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Validation of the perceived stress scale (PSS-10) in medical and health sciences students in Hong Kong

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Abstract

Introduction: The demanding nature of medical and health sciences studies can cause stress among students in these disciplines affecting their wellbeing and academic performance. The Perceived Stress Scale (PSS-10) is a widely used measure of perceived stress among medical students and healthcare professionals that has not yet been validated among medical and health sciences students in Hong Kong. The aim of this study is to establish the construct validity and reliability of the PSS-10 in this context.

Methods: 267 final year medical and health sciences students were surveyed using the PSS-10. The data were analysed using exploratory factor analysis for construct validity and Cronbach's alpha coefficient and corrected item-total correlations for reliability.

Results: Exploratory factor analysis revealed a two-factor structure for PSS-10, with Cronbach's alpha of 0.865 and 0.796, indicating good internal consistency. Corrected item-total correlations showed satisfactory correlation ranged from 0.539 to 0.748 for all items and their respective subscale. Both tests supported PSS-10 as a two-factor scale.

Conclusion: The PSS-10 is a valid measure for assessing perceived stress in Hong Kong medical and health sciences students.

Keywords: Undergraduate Students, Medicine, Nursing, Pharmacy, Health Sciences, Validation, Perceived Stress

Practice Highlights

- It is important to have a valid instrument for early detection of stress in health science students.
- Perceived Stress Scale (PSS-10) has a two-factor structure, a finding that is consistent with most other studies.
- PSS-10 has satisfactory internal consistency and reliability.
- PSS-10 can be used to assess the level of stress in medical and health sciences students.

I. INTRODUCTION

Undertaking studies in healthcare disciplines can be stressful as the programmes are demanding and students are often competing with higher achieving peers from admission to graduation. Significant stress can lead to psychological distress that has negative implications on

current and future performance. Medical students have a higher prevalence of distress and poorer mental quality of life than their non-medical peers (Dyrbye et al., 2006; Shin et al., 2016), and also experience sleep deprivation, anxiety, and feelings of social isolation as revealed in focus group interviews conducted by Henning et al.

(2010). There may also be a negative impact in quality of patient care (Firth-Cozens, 2001) and higher rate of medical errors (West et al., 2009). High perceived stress level correlated to impaired clinical performances in nursing students, including application of knowledge, clinical skills and communication (Ye et al., 2018). High level of stress and impaired quality of life were also found in third year pharmacy students in the United States (Marshall et al., 2008). In a study on pre-medical and health sciences students, higher perceived stress was a predictor of poor academic achievement (Henning et al., 2018).

As in many Asian cultures, Hong Kong students in general are under pressure to perform well in school as education is viewed as a crucial stepping-stone to success (S. Chan, 1999; Tan & Yates, 2011). This pressure may be particularly pronounced in medical students who manifest a greater degree of psychological distress, including perceived stress, depressive symptoms and anxiety, than other university students (Wong et al., 2005). A survey on medical students from the University of Hong Kong also revealed that majority of medical students were screened positive for minor psychiatric disorders and up to 95% of them were burned out (Chau et al., 2019). Many students may be “pushed” into a career path by extrinsic factors such as parental expectation (Sreeramareddy et al., 2007) or as a part of family tradition. Asian medical students may also tend to focus on academic achievement and seek to outperform their peers (Henning et al., 2011). Given the risk for developing high level of stress for these students, and the particularly intense environment in Hong Kong, it is important to have a valid instrument for early detection of stress so that appropriate strategies may be instituted at an early stage.

The Perceived Stress Scale (PSS-10) (Cohen, 1988) is widely used to measure perceived stress among healthcare students and doctors in different countries (Jones et al., 2015; Wongpakaran & Wongpakaran, 2010), and healthcare workers in Hong Kong (Chua et al., 2004). Healthcare students and healthcare workers may respond differently to a stressful event, as shown in the studies by Chua et al. (2004) and Wong et al. (2004), where the psychological effects of the SARS outbreak were different for healthcare students and workers. PSS-10 has been translated and validated in various languages, including Spanish, Turkish, Portuguese, Chinese, Thai and Japanese, among different populations such as patients, students, pregnant women, and adults in the general population (Lee, 2012). These validation studies are fundamentally robust, yet validating the PSS-10 is important in the specific undergraduate medical and health professions educational context in Hong Kong.

Our study population is subject to different cultural, societal and educational influences that affect the perception of stress and the understanding of the items in the instrument so validation studies done elsewhere may not be applicable to our local context. The aim of this study is therefore, to establish the construct validity and reliability of the PSS-10 for use in this population.

II. METHODS

A. Participants and Data Collection

All final year students undertaking studies in Li Ka Shing Faculty of Medicine in the University of Hong Kong (HKUMed) in the academic year of 2014-2015 were the target population of this study. A research assistant, who was not involved in teaching and assessment of the students, invited the students to participate in the study during a designated compulsory face-to-face teaching session for each programme. Those who provided written consent completed a written questionnaire in January - February 2015 or June 2015. The specific time for each cohort was chosen to avoid known stressful periods such as exams. The questionnaire included the PSS-10 and demographic information.

B. Measure

The Perceived Stress Scale (PSS-10) (Cohen, 1988) was chosen as the instrument for measuring perceived stress. We considered other often-used instruments including the Depression Anxiety Stress Scale (DASS) (Lovibond & Lovibond, 1995) that measures depression and anxiety, in addition to stress and the General Health Questionnaire (GHQ) (Goldberg & Hillier, 1979) that measures medical complaints as a reflection of emotional stress, but these looked at broader conceptualisations of psychological distress beyond the scope of our study. PSS-10 was the most fit-for-purpose in measuring stress in terms of respondents' views about their lives. In addition, we wished to be able to compare the stress in medical and health professions students to other key local comparator populations (e.g. university students, doctors, general population etc) and using the same instrument would facilitate this comparison.

PSS-10 is a 10-item instrument that assesses the extent of stress of respondents. PSS-10 is the abbreviated version of the original instrument with 14 items (PSS-14). A brief version with four items (PSS-4) is also available. Among the three versions of PSS, PSS-10 was found to be superior in psychometric properties, in terms of validity and reliability, than the other two versions (Lee, 2012). In the PSS-10, respondents rate statements about how unpredictable, uncontrollable, and overloaded they find their lives on a 5-point Likert scale from “never” to “very often”. Each response is converted to a score of 0 to 4 with the overall PSS score computed as

the total score of the 10 items, with four reverse-coded items. The higher the score, the worse the perceived stress, with a maximum score of 40. There is no specific cut-off score that corresponds to high or low stress. We used the original English version of PSS-10 because as an English-medium university, students at HKUMed are taught in English (except during bedside teaching and clinical practicums) and students are proficient in English.

C. Data Analysis

To establish the construct validity of the PSS-10, exploratory factor analysis (EFA) was performed on the responses to PSS-10 items by final year medical students, using principal component extraction with varimax rotation and the criterion of eigenvalue greater than 1.00. The Kaiser-Meyer-Olkin (KMO) measure equal to or greater than 0.5 was used to indicate sampling adequacy, while the Barlett's Test of Sphericity with $p < 0.001$ was used to ensure the appropriateness of the

data set for EFA. Cumulative variance explained in the factor structure identified by EFA model was reported.

Cronbach's alpha coefficient and corrected item-total correlations were used to examine reliability. Cronbach's alpha coefficient was calculated to assess the internal consistency of each scale, which was considered acceptable if greater than 0.7 (Nunnally, 1994). Corrected item-total correlations were evaluated by Pearson's correlation coefficient. A correlation of more than 0.4 was considered satisfactory (Wolfenbarger & Gilly, 2003).

III. RESULTS

A total of 267 students completed the survey, with an overall response rate of 86.5%. 104 (39%) of the respondents were male (Table 1). Female students had significantly higher perceived stress than male students (20.84 vs 18.59; $p < 0.001$). Table 2 shows the descriptive statistics for PSS-10 items and total score by programme of study.

	All (n=267)	Average PSS-10
Age (mean)	22.71	19.95
Gender		
<i>Male</i>	104	18.59
<i>Female</i>	160	20.84
Programme of study		
<i>MBBS</i>	120	18.17
<i>BNurs</i>	94	21.20
<i>BChinMed</i>	13	21.77
<i>BPharm</i>	28	22.39
<i>BBMS</i>	10	20.20

MBBS: Bachelor of Medicine and Bachelor of Surgery; BNurs: Bachelor of Nursing; BChinMed: Bachelor of Chinese Medicine; BPharm: Bachelor of Pharmacy; BBMS: Bachelor of Biomedical Sciences
*Numbers may not add up to the total number of respondents due to missing data

Table 1. Demographic of respondents and average PSS-10 score

	All (n=265)	MBBS (n=120)	BNurs (n=94)	BChinMed (n=13)	BPharm (n=28)	BBMS (n=10)
<i>In the last month, how often have you...</i>						
1. been upset because of something that happened unexpectedly	2.10	1.83	2.27	2.62	2.39	2.30
2. felt that you were unable to control the important things in your life	2.05	1.79	2.19	2.31	2.46	2.40
3. felt nervous and "stressed"	2.19	1.87	2.39	2.31	2.64	2.60
4. felt confident about your ability to handle your personal problems	2.19	2.25	2.21	2.00	1.93	2.20
5. felt that things were going your way	2.11	2.21	2.07	2.00	1.93	1.90
6. found that you could not cope with all the things that you had to do	1.97	1.77	2.07	2.23	2.39	2.00
7. been able to control irritations in your life	2.19	2.25	2.12	2.15	2.14	2.40
8. felt that you were on top of things	1.79	2.00	1.66	1.46	1.46	1.90
9. been angered because of things that were outside of your control	1.94	1.81	2.19	1.85	1.82	1.60
10. felt difficulties were piling up so high that you could not overcome them	1.96	1.77	2.15	2.08	2.14	1.70
Total*	19.93	18.17	21.20	21.77	22.39	20.20

MBBS: Bachelor of Medicine and Bachelor of Surgery; BNurs: Bachelor of Nursing; BChinMed: Bachelor of Chinese Medicine; BPharm: Bachelor of Pharmacy; BBMS: Bachelor of Biomedical Sciences
*Total score is calculated by the sum of the 10 PSS items, with item 4, 5, 7 and 8 reverse coded.

Table 2. Mean score for PSS-10 items by programme of study

A. Exploratory Factor Analysis on PSS-10

Using the final year medical and health sciences student data for EFA (Table 3), the KMO measure for PSS-10 was 0.823, indicating sampling adequacy. The scale had a p-value of <0.001 for the Bartlett's Test of Sphericity, confirming variability in the data was sufficient. The factor loadings of varimax rotated solution and the eigenvalue of the two factors identified (Perceived Helplessness and Perceived Control) are shown in Table 3. The cumulative variances explained were 61.386%.

B. Reliability

Cronbach's alpha for the two factors were 0.865 and 0.796 respectively, which indicates good internal

consistency reliability (Table 4). To determine the robustness of the analysis, each item was deleted in turn from the calculation and the resulting Cronbach's alpha remained high (0.724-0.859). Corrected item-total correlations showed satisfactory correlation for all items and their respective subscale (range from 0.539 to 0.748) (Table 4). Items with the highest corrected item-total correlation were item 2 ("felt that you were unable to control the important things in your life"), item 3 ("felt nervous and 'stressed'"), and item 10 (felt difficulties were piling up so high that you could not overcome them). Both tests supported the PSS-10 as a two-factor scale.

		Factor loading	
		Perceived helplessness	Perceived control
In the last month, how often have you...			
2.	felt that you were unable to control the important things in your life	0.826	-0.168
1.	been upset because of something that happened unexpectedly	0.793	0.021
3.	felt nervous and "stressed"	0.793	-0.167
10.	felt difficulties were piling up so high that you could not overcome them	0.782	-0.154
9.	been angered because of things that were outside of your control	0.712	0.099
6.	found that you could not cope with all the things that you had to do	0.698	-0.132
4.	felt confident about your ability to handle your personal problems	-0.017	0.815
5.	felt that things were going your way	-0.102	0.811
7.	been able to control irritations in your life	-0.100	0.774
8.	felt that you were on top of things	-0.086	0.732
	Eigenvalue	3.879	2.260
	% of variance	38.791	22.595
	Cumulative % of variance	61.386	

Table 3. Factor loadings by exploratory factor analysis for PSS-10

		Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
In the last month, how often have you...			
<i>Perceived helplessness</i> (Cronbach's Alpha = 0.865)			
1.	been upset because of something that happened unexpectedly	0.674	0.840
2.	felt that you were unable to control the important things in your life	0.748	0.826
3.	felt nervous and "stressed"	0.705	0.835
6.	found that you could not cope with all the things that you had to do	0.591	0.854
9.	been angered because of things that were outside of your control	0.562	0.859
10.	felt difficulties were piling up so high that you could not overcome them	0.688	0.838
<i>Perceived control</i> (Cronbach's Alpha = 0.796)			
4.	felt confident about your ability to handle your personal problems	0.635	0.732
5.	felt that things were going your way	0.652	0.724
7.	been able to control irritations in your life	0.609	0.745
8.	felt that you were on top of things	0.539	0.781
Cut-offs for item-total correlation: <0.4 indicates poor correlation between item and total score.			

Table 4. Corrected Item-Total Correlation

IV. DISCUSSION

A. Exploratory Factor Analysis

Exploratory factor analysis for PSS-10 revealed a two-factor structure, which was consistent with the findings in the original study (Cohen, 1988) and other validation studies (Andreou et al., 2011; Chaaya et al., 2010; Lesage et al., 2012; Leung et al., 2010; Örucü & Demir, 2009; Siqueira et al., 2010; Wongpakaran & Wongpakaran, 2010). The two factors identified in our study were related to the concept of control and ability to cope, as

reflected in the positively-worded items, and the concept of helplessness, as reflected in negative items, respectively. The three items that loaded most heavily on the helplessness factor related to a lack of control (item 2), anxiety (item 3) and feeling overwhelmed (item 10).

B. Locus of Control

It was evident that feeling unable to control important things in life (Item 2) greatly contributed to perceived stress of students. (Table 4) External locus of control,

where people believe external factors control success or failure, is associated with higher stress (Linn & Zeppa, 1984) and understandable for healthcare students. For example, the teaching timetable is often changed at the last minute as the teachers might have urgent clinical duties or they may be expected to do more self-directed learning in which the breadth or depth of the learning may not be made clear. The expectations for clinical skills in clinical settings are often different from what was taught in school (Gibbons et al., 2008). The uncertainty of the curriculum, progress and assessment also contribute to stress in healthcare students (Elzubeir et al., 2010). Moreover, as the most junior member of the healthcare team, students have no decision-making capacity and may feel helpless when confronted with situations beyond their expertise or observe actions contrary to their personal views (Jennings, 2009).

C. Anxiety

Feeling nervous (item 3) was another contributing factor for perceived stress (Table 4). Medical and health sciences students are required to sit high-stakes examinations in order to be promoted to the next year of study or to graduate, where test anxiety is understandably prevalent (Encandela et al., 2014). Clinical competency exams such as OSCEs are particularly anxiety-provoking (Muldoon et al., 2014). This is especially relevant to the final year students in this study, as the final summative exams in all programmes are intense. In particular, the written final Bachelor of Medicine and Bachelor of Surgery (MBBS) exam covers material from the whole year and all disciplines including medicine, surgery, psychiatry, obstetrics and gynaecology, paediatrics, orthopaedics, and family medicine, and also includes a clinical competency test in each discipline. This final exam constitutes the licensing exam to become a doctor in Hong Kong.

In addition, the vast majority of students admitted to undergraduate healthcare professions studies in Hong Kong are secondary school graduates. The age-related level of maturity may affect their ability to cope with a strenuous, content-rich curriculum as well as the pressures of clinical practicums and clerkships. Students have raised concerns about exam-induced anxiety and the heavy academic workload and in fact, the most common reason for students to seek counselling support at our institution is because of academic-related stress or psychological distress.

Working in the clinical environment also produces anxiety, especially when starting a new rotation in a new discipline when students often lack clinical experience, are unfamiliar with the ward, encounter difficult patients, and have a fear of making mistakes (Sharif & Masoumi,

2005). The hierarchical medical culture is more pronounced in healthcare settings and can be intimidating for undergraduate healthcare professions students who are seen as the lowest rung on the ladder. Other situations where the students are singled-out, such as during simulations, being observed, evaluated or video-recorded, also increases anxiety (Nielsen & Harder, 2013) especially as these teaching sessions are done in small groups. The style of learning for our students in these clinical years also require a more proactive, interactive and self-reliant style of learning. In addition to scheduled bedside teaching with a clinician, students have to seek out patients to clerk in order to hone their clinical skills and gain clinical experience. This may be an adjustment to students used to a more traditional classroom style and textbook learning.

D. Overwhelmed

The third most important item contributing to high perceived stress was the feeling of being overwhelmed with the workload and difficulties (item 10) (Table 4). Healthcare studies are well-known for being content heavy. Students have a heavy workload including long hours of lectures, tutorials, laboratories and clinical attachments, and are also expected to spend substantial time on independent study. Because most healthcare professions students in Hong Kong are admitted to such programmes directly upon completion of secondary education, higher diploma or associate degree, the curricula are even more packed with basic foundational as well as profession-specific advanced content.

Students in their final year of study have to contend with clinical experiential learning but must also further develop their knowledge base. This entails acquiring a huge volume of factual content as well as applying concepts to clinical scenarios. Students must work more independently in clinical attachments and may have some responsibility for patient care or administrative work. For example, nursing students' progress from having practicums in small groups to shadowing a practising nurse, and working as a member of the nursing team in the ward in their senior years.

In addition, clinical teaching settings in Hong Kong, can be challenging learning environments especially the tertiary care teaching hospitals where much of the training takes place. The business of routine patient care already involving a multitude of staff makes it a daunting place for healthcare professions students who have to compete with each other for the opportunity to clerk patients.

In the clinical environment, students also come face-to-face with difficult situations and experience feelings that they may have difficulty resolving. This may include having problems communicating communication with patients or their families, struggling with ethical dilemmas such as witnessing a medical error, or experiencing the illness experience of patients and the helplessness of not being able alleviate their suffering. Medical students can be overwhelmed by the burden of suppressing their own natural emotions when facing the pain and suffering of their patients (Jennings, 2009). Likewise, nursing students also expressed that workload from clinical work and their own studies exceeded their physical and emotional capacity (C. K. Chan et al., 2009).

E. Limitations

At the time of data collection, no data were collected for other scales of similar or opposite construct. Hence no convergent or divergent validity could be calculated. Also, test-retest reliability could not be done as this was a one-off cross-sectional survey. Despite these limitations our data supported a two-factor structure of the PSS-10, consistent with the original and other previous studies.

V. CONCLUSION

Demonstrating good construct validity and internal consistency, PSS-10 is a valid measure for assessing self-reported stress in medical students as well as in health sciences students. Longitudinal studies on student stress using this measure will help to assess the extent and patterns of stress in a high-risk population in order to develop timely interventions.

Notes on Contributors

JY Chen and JPY Tsang reviewed the literature, designed the study, performed data collection and data analysis, and developed the manuscript. WY Chin, A Tiwari, J Wong, ICK Wong, A Worsley, Y Feng, MH Sham and CS Lau advised on the study design, facilitated data collection and gave critical feedback on the manuscript. All authors have read and approved the final manuscript.

Ethical Approval

Ethical approval of this study was granted by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (Reference No.: UW 14-472). All participants have given written consent for their data to be used in the research and for publication.

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Declaration of Interest

The authors declare that there is no conflict of interest.

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