 subscales: Sense of being out of control (item 4, 5, 6, 7, 9, 10 and 13) and Feeling of
165 tension (item 1, 2, 3, 8, 11, 12 and 14). The PSS-14 uses a five-point Likert scale.
166 Each item is scored from 0 (strongly disagree) to 4 (strongly agree) and summed. The
167 total score varies from 0 to 56, and higher scores indicate a higher level of stress as an
168 outcome.

169 **3.4. Cross-culture Adaption**

170 Culture is defined as learned, shared and transmitted knowledge of values,
171 beliefs, norms and lifeways of a particular group that guides an individual or group in
172 their thinking, decisions, and actions in patterned way (Leininger, 1988). It is
173 recognized that if questionnaires are to be used across cultures, the items must not
174 only be translated well linguistically, but also must be adapted culturally to maintain
175 the content validity of the instrument at a conceptual level across different cultures
176 (Beaton et al., 2000).

177 The original English version of SNSI is authorized and provided by its original
178 author via an email, and some translation steps were undertaken according to Brislin's
179 translation guidelines (Brislin, 1970) and cross-cultural adaption guidelines (Beaton et
180 al., 2000; Wild et al., 2005). Moreover, the original author participated in the whole
181 process and gave guidance throughout the study.

182 In the first step the SNSI was translated from English into Chinese by a
183 professional, bilingual translator. An independent translator then performed a back
184 translation. In the next step, any discrepancies between the original and back
185 translation of the SNSI was explored by a panel of bilingual people which included
186 three nursing and two psychology experts. In this way the cultural and linguistic
187 equivalence of the equivalence of each item was confirmed. For example, the direct
188 translation of some words "entertainment" and "feedback" were modified into
189 culturally adapted words such as "rest or relax" and "attention, recognition and
190 feedback", respectively. In the third step, the translated SNSI, the SNSI-CHI, was
191 piloted for acceptability with 10 nursing students. Amendments to the wording of
192 items were made according the participant's comments. A consensus was sought and
193 achieved amongst participants that the SNSI-CHI had clear wording, clarity and
194 excellent cultural equivalence.

195 Henan's culture is similar to China's culture in almost all aspects, also the
196 translators were from different parts of China. Hence, the translation is likely to be
197 acceptable across China.

198 **3.5. Ethics**

199 The Ethical Review Board of Zhengzhou University, Zhengzhou, Henan, China,
200 approved this study. All participants received participant information details at the
201 beginning of the interview. All participants indicated their informed consent to
202 participate in writing (Declaration of Helsinki, 2013).

203 **3.6. Data collection**

204 A stratified cluster random sampling of nursing students were recruited from
205 Schools of Nursing in medical colleges or universities in Henan Province from August
206 2017 to January, 2018.

207 Two medical colleges or universities were randomly selected from five in Henan
208 Province, and were then stratified them into four layers according to grade (Freshman,
209 sophomore, junior and senior); then six classes were randomly selected in each layer.
210 Survey stations were established in the classrooms in School of Nursing and the
211 nursing students were invited to approach.

212 Four investigators received training in the administration of the questionnaires
213 and a preliminary pilot was carried out with 60 nursing students. This identified
214 possible problems in the investigators understanding of particular SNSI-CHI items
215 and the questionnaire was revised where necessary. A one-to-one, face-to-face data
216 collection method was then used in this study. The questionnaire used was completed
217 or answered voluntarily by the participants in the classroom settings. Data collection
218 was both private and anonymous.

219 The targeted sample was 1100 nursing students, and 1076 of them completed the
220 survey, providing a complete response rate 97.82%. The study sample exceeded key
221 psychometric criteria of 20:1 subjects to number of scale items ratio (Pedhazur, 1997)
222 and exceeded the specification of $N > 1,000$ as "excellent" (Comfrey and Lee, 1992).
223 Our targeted sample met the general rule in psychometric research that a large sample
224 is essential (Osborne and Costello, 2004).

225 **3.7. Data analyses**

226 Data analysis and management used SPSS (version 21.0; IBM Corp, Armonk,
227 NY, USA) and AMOS (version 22.0; SPSS Inc., Chicago, USA). This adhered to the
228 COSMIN (COnsensus-based Standards for the selection of health Measurement
229 INstruments) guideline (Mokkink et al., 2016; Mokkink et al., 2010).

230 The internal consistency of the SNSI-CHI was estimated using Cronbach's α .
231 Item-to-total and inter-item correlations were calculated using Pearson's correlation
232 coefficients. Stability was estimated by test-retest correlation coefficient (intra-class
233 correlation coefficient, ICC).

234 The content validity of the SNSI-CHI was calculated using item level content
235 validity index (I-CVI) and scale level content validity index (S-CVI). The S-CVI
236 includes S-CVI/UA (universal agreement), the proportion of items on a scale that

237 received relevancy ratings of 3 or 4 by all the experts, and S-CVI/Ave (average), i.e.
238 the average of the I-CVIs for all items on the scale (Polit and Beck, 2006). A panel of
239 clinical and theoretical experts scored each item of the SNSI-CHI. Two head nurses,
240 two nursing professors and two expert clinical practitioners rated each item as either:
241 1=not relevant; 2=somewhat relevant; 3=quite relevant; and 4=highly relevant. The
242 "quite relevant" and "highly relevant" were given a score of one, all other ratings
243 received a score of zero. The construct validity of the SNSI-CHI was established
244 using Exploratory (EFA) and confirmatory factor analysis (CFA). The total sample
245 was split randomly into two groups. An initial EFA was conducted with one group of
246 538 participants. The CFA was then undertaken on data from the independent second
247 group of 538 participants. Concurrent validity of the SNSI-CHI was explored using
248 Pearson correlation coefficients and the PSS-14.

249 The predictive validity of the SNSI-CHI was estimated using Receiver operator
250 characteristic (ROC) curves, measures of sensitivity and specificity, and the Youden's
251 index. The PSS-14 as criterion allowed classification of participants into those with
252 high ($PSS-14 \geq 27$) and low stress ($PSS-14 < 27$) symptoms (Chen et al., 2015).
253 $P < 0.05$ was defined as statistically significant.

254 **4. Results**

255 **4.1. The sample**

256 Of the 1076 nursing students, 795(73.9%) were from rural and 281(26.1%) urban
257 areas; 80(7.4%) were male and 996 (92.6%) were female. Age ranged from 18 to 25,
258 with a mean value of 21.16 ± 1.24 years. (See **Table 1**).

259 **4.2. Reliability**

260 The total Cronbach's α of the SNSI-CHI was 0.886, each factor was 0.885, 0.887,
261 0.892 and 0.874, respectively. The deletion of two items (item 7 and 20) would
262 improve the overall Cronbach's α for the overall measure (**Table 2**). The item-to-total
263 correlations ranged between $r = 0.351$ and $r = 0.664$, with an average correlation of
264 $r = 0.569$ (**Table 2**). The inter-item correlations ranged from $r = 0.120$ to $r = 0.669$ and
265 the test-retest ICC of SNSI-CHI was 0.996 (95% CI, 0.992-1.00, $P < 0.001$). The

266 Cronbach's α of PSS-14 was 0.719.

267 **4.3. Validity**

268 **4.3.1. Content validity**

269 The S-CVI/UA and S-CVI/Ave provided values of 0.954 and 0.727, respectively.
270 Six experts assessed the content validity of the items of the SNSI-CHI by rating the
271 I-CVIs of each item. This ranged from 0.833-1.000.

272 **4.3.2. Construct validity**

273 In the EFA the Kaiser-Meyer-Olkin (KMO) was 0.963, and Bartlett's Test of
274 Sphericity was 10389.365 and statistically significant ($P < 0.01$). Principal
275 components analysis extracted four factors with eigenvalues >1.00 which explained
276 75.013% of the total variance. The factor loadings and communality values can be
277 seen in **Table 3**. In the CFA the fit indices for this four factor structural equation
278 model of the SNSI-CHI were CMIN/DF = 1.404, GFI= 0.954, AGFI = 0.943, CFI =
279 0.992, TLI = 0.991, RMSEA = 0.027, RMR =0.032, respectively. Four factors and
280 items distribution were as following: academic load (item 1, 2, 3, 8, and 20), clinical
281 concerns (item 13, 14, 16, 17, 18, 19), interface worries (item 4, 5, 6, 7, 15, 21, and 22)
282 and personal problems (item 9, 10, 11, and 12). **Figure 1** shown the structural
283 equation model and the standardized regression coefficients of four-factor model of
284 SNSI-CHI.

285 **4.4. Concurrent validity**

286 The total scores of the SNSI-CHI and PSS-14 were positively correlated ($r =$
287 0.493, $P < 0.01$), and the correlations of the SNSI-CHI subscales with the subscales of
288 the PSS-14 ranged from $r = 0.330$ to $r = 0.844$. Sense of being out of control had the
289 weakest positive correlation with the SNSI-CHI subscale Personal problems ($r = 0.330$,
290 $P < 0.01$), and had the strongest positive correlation with the PSS-14 ($r = 0.844$, $P <$
291 0.01), than other correlations. (See **Table 4**).

292 **4.5. Predictive validity**

293 With PSS-14 as criterion, the optimal cut-point for the area under the receiver
294 operator characteristic (ROC) curve of SNSI-CHI was 0.773 (95% CI: 0.727-0.820, P
295 < 0.005), **Fig. 2**. The optimal cut-point was 65, and sensitivity and the specificity

296 were 71.7% and 75.1%, respectively. In other words, a total score ≥ 65 of SNSI-CHI
297 indicated a high level of perceived stress symptoms; whereas the total score < 65 of
298 SNSI-CHI indicated a lower level perceived stress symptoms, The $PPV = a / (a + c)$
299 $= 82.8\%$, $NPV = d / (b + d) = 96.7\%$.

300 **4.6. Descriptive analysis of SNSI-CHI**

301 Scores on the SNSI-CHI ranged from 22 to 110 with a mean for all items was
302 58.455 ± 13.903 . The item "not having enough time for family" (2.982 ± 1.160) had
303 the highest mean score, followed by "peer competition" (2.892 ± 1.012), "fear of
304 failing in course" (2.853 ± 1.056), and "examination and/or grades" (2.852 ± 1.071).
305 "Relationships with parents" had the lowest mean score of 1.972 ± 0.990 . **See Table 2.**

306 **5. Discussion**

307 This study is the first to test the reliability and establish cross-cultural validity of
308 the SNSI in a sample of Chinese nursing students. The findings, which support the
309 reliability and validity of the Chinese version of the SNSI (SNSI-CHI) in this
310 population, are compared and contrasted with other translated versions of the SNSI
311 measure.

312 The SNSI-CHI shows better internal consistency (α of 0.886) than the Turkish
313 version (0.86) (Sarikoc et al., 2017) and American version in which all subscales apart
314 from the personal problems subscale just exceed 0.70 (Baker, 2012). The Cronbach's
315 α reported within all of the SNSI translation studies exceed the recommended
316 standard (≥ 0.70) ((Guo et al., 2017; Terwee et al., 2007).

317 In this study, deletion of SNSI items did not improve the scale total Cronbach's
318 alpha, with two exceptions. Deletion of items 7 and 20 lead to improved Cronbach's α
319 of 0.898 and 0.888, respectively. Item 7 "College/School response to student needs"
320 identifies that the relationship between the organisation and student need is a key
321 source of stress for students and this mitigates against its deletion. This suggests,
322 therefore, that senior academics administering nurse education in this setting need to
323 identify, be aware of and respond to student need. Student need is a basic condition
324 for maintaining human survival and development, and is a basic driving force of

325 individual psychological activities and behaviors (Perlovsky, 2016). The satisfaction
326 of individual need is thought to eliminate or relieve the anxiety and pain experienced,
327 reduce perceptions of pressure and maintain a good sense of self and comfort
328 (Orlando, 1987). Item 20 (not clear in their goals) captures perceptions about
329 self-realization and identifies that this is also a key source of stress for student nurses
330 in this setting, suggesting that this item should also be retained. A lack of
331 self-realization is a major concern for students which may subsequently lead to future
332 anxiety, stress and depression and other negative emotions Maslow (1987). Although
333 there were some limitations surrounding the reliability of items 7 and 20, they were
334 retained given their theoretical importance.

335 The inter-item correlations of SNSI-CHI ranged from 0.30 to 0.70, except for
336 items 7 and 11 ($r=0.120$), which measured "College/School response to student
337 needs" and "Relationships with parents". The item-to-total correlations ranged from
338 0.351 to 0.664 ($P<0.001$), with an average correlation of 0.569. The SNSI-CHI has
339 good internal consistency reliability (Guo et al., 2017; Sijtsma, 2009). The test-retest
340 ICC was 0.996 (95% CI, 0.992-1.00, $P<0.001$), which exceeds the recommended
341 criterion of 0.90 (Nunnally and Bernstein, 1994) indicating temporal stability.

342 In our study, the I-CVIs ranged between 0.833 and 1.000. The SNSI-CHI
343 showed good content validity, the S-CVI/UA and S-CVI/Ave was 0.818 and 0.700
344 respectively. Indicators of good content validity include I-CVI ≥ 0.80 , an S-CVI/UA \geq
345 0.40, and an S-CVI/Ave ≥ 0.90 (Polit and Beck, 2006).

346 Construct validity was tested by EFA and CFA. The EFA revealed four factors
347 accounting for 75.013% of the total variance, with all factor loadings of 22 items of
348 SNSI-CHI exceeding 0.30 (Gao et al., 2015). The factor structure and amount of the
349 accumulated variance found for the SNSI-CHI in this study was similar to the original
350 study (Jones and Johnston, 1999) and other previous three studies (Sarikoc et al., 2017;
351 Shukla et al., 2013; Baker, 2012). However, item 14 (too much responsibility), item
352 18 (Atmosphere created by teaching staff) and item 20 (I am not sure what is expected
353 of me) loaded on both factor 1 (academic load) and factor 2 (clinical concerns)
354 simultaneously, in the study of the original author (Jones and Johnston, 1999). In this

355 study, item 20 only belongs to the factor 1, while item 14 and item 18 only belong to
356 factor 2.

357 SNSI-CHI has a simple structure, probably as a result of the excellent sample
358 size. In addition, this finding maybe influenced by traditional Chinese culture and the
359 form of nurse education in this setting. The protection of patient well-being is
360 perhaps the most pressing or more pertinent demand facing student nurses in hospital
361 and thus the “self-perceived responsibility of taking care of the patients” was reported
362 as a most concerning issue in the clinical setting by the nursing students of this study
363 (item 14). The clinical teaching experience by student nurses is usually one-to-one
364 in this context, and the learning atmosphere created by teachers may have more
365 immediate influence on students than teachers in the School of Nursing (asked by
366 item 18) (Schmidt and Mamede, 2015; Zhou et al., 2016). A focus on achieving high
367 test scores may be greater within the Universities of China (item 20), compared to
368 Western culture (item 20) a broader assessment of attainment results in test scores
369 being ranked as a comparatively less concerning source of stress (Khalaila, 2015).
370 CFA was used to further verify the construct validity of the SNSI-CHI in the
371 randomly selected independent sample and the results confirmed that the factor
372 loadings and explained variances were strong and consistent with the EFA, with the
373 four-factor structure associated with good model fit indexes.

374 Pearson's correlations between the total SNSI-CHI and PSS-14 scores and
375 individual SNSI-CHI items with PSS-14 subscales were consistently strong and in the
376 expected direction indicating good concurrent validity (Sousa et al., 2010) as seen
377 previously. Significant correlations in the expected directions have been reported for
378 the original English language-version of SNSI with Marlowe-Crowne Social
379 Desirability Index (MC-SDS) in the Cohort 1/2 data set (Academic load, $r=-0.23$, $P<$
380 0.0005 ; Clinical concerns, $r=-0.31$, $P<0.0005$; Interface worries, $r=-0.23$, $P=0.001$;
381 Personal problems, $r=-0.28$, $P<0.0005$; SNSI total, $r=-0.34$, $P<0.0005$), and the
382 General Health Questionnaire (30-item version, GHQ-30) in 1993/94 data set all
383 correlations exceeded 0.26 , $P=0.001$ (Jones and Johnston,1999).

384 The area under the ROC curve of SNSI-CHI was 0.773 in this study which

385 compares well with benchmark range between 0.5 and 1.0, with ≥ 0.7 indicating a
386 good screening effect (Guo et al., 2017). The cut-off point of the Chinese version of
387 the SNSI was 65, suggesting that the nursing students whose score was ≥ 65 perceived
388 a high level of perceived stress symptoms. Approximately one in ten
389 (114/1076=10.59%) of respondents experience high levels of stressful demand. This
390 study is the first to identify the cut-off point (the value that distinguishes student
391 response as negative or positive) of SNSI-CHI, however, additional follow-up studies
392 are required to further confirm this.

393 In this study, the mean score of all items of SNSI-CHI was 58.455, which
394 exceeded both Jones and Johnston' study in the United Kingdom (45.75) (Jones and
395 Johnston,1999) and Baker' study in America (not more than 25) (Baker, 2012). In
396 addition, more than one-tenth of nursing students experienced high levels of stressful
397 demand. One reason for this could be that Chinese students may enter the course
398 having already been placed under duress by the NCEE to gain admission to the
399 Bachelor degree nursing program. Following entry, students then encounter a new,
400 heavily medical or life sciences-based curriculum, combined with a nursing clinical
401 workload, while also having to navigate new social networks (You et al., 2015). In
402 addition, nursing students face competition for employment, combined with the
403 relatively lower social position of nursing in the inland area of China. This is
404 especially true in Henan province which has a large population and a relatively poor
405 state of social and economic development. Student nurses may also suffer a lack of
406 professional identity and experience role stress, particularly as they are initially
407 socialized into the nursing profession (Sun et al., 2016). As such, they may be more
408 vulnerable and susceptible to negative emotion (i.e. stress, anxiety and depression)
409 (You et al., 2015; Smith and Yang, 2017).

410 Ranking the score of each item from high to low identified the four most
411 stressful items to be item 22 (not having enough time for family), item 4 (peer
412 competition), item 8 (fear of failing in course), item 3 (examination and/or grades).
413 Item 11 (relationships with parents) had the lowest mean score. The most demanding
414 stressors experienced by nursing students in this setting are mainly due to a lack of

415 free time, peer pressure and fears surrounding exam failure, which is consistent with
416 findings from a previous study (Song and Lindquist, 2015). "Relationships with
417 parents" was a less acute source of stress for nursing students than other aspects
418 possibly reflecting Chinese historical origins, living habits, values, customs and
419 culture (Luk et al., 2017).

420 In summary, the SNSI-CHI is a short, reliable, and valid instrument that is
421 appropriate for use with Chinese nursing students. The SNSI-CHI has few items,
422 simple content and structure and is acceptable to students. It is easy to administer and
423 can be useful for early detection of stress symptoms for Chinese nursing students. The
424 study presented here has some limitations. For example, the study sample was
425 confined to the Henan Province, which may limit its generalizability. A larger and
426 more diverse sample would strengthen any future research. This study only assessed
427 the negative influence of stress on nursing students, but did not evaluate the positive
428 effects that pressure and challenges may have people. Sources of eustress related to
429 enhanced performance, the achievement of clinical academic goals and positive
430 well-being have still to be developed.

431 **6. Conclusion**

432 This study is the first to examine the cross-cultural validity of the Student Nurse
433 Stress Index Scale in this setting. The study is explored the psychometric properties of
434 a Chinese version of the SNSI in the population of Chinese student nurses and has
435 demonstrated excellent reliability and validity of the measure.

436 **7. Relevance to clinical practice**

437 Although further research is needed to further confirm the measure's reliability
438 and validity for nursing students stress in other settings in China, these findings show
439 great promise for the use of this measure in Chinese nursing students.

440 **8. Future Usage**

441 If other researchers want to use the Chinese Version of the Student Nurse Stress
442 Index Scale (SNSI-CHI), please don't hesitate to contact the author Lina Guo
443 ([Email:guolina09@126.com](mailto:guolina09@126.com)) to obtain the translated version freely.

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448 **Disclosure**

449 The authors stated that they have no conflicts of interest.

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