

Psychometric Properties of the Malay Version Chronic Stress Screening Scale (CSSS) among Manufacturing Industry Workers

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ABSTRACT

Background: This study evaluated psychometric properties of the Malay version of 12-item Chronic Stress Screening Scale (CSSS) among manufacturing industry workers.

Materials and Methods: A cross sectional study was conducted in a pipeline manufacturing company at Kuantan. A total of 42 production workers who fulfilled the inclusive criteria were recruited randomly as participants. The Malay version of CSSS was translated and back translated before administration to ensure face validity. Psychometric properties of CSSS were evaluated in term of its construct validity, internal consistency reliability and concurrent validity with Perceived Stress Scale (PSS-10).

Result: Total CSSS scores did not differ significantly across socio-economic characteristics ($p > .05$). Construct validity was established by a 2-factor structure extracted using principal component analysis under varimax rotation ($\sigma^2 = 50.53\%$) with factor loadings of items ranged from 0.52 to 0.83. *KMO* value (> 0.5) and significant Bartlett's Test indicated items adequacy and appropriateness for factor analysis. Internal consistency reliability was shown by high Cronbach's alpha coefficient at 0.84. Concurrent validity was reflected by significant correlation with PSS-10 [$r(40) = 0.67, p < 0.05$]. Chronically stressed respondents as classified according to CSSS were found having higher PSS-10 scores [$t(40) = -3.11, p < 0.05$]

Conclusion: This is the first study that evaluates psychometric properties of the Malay version of CSSS. The findings supported that Malay version CSSS is a valid and reliable scale to measure chronic stress level among manufacturing industry workers.

Keywords: CSSS, PSS-10, psychometric, validity, reliability, manufacturing industry

1.0 Introduction

Research on stress has been done extensively in multiple disciplines for nearly a century. Exposure to stress could be acute or chronic, both with different impacts on mind and body. Acute stress has been defined as stress that lasts for a period of minutes to hours, and chronic stress as stress that persisted for several hours per days for weeks and months (Dhabhar & McEwen, 1997). While acute stress leads to rapid changes throughout almost all body systems, to meet with sudden danger, or commonly known as fight or flight response temporarily, chronic stress could have real health consequences on mind and body resulting from repeated exposure to different or same stressors.

Enormous research have linked chronic stress with the onset of diseases and symptomatic experience such as cardiovascular diseases (Ornish, 2009), cancers (Antonova & Mueller, 2008; Moreno-Smith et al., 2010), cold (Cohen et al., 1997), headache, musculoskeletal pain (Dyrehag et al., 1998), fatigue and insomnia (Basta et al., 2007). Studies also found that chronic stress is closely related absenteeism, turnover, time performance, morale and accidents at the workplace (Beehr, 2014; World Health Organization, 2003). According to Mohd Rafee et al. (2013), chronic stress is one of the most common psychosocial hazard at the workplace. The American Institute of Stress (2013) estimated that U.S. companies lose up to \$300 billion per year due to stress-related absenteeism, lost productivity, turnover and stress-related health care costs. While chronic stress is affecting every individual physically, mentally and emotionally, it is very essential to have valid and reliable scale to monitor or measure the level of chronic stress.

Despite being widely discussed in various aspects, researchers still find it difficult to achieve consensus on a satisfactory definition of stress. For instance, the theoretical orientations to explaining stress could be categorized into 3 distinct concepts: stimulus oriented, response oriented and interaction oriented. The Trier Inventory of Chronic Stress (TICS) is a questionnaire developed based on the interaction oriented concept, saying that stress occurs through the active engagement of a person with demands from the environment and available resources to deal with the demands (Richter & Hacker, 1998; Schulz & Schönpflug, 1982). TICS is a 57-item scale that could measure chronic psychosocial stress within 9 factors, namely work overload, social overload, chronic worrying, pressure to perform, work discontent, social isolation, excessive demands from work, lack of social recognition, and social tensions. While there is a need to have a short instrument that could measure chronic stress with minimum number of items for screening purposes, Schulz et al. (2011) decided to put together the first 12 items in TICS with highest factor loadings in the first factor that could explained 28.4% of the total variance under unrotated factor matrix to form a shorter questionnaire: Chronic Stress Screening Scale (CSSS).

The 12-item CSSS is a short questionnaire that could measure level of chronic stress experience by using aggregated total scores. Validity and internal consistency of CSSS have been previously established among German population (Schulz et al., 2004). However, CSSS has not been translated and validated in Malay, and to our knowledge, none of the published articles have addressed the psychometric properties of CSSS in Malay. The objective of this study is to investigate the psychometric properties of CSSS in terms of its construct validity, concurrent validity and internal consistency to be used among manufacturing industry workers.

2.0 Materials and Methods

2.1 Study design and study population

A cross-sectional study was conducted among production workers from a pipeline manufacturing company at Kuantan in mid-November 2013. This study served as a pilot study for a larger study that examined the effectiveness of participatory ergonomics intervention in reducing stress level and improving musculoskeletal health among manufacturing industry workers. Cocks and Torgerson (2013) suggested that the minimum sample size of pilot study should be about 9% from the sample size of parent study. Therefore, this study recruited 42 workers who fulfilled the inclusive criteria as the study respondents. Workers who are above 18 years old and have been working for the company for at least 3 months were recruited randomly from the name list provided by the management. Written consent from all the participants were obtained before questionnaires administration. All the research protocol of this study was approved by the Research Ethics Committee of Universiti Putra Malaysia.

2.2 Measures

2.2.1 Chronic Stress Screening Scale (CSSS)

CSSS is a 12-item scale that could measure chronic stress based on 5 different types of chronic stress experience: chronic anxiety, work related overload, social overload, overextension and lack of social recognition. Respondents were asked to rate how often he made the relevant experience in the last 3 months based on a 5-point Likert scale that ranged from 0 (never) to 4 (very often). Total CSSS scores are obtained by summing across all items' scores. Total scores of CSSS ranged from 0 to 48 and higher scores indicates greater chronic stress level.

The original version of CSSS is in German language but the English version of CSSS was requested from the publisher. The English version of CSSS was forward translated to Malay version by the author and another postgraduate student with good command in English and Malay languages. Conceptual equivalent of a word or phrase is emphasized rather than literal translations during translation process. The translated scale was then reviewed by a senior lecturer at the Department of Community Health, UPM to identify and resolve any inadequate expressions of the translation. The translated and reviewed Malay version of scale was then back translated to English version by another postgraduate student who has not seen the original scale to ensure face validity of the scale and to identify potential discrepancies with the translated scale. The final version of CSSS was pre-tested among 5 undergraduate students before actual data collection.

2.2.1 Perceived Stress Scale (PSS-10)

PSS-10 is a self-reported questionnaire that was designed to measure the degree to which individuals appraise situations in their lives as stressful (Cohen & Williamson, 1988). It is a 10-item scale, which comprised of 6 negatively stated items that measure individual perceived stress and 4 positively stated items that measure individual coping ability. Respondents were asked to rate the occurrence frequency of each item during the last month

based on a 5-point Likert scale that ranged from 0 (never) to 4 (very often). Total PSS-10 scores are obtained by summing across all items' scores after reversing the scores of the 4 positively stated items (0 = 5, 1 = 4, 2 = 3). The total score of PSS-10 ranged from 0 to 40 and higher score indicates greater individual perceived stress. In Malaysia, various studies had reported the use of Malay or English version of PSS-10 to measure perceived stress among different populations such as students, teachers, patients and prisoners (Gillani et al., 2011; Hadi et al., 2009; Hazrina and Ahmad, 2012).

2.3 Statistical Analysis

Data entry and analysis were performed using the Statistical Package for the Social Sciences (SPSS) version 21.0. All the data was screened for missing values, outliers and normality before further statistical analysis. CSSS scores and PSS-10 scores were normally distributed as shown by Shapiro-Wilk test ($p > .05$). For descriptive analysis, categorical data was presented in frequency and percentage while continuous data was presented in mean (M) and standard deviation (SD). Independent-Samples T Tests or one-way ANOVA tests were conducted to determine differences of CSSS scores across socio-demographic characteristics. Construct validity of CSSS was established by principal component analysis to extract factors using varimax rotation (eigenvalues > 1) with 0.33 set as the minimum factor loading values. Sample adequacy and appropriateness were further assessed by the Kaiser-Meyer-Olkin (KMO) measure and Barlett's Test of Sphericity. Internal consistency reliability of CSSS was determined by Cronbach's alpha coefficients. Alpha (α) value > 0.7 was considered acceptable (Tavakol & Dennick, 2011). Concurrent validity of CSSS was evaluated using Pearson correlation test with PSS-10. PSS-10 score was compared against level of chronic stress according to CSSS using Independent-samples t-test. All the statistical analysis results were considered as significant at p -value $< .05$.

3.0 Results

3.1 Socio-demographic characteristics and CSSS scores of respondents

Table 1: Socio-demographic Characteristics and CSSS Score of respondents (N=42)

Variable	Mean (SD)	Frequency (%)	Mean CSSS score (SD)	<i>p</i>
Age (years)	24.9 (5.3)			-
Gender				
Male		42 (100)	20.6 (7.3)	-
Marital status				
Single		31 (73.8)	20.8 (6.3)	0.87**
Married		10 (23.8)	20.3 (10.5)	
Divorced		1 (2.4)	17.0 (0.0)	
Educational attainment				
Secondary School		37 (88.1)	20.7 (6.9)	0.75*
Diploma		5 (11.9)	19.6 (10.7)	
Work position				
Operator/General worker		37 (88.1)	20.5 (6.9)	0.79*
Supervisor		5 (11.9)	21.4 (10.9)	
Monthly income (RM)				
901 – 1500		23 (54.7)	19.7 (6.8)	0.43**
1501 – 3000		17 (40.5)	21.1 (8.2)	
> 3000		2 (4.8)	26.5 (3.5)	
Work duration (hours)				
35 – 40		4 (9.5)	19.5 (3.9)	0.88**
41 – 48		4 (9.5)	19.3 (4.6)	
> 48		34 (81.0)	20.9 (7.9)	
Smoking status				
Never smoker		6 (14.3)	17.8 (6.8)	0.59**
Former smoker		5 (11.9)	20.0 (7.5)	
Current smoker		31 (73.8)	21.2 (7.5)	
Duration of exercise weekly				
Never		13 (31.0)	20.3 (7.6)	0.50**
1 – 3 hours		26 (61.9)	21.3 (7.1)	
> 3 hours		3 (7.1)	16.0 (9.5)	

* Independent-samples t-test, ** one-way ANOVA test

Table 1 shows the socio-demographic characteristics and mean CSSS scores of respondents. All the respondents are male workers, with mean (SD) age at 24.9 (5.3) years. Most of the respondents are singles (73.8%) and attained secondary school level as highest education level (88.1%). Of all the 42 respondents, 37 (88.1%) of them work as operators or general workers while 5 (11.9%) of them work as supervisors. There were 54.7% of workers reported as having monthly income in the range of RM900 to RM1500, followed by RM1501 to RM3000 (40.5%) and more than RM3000 (4.8%). Majority of them (81%) had been working extensively for more than 48 hours weekly inclusive of work overtime. A total of 31 respondents are current smokers while 26 respondents spend about 1 to 3 hours weekly for exercises or sport activities.

The mean (*SD*) CSSS score of the respondents was 20.6 (7.3). Independent-samples *t*-tests and one-way ANOVA tests revealed that there were no significant differences in mean CSSS scores across socio-demographic characteristics such as marital status, education attainment, work position, monthly income, work duration, smoking status and duration of exercise ($p > .05$).

3.2 Construct validity

Table 2: Items and Factor Loadings for CSSS using Principal Component Extraction with Varimax Rotation

Items	Factor 1 ($\alpha = 0.82$)	Factor 2 ($\alpha = 0.71$)
1. I worry that something unpleasant will happen.	0.70	
2. I try in vain to gain recognition for my good work.	0.39	
3. I have too many duties to fulfill.		0.52
4. I cannot suppress worrisome thoughts.	0.64	0.51
5. Although I do my best, my work is not appreciated.	0.59	
6. I experience having too much to do.		0.57
7. I worry a lot and cannot stop.	0.62	0.46
8. I am not able to perform as well as expected.	0.72	
9. My responsibility for others become a burden to me.		0.83
10. My work overwhelms me.		0.82
11. I worry that I will not be able to fulfil my tasks	0.71	
12. My worries overwhelm me.	0.56	0.48
Variance explained, %	25.47	25.06
Kaiser-Meyer-Olkin (<i>KMO</i>) Measure of Sampling Adequacy	0.72	
Bartlett's Test of Sphericity	< .05	

Factor loading <0.33 were removed

Table 2 shows the exploratory factor analysis of items in CSSS using principal component extraction with varimax rotation. Two factors extracted after rotation accounted for 50.53% of the total variance. Factor 1 consisted of 8 items (item 1, 2, 4, 5, 7, 8, 11 and 12) with factor loadings ranged from 0.39 to 0.72 while factor 2 consisted of 4 items (item 3, 6, 9 and 10) with factor loadings ranged from 0.52 to 0.83. The items of CSSS were appropriate and adequate for factor analysis as indicated by *KMO* value which was higher than 0.5 and significant Bartlett's Test of Sphericity.

3.3 Internal consistency reliability

The Malay version of CSSS showed excellent internal consistency reliability with Cronbach's alpha coefficient at 0.84. Cronbach's alpha coefficient for the 7-item factor 1 and 5-item factor 2 were 0.82 (excellent reliability) and 0.71 (good reliability) respectively as shown in Table 2. The analysis showed that Cronbach's alpha coefficients did not improved by items elimination.

3.4 Concurrent validity

Table 3: Correlation between total scores of CSSS and PSS-10

Scales	Mean	SD	CSSS	PSS-10
CSSS	17.4	3.3	1	
PSS-10	20.6	7.3	0.67*	1

* $p < .05$

As shown in Table 3, total score of CSSS ($M = 17.4$, $SD = 3.3$) and PSS-10 ($M = 20.6$, $SD = 7.3$) were significantly correlated, $r(40) = 0.67$, $p < 0.05$. The findings of CSSS and PSS-10 correlations confirmed the concurrent validity of CSSS.

3.5 Comparison of CSSS and PSS-10

Table 4: Total scores of PSS-10 by level of chronic stress according to CSSS classification

	Level of chronic stress based on CSSS total score	
	Low to average (N=36)	High (N=6)
Mean PSS-10 score (SD)	16.8 (3.1)	21.0 (2.1)
p -value *	< .05	

* Independent-samples t-test

There were 6 respondents reported as having total CSSS score ≥ 20.7 [$17.4 (M) + 3.3 (SD)$] and they were considered as having high chronic stress. The rest of the respondents were considered as having low to average level of chronic stress. Independent-samples t-test revealed that respondents having high chronic stress ($M = 21.0$, $SD = 2.1$) reported significant higher score of PSS-10 as compared to respondents having low to average level of chronic stress ($M = 16.8$, $SD = 3.1$), $t(40) = -3.11$, $p < 0.05$. According to CSSS, a person is chronically stressed when he worries a lot, feels overextended and overwhelmed, and receives no recognition for their efforts (Schulz et al., 2011) while a person with high PSS-10 scores indicates higher perceived stress. Taken together, these results suggested that chronically stressed person would have higher PSS scores, or could be interpreted as having greater perceived stress.

4.0 Discussion

The findings of the study suggested that the Malay Version of CSSS has shown adequate psychometric properties to measure chronic stress among manufacturing industry workers. In term of construct validity, the 2-factor structure found in this study was consistent with study done by (Petrowski et al., 2012) Factor 1 was identified as lack of satisfaction due to unsatisfactory job conditions and social conditions while factor 2 was identified as high demand referring to specific job conditions and social conditions. The value of 0.33 was chosen as the minimum factor loading because this value explained about 10% of the variance in a factor. According to Chua (2013), items that could contribute more than 10% of variance to a construct shall be categorized under that construct. This study found that item 4, 7 and 12 cross-loaded on both factors with difference less than 0.2. Cross-loadings were acceptable because these 3 items belongs to the same scale (Chronic Worrying scale) in TICS and they loaded slightly higher in factor 1 compared to factor 2.

The internal consistency reliability of CSSS was excellent as shown by high Cronbach`s alpha coefficient of 0.84. A lot of arguments have been made on the Cronbach`s alpha value. A low alpha value could be due to a low number of questions, poor interrelatedness between items or heterogeneous constructs while high alpha value may suggest that some items are redundant. There are different reports about the acceptable values of alpha value, ranging from 0.70 to 0.95 (Tavakol & Dennick, 2011)

Concurrent validity of CSSS was established by moderate correlations with PSS-10 scores. PSS-10 was selected as the suitable “gold” standard to establish concurrent validity because both scales measure similar and related constructs. PSS-10 measure the degree to which situations in one's life are appraised as stressful in the context of perceived stress event and one`s coping ability while CSSS measure different types of chronic stress experience in the context of environmental demands and resources to cope with demands (Cohen & Williamson, 1988; Schulz et al., 2004). Besides, the Malay version of PSS-10 has shown good psychometric properties over worker population as well (Al-Dubai et al., 2014).

This study has some limitations. The respondents were recruited from only one manufacturing company may have affected the generalizability of the study due to homogeneous sample. The sample size is relatively small because it is a pilot study from larger study. Gender bias was present because all the respondents are male workers. Another limitation of this study was the absence of test-retest reliability assessment of the scale.

5.0 Conclusion and recommendation

In conclusion, the results of this study indicate that the Malay version of CSSS is a valid and reliable scale to measure chronic stress among manufacturing industry workers. It should be emphasized that current study is just a pilot study. Future research in larger sample size should include confirmatory analysis in the method, including test-retest reliability and confirmatory factor analysis.

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Declaration

Author(s) declare that there are no conflicts of interest.

Authors contribution:

- a) Conception and design of the project: all authors
- b) Acquisition of data: Lim Chee Siang,
- c) Writing of the manuscript: Lim Chee Siang, Dr. Mohd Rafee Baharuddin, Assoc. Prof. Dr. Anita Abd Rahman
- d) Statistical analysis: Lim Chee Siang, Prof. Dr. Shamsul Azhar Shah
- e) Critical review and significant revision of the manuscript: all authors

References

- Al-Dubai, S., Ganasegeran, K., Barua, A., Rizal, A., & Rampal, K. (2014). Evaluation of psychometric properties of the malay version perceived stress scale in two occupational settings in malaysia. *Annals of Medical and Health Sciences Research*, 4(Suppl 2), S104–7. <http://doi.org/10.4103/2141-9248.138023>
- American Institute of Stress. (2013). *Workplace stress*. Retrieved 3 May, 2015 from <http://www.stress.org/workplace-stress/>
- Antonova, L., & Mueller, C. R. (2008). Hydrocortisone down-regulates the tumor suppressor gene BRCA1 in mammary cells: a possible molecular link between stress and breast cancer. *Genes, Chromosomes & Cancer*, 47(4), 341–52. <http://doi.org/10.1002/gcc.20538>
- Basta, M., Chrousos, G. P., Vela-Bueno, A., & Vgontzas, A. N. (2007). CHRONIC INSOMNIA AND STRESS SYSTEM. *Sleep Medicine Clinics*, 2(2), 279–291. <http://doi.org/10.1016/j.jsmc.2007.04.002>

- Beehr, T. A. (2014). *Psychological Stress in the Workplace (Psychology Revivals)*. Routledge. Retrieved from <https://books.google.com/books?hl=en&lr=&id=xFvXAwAAQBAJ&pgis=1>
- Cocks, K., & Torgerson, D. J. (2013). Sample size calculations for pilot randomized trials: A confidence interval approach. *Journal of Clinical Epidemiology*, 66(2), 197–201. <http://doi.org/10.1016/j.jclinepi.2012.09.002>
- Cohen, S., Doyle, W. J., Skoner, D. P., Rabin, B. S., & Gwaltney, J. M. (1997). Social ties and susceptibility to the common cold. *JAMA*, 277(24), 1940–4. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/9200634>
- Cohen, S., & Williamson, G. M. (1988). Perceived stress in a probability sample of the United States. In S. Spacapan & S. Oskamp (Eds.), *The Social Psychology of Health* (Vol. 13, pp. 31–67). Sage. <http://doi.org/10.1111/j.1559-1816.1983.tb02325.x>
- Dhabhar, F. S., & McEwen, B. S. (1997). Acute stress enhances while chronic stress suppresses cell-mediated immunity in vivo: a potential role for leukocyte trafficking. *Brain, Behavior, and Immunity*, 11(4), 286–306. <http://doi.org/10.1006/brbi.1997.0508>
- Dyrehag, L. E., Widerström-Noga, E. G., Carlsson, S. G., Kåberger, K., Hedner, N., Mannheimer, C., & Andersson, S. A. (1998). Relations between self-rated musculoskeletal symptoms and signs and psychological distress in chronic neck and shoulder pain. *Scandinavian Journal of Rehabilitation Medicine*, 30(4), 235–42. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/9825388>
- Gillani, S. W., S, S. A. S., Sari, Y. O., Sarriff, A., Amin, A., & Baig, M. (2011). Perceived Stress Scale Psychometric Validation for Malaysian Diabetic Patients, 1(4), 156–163.
- Hadi, A. A., Naing, N. N., Daud, A., Nordin, R., Sulong, M. R., And, & 1. (2009). Prevalence and Factors Associated With Stress Among Secondary School Teachers in. *Southeast Asian J Trop Med Public Health*, 40(6), 1359–1370.
- Mohd Rafee, B.B., Lim, C.S., Sam, W.Y & Nazmin, H. (2013). *Practical guide to OSH risk management. Understanding, evaluating and implementing HIRARC at workplace*. Bangi, Malaysia: NIOSH.
- Moreno-Smith, M., Lutgendorf, S. K., & Sood, A. K. (2010). Impact of stress on cancer metastasis. *Future Oncology (London, England)*, 6(12), 1863–81. <http://doi.org/10.2217/fon.10.142>
- Nurul Hazrina, M., & Ahmad, A. (2012). A Validity Study of Malay-translated Version of Perceived Stress Scale. *Malaysian Journal of Forensic Sciences*, 3(1), 52–57.
- Ornish, D. (2009). *Dr. Dean Ornish's Program for Reversing Heart Disease: The Only System Scientifically Proven to Reverse Heart Disease Without Drugs Or Surgery*. Random House Publishing Group. Retrieved from <https://books.google.com/books?id=O1SHkQEACAAJ&pgis=1>

- Petrowski, K., Paul, S., Albani, C., & Brähler, E. (2012). Factor structure and psychometric properties of the trier inventory for chronic stress (TICS) in a representative german sample. *BMC Medical Research Methodology*, 12(1), 42. <http://doi.org/10.1186/1471-2288-12-42>
- Richter, P., & Hacker, W. (1998). *Workload and strain: Stress, fatigue, and burnout in working life*. Germany: Asagner.
- Schulz, P., Schlotz, W., & Becker, P. (2004). Trierer Inventar zum Chronischen Stress (TICS) [Trier Inventory for Chronic Stress (TICS)]. Hogrefe. Retrieved from <http://eprints.soton.ac.uk/50017/>
- Schulz, P., Schlotz, W., & Becker, P. (2011). The Trier Inventory of Chronic Stress (TICS)-Manual. Gottingen, Germany: Hogrefe.
- Schulz, P., & Schönpflug, W. (1982). Regulatory activity during states of stress. *Series in Clinical & Community Psychology: Achievement, Stress, & Anxiety*, 51–73.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53–55. <http://doi.org/10.5116/ijme.4dfb.8dfd>
- World Health Organization. (2003). Work organisation and Stress. *Protecting Workers Health*, 1–27. http://doi.org/9241590475_1729-3499