

REVIEW ARTICLE

Volume 9 Issue 1 2017

DOI: 10.21315/eimj2017.9.1.1

ARTICLE INFO

Submitted: 29-01-2017

Accepted: 09-02-2017

Online: 31-03-2017

A Systematic Review on Validity Evidence of Medical Student Stressor Questionnaire

Muhamad Saiful Bahri Yusoff

*Department of Medical Education, School of Medical Sciences,
Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan,
Malaysia*

To cite this article: Yusoff MSB. A systematic review on validity evidence of medical student stressor questionnaire. *Education in Medicine Journal*. 2017; 9(1): 1–16. <https://doi.org/10.21315/eimj2017.9.1.1>

To link to this article: <https://doi.org/10.21315/eimj2017.9.1.1>

ABSTRACT

Introduction: Detecting sources of stress of medical students is important for planning wellness program to improve their psychological wellbeing. One of instruments to detect the sources of stress is the Medical Student Stressor Questionnaire (MSSQ). A systematic review was performed to find out evidence to support its validity in term of content, response process, internal structure, relation to other variables, and consequences. **Method:** The author planned, conducted and reported this study according to PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) standard of quality for reporting meta-analyses. Systematic search was performed on EBSCOhost, Scopus, Proquest, PubMed, Web of Science and Google Scholar databases. **Result:** The author yielded 613 relevant articles based on search terms, 44 articles had used MSSQ, and after critical appraisal, only 18 articles provided evidence to support validity MSSQ and thus were included in the systematic review. **Conclusion:** This systematic review supports the validity of MSSQ in relation to content, response process, internal structure, relations to other variables, and consequences of its scores. MSSQ is a valid tool to detect sources of stress in medical students and its results can be utilised as a guide to plan wellness program or intervention to improve medical students' wellbeing.

Keywords: *Stress, Anxiety, Depression, MSSQ, Sources of stress*

CORRESPONDING AUTHOR

Dr. Muhamad Saiful Bahri Yusoff, Department of Medical Education, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia | Email: msaiful_bahri@usm.my

INTRODUCTION

Medical training has always been perceived as highly stressful environment by students (1–3). Studies have revealed medical students experienced high prevalence of psychological distress, ranging from 21.6% to 56% (4, 5). The psychological distress is more prevalent among them compared to other students (2). In fact a longitudinal study has shown that prevalence of depression symptoms among them prior

to medical training was less than 2% (1, 6) which is similar to general population (7), later the prevalence escalated up to 30% at the end of the first year medical training (1). The commonest psychological health problem among medical students was anxiety (41.1%–56.7%), followed by depression (12%–30%) and stress (11.8%–19.9%) (1, 8). These alarming signs indicate medical students' are facing a growing psychological pressure during medical training. It should be reminded that

chronic exposure to excessive psychological pressure exerts unfavourable effects on their emotional, mental and physical health (3, 9). The excessive psychological pressure could lead to unwanted consequences such as interpersonal conflict (3), sleeping problems (10), low academic and poor clinical performance (11). It could also lead to decrease attention, reduce concentration, impinge on decision making, and reduce students' abilities to establish good relationships with patients resulting in feeling of inadequacy and dissatisfaction with clinical practice in the future (3, 9, 12). Even more, it was linked with suicide, drug abuse and use of alcohol (3, 9, 13–16). Therefore, early intervention could improve this condition.

Studies have consistently shown that stressors contributing to the high prevalence of psychological distress among medical students are related to the academic requirements (3–5, 17, 18). They found that the most common stressors were tests and examinations, time pressure, too many content to be studied, getting behind in work, conflicting demands, not getting work done within time planned and heavy workload (4, 5, 19, 20). A small number of medical students suffer from personal problems, but the effect of this on their psychological distress and academic success is unclear (18, 21–24). Curriculum differences in medical schools may not necessarily cause differences in the overall pattern of stressors, although rank of some stressors may be significantly different (19, 20). It is worthy highlighting that early detection of potential stressors could help medical schools to design appropriate intervention to improve their psychological health.

Many instruments used today measure level or amount of stress of medical students, but none specifically looking at where this stress coming from like the Medical Student Stressor Questionnaire (MSSQ) (25). MSSQ was developed with the purpose of identifying sources of stress in medical students based on the literature,

expert opinions and several stress models. MSSQ has two versions that are the 40 items MSSQ (MSSQ-40) and the 20 items MSSQ (MSSQ-20). Both version of MSSQ identify sources of stress in medical students that related to academic (ARS), interpersonal (IRS), teaching and learning (TLRS), social (SRS), drive/desire (DRS), and group activity (GARS). It is a self-report, self-scoring instrument that require students to rate the intensity of stress caused by each potential sources of stress on a scale of 0–4 (causing no stress to causing extreme stress) (26–29). Since 2010, the MSSQ has been used by more than 100 users from various backgrounds (i.e., undergraduates, postgraduates, educators, specialists and researchers) and countries (i.e., US, UK, UAE, Saudi Arabia, India, Indonesia, Pakistan, Sri Lanka, Norway, many more) for training, research and evaluation (30). It was critically appraised by Salazar in 2015 (25) and the report was published in MedEdPORTAL that is freely accessible to all levels of users to encourage medical educators around the globe to evaluate the potential sources of stress among their students, and thus early interventions could be planned to alleviate the stressor. MSSQ is indexed in the PsycTESTS database published by American Psychologist Association. Despite the widespread use of MSSQ, none of study systematically reviews on evidence to support its validity. This study aimed to find out evidence to support validity of MSSQ as a tool to discover sources of stress of medical students during medical training.

METHODOLOGY

The author planned, conducted and reported according to PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) standard of quality for reporting meta-analyses (31). It guides authors on ways to ensure the transparent and complete reporting of systematic reviews and meta-analyses (31). It consists of 27 checklist items to help

authors to assess the benefits and harms of interventions (31). The checklist items guide authors on proper ways to determine title, writing abstracts, planning protocol for systematic review and meta-analysis, reporting results, discussion on findings and declaration of funding. Ethical review was not done given nature of research was systematic review of previously published research.

STUDY QUESTIONS

We sought to find out evidence to support validity of MSSQ from five sources (32) which are:

1. **Content:** do items of instrument completely represent the construct? The extent of a measure includes a specific set of items to reflect content of the intended attribute to be measured;
2. **Response process:** do items of instrument completely understood by subjects? It is concerned with the relationship between the intended construct and the thought processes of subjects while responding to the items;
3. **Internal structure:** do items of instrument measuring the proposed constructs? It is dealing with the degree of relationship between/among items and constructs as proposed and commonly represented by reliability and factor structure;
4. **Relations to other variables:** do measurement scores correlate with other variables? It is concerned with the relationship of measurement scores with external variables measured by another instrument assessing similar concepts or specific set of criterion. It can be represented in the form of convergent, discriminant, predictive and concurrent; and
5. **Consequences of a measurement:** do measurement scores really make a difference? It is dealing with evidence regarding the significance of

measurement scores on specific intended or unintended outcomes.

STUDY ELIGIBILITY

Broad inclusion criteria were used to present a comprehensive overview of MSSQ validity. Original research published in Malay or English language were included if they investigated any forms of MSSQ validity. We excluded any studies that did not report any of forms of MSSQ validity.

STUDY IDENTIFICATION

The author performed literature search through Systematic search of Ebscohost, Scopus, ProQuest, PubMed, Web of Science, and Google Scholar databases using search terms for Medical Student Stressor Questionnaire or MSSQ. No time limit was specified in searching and the last date of search was December 2016. Titles and abstracts of the searched articles were read through for relevance. Country, participants, method, measured outcomes, results and forms of validity evidence were the key issues of inclusion criteria for in-depth study of the full articles. Original articles must report any form forms of validity evidence otherwise they were not included in the systematic review. Other articles were searched manually from the reference lists of primary articles.

STUDY SELECTION

The author worked solely to screen all titles and abstracts for inclusion. Initial screening was performed at two phases which were titles screening and evaluation of abstract. At the first phase of the initial screening, article titles were appraised based on its relevancy to this study; relevant titles were selected for further evaluation of abstracts and irrelevant titles were excluded from the study. The abstracts of selected titles were further appraised based on the inclusion criteria mentioned previously. Articles with abstracts

that fulfilled the inclusion criteria were included for detail evaluation. The selected articles were undergone in-depth appraisal based on the priori criteria for inclusion in the systematic review. The study selection was illustrated in the figure 1.

EVIDENCE SYNTHESIS

The selected articles were appraised in detail. Information related to country, samples, methods, measured outcomes, results and validity evidence forms were synthesised in the Table 1.

RESULT

Study Flow

The author yielded 613 potentially relevant articles from the databases at the initial screening process based on the search terms (Figure 1). After reading through their titles

and abstracts, 52 articles were retrieved for further evaluation. Following that, 44 articles were recognised as potential articles for inclusion in the systematic review. After the critical appraisal, 18 articles were appropriate for inclusion in the systematic review, and 26 articles were excluded due to none of content reporting on validity evidence of MSSQ.

Study Characteristics

The author identified 18 studies that appropriate for systematic review with a total of 5971 medical students involved from various phases of medical training (Table 1) (26–29, 33–46). The earliest study the author identified was in 2010 (26) and the latest in 2016 (46). All of other studies (n = 16) (27–29, 33–45) were published in between 2010 and 2016. Majority of the studies were performed in Malaysia (n = 10), followed by Nepal (n = 3), India (n = 3), Romania (n = 2) and Netherland (n = 1).

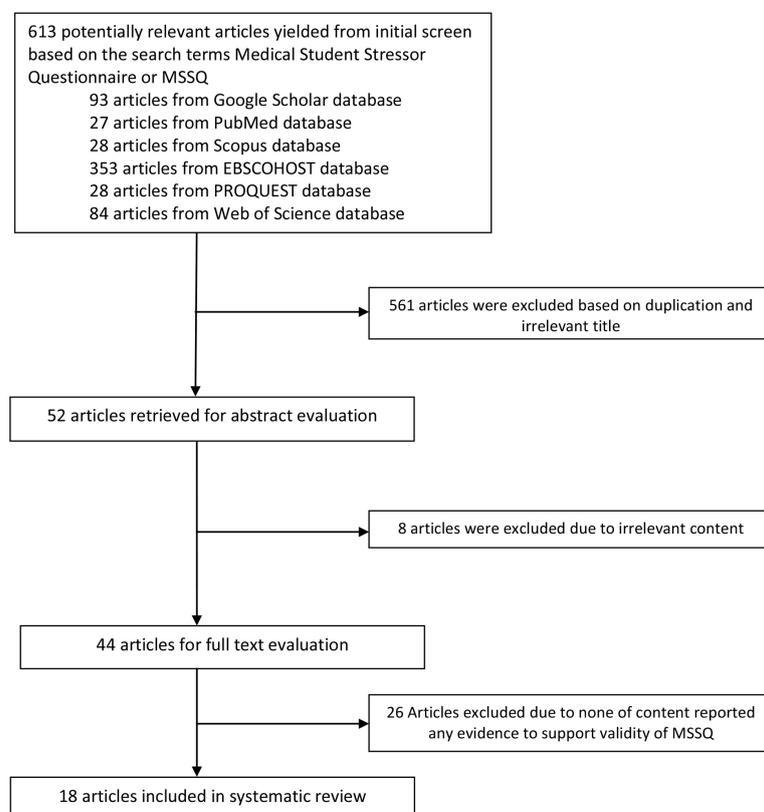


Figure 1: The systematic review flowchart

Table 1: Summary of studies included

Study/country	Samples	Methods	Measured outcomes	Results	Form of validity evidence
Yusoff et al. (2010)(26) Malaysia	761 year 1 to year 5 medical students Universiti Sains Malaysia	Develop MSSQ: literature and expert opinion Validate face validity of MSSQ Validate construct validity of MSSQ : EFA	Content validity Internal consistency Construct validity	Content was valid Items were understood by students Overall Cronbach's alpha more than 0.8 EFA proposed 6 constructs of MSSQ with 40 items Construct reliability ranged from 0.65 to 0.92	Content Response process Internal structure
Yusoff (2011) (28) Malaysia	359 year 1 medical students Universiti Sains Malaysia, Universiti Putra Malaysia, Universiti Malaysia Sabah and Universiti Malaysia Sarawak	To validate construct validity of MSSQ-40: EFA	Construct validity Internal consistency	40 items MSSQ with 6 constructs were reproduced. Overall Cronbach's alpha more than 0.8 Construct reliability ranged from 0.70 to 0.91	Internal structure
Yusoff (2011) (27) Malaysia	359 year 1 medical students Universiti Sains Malaysia, Universiti Putra Malaysia, Universiti Malaysia Sabah and Universiti Malaysia Sarawak	To validate construct validity of MSSQ-40: CFA	Construct validity Internal consistency	The final goodness of fit model was 20 items MSSQ with similar 6 constructs Overall Cronbach's alpha was more than 0.8 Construct reliability ranged from 0.71 to 0.92	Internal structure
Yusoff (2011) (33) Malaysia	359 year 1 medical students Universiti Sains Malaysia, Universiti Putra Malaysia, Universiti Malaysia Sabah and Universiti Malaysia Sarawak	Determine risk factors of psychological distress GHQ-12 measured psychological distress MSSQ-40 Binary logistic regression	Risk factors of psychological distress	Students who perceived academic stressors as causing high to severe stress are 16 times more risk to develop distress Students who perceived DRS and GARS as causing high stress at higher risk to develop psychological distress	Consequences

(continued on next page)

Table 1: (continued)

Study/country	Samples	Methods	Measured outcomes	Results	Form of validity evidence
Othman et al. (2013)(34)	164 Pharmacy students	Determine reliability of MSSQ-40	Internal consistency	Overall Cronbach's alpha was more than 0.8	Internal structure
Malaysia	84 Health Sciences students UiTM Bertam Penang			Construct reliability ranged from 0.73 to 0.91	
Yen Yee et al. (2013)(35)	205 pre-clinical and clinical medical students, Universiti Sains Malaysia	Comparing stressors between two different institutions: MSSQ-40	Association between institutions and stressors	USM medical student significantly perceived more academic stress than UM	Consequences
Malaysia					
Netherland	177 pre-clinical and clinical medical students, Universiteit Maastricht			USM medical student significantly perceived more group activity stress than UM UM medical student significantly perceived more social stress than USM	
Yusoff (2013) (29)	167 year 1 medical students	Stability of MSSQ-40 over 3 measurements: reliability analysis and ICC	Internal consistency at different time intervals	Overall Cronbach's alpha ranged from 0.96 to 0.97	Internal structure
Malaysia	Universiti Sains Malaysia		Intra-class correlation coefficient	Construct reliability ranged from 0.72 to 0.97 ICC of six constructs was more than 0.4	
Alina et al. (2014)(36)	421 year 1 medical students (267 Romanian & 154 International)	Determine correlation between personality traits and academic stress	Correlation between personality traits (NEOFFI) and academic stress (MSSQ-20)	Positive correlation between neuroticism and MSSQ ($r = 0.449$, $p < 0.001$) Positive correlation between trait anxiety and MSSQ ($r = 0.466$, $p < 0.001$) Negative correlation between extraversion and MSSQ ($r = -0.158$, $p = 0.01$) Negative correlation between conscientiousness ($r = -0.127$, $p = 0.037$)	Relation to other variables
Romania	University of Medicine and Pharmacy "Iuliu Hatieganu"		Correlation between trait anxiety (STAI)		

(continued on next page)

Table 1: (continued)

Study/country	Samples	Methods	Measured outcomes	Results	Form of validity evidence
Bob et al. (2014)(37)	267 year 1 medical students	Translate and validate MSSQ-20 in Romanian Language	Construct validity	6 constructs of MSSQ-20 supported	Response process
Romania	University of Medicine and Pharmacy "Iuliu Hatieganu"	EFA Reliability analysis	Internal consistency	Overall Cronbach's alpha 0.88 Construct reliability ranged from 0.70 to 0.90	Internal structure
Upadhayay (2014)(38)	91 year 1 medical students and 33 year 1 dental students	To find out the relationship among entrance examination marks, cognitive function and stressors during their first year of studies.	Correlation between entrance examination, cognitive function and stressors	The cognitive Function score was negatively correlated ($r = -0.2, p = 0.046$) with teaching and learning-related stressor. All constructs of MSSQ significantly correlated with emotion and other stressor (EOS) ranged from 0.30 to 0.61	Relation to other variables
Nepal	BP Koirala Institute of Health Sciences	MSSQ-40			
Upadhayay (2014)(39)	85 year 1 medical students	Association of stressors, heart-rate variability (HRV) and cortisol level with academic performance	Correlation between stressors, HRV, cortisol level and academic performance	Students with high academic related stress have high sympathetic activity (LF percent). Students with high drive and desire related stress have lower parasympathetic activity (HF percent) Students with high group activities related stress have increased cardiac-sympatho activity (low mean RR) The beginning (ARS, IPL and SRS) and mid-year stressors (IPL and TLRS) were positively associated with academic performance.	Relation to other variables
Nepal	BP Koirala Institute of Health Sciences	Spearman correlation			

(continued on next page)

Table 1: (continued)

Study/country	Samples	Methods	Measured outcomes	Results	Form of validity evidence
Fuad et al. (2015)(40)	743 year 1 to 5 medical students	Determine risk factors of stress, anxiety and depression	Stress Anxiety	ARS, GARS and DRS were the risk factor of stress	Consequences
Malaysia	Management and Science University	DASS-21 MSSQ-40 Multiple logistic regression	Depression Stressors Socio-demographic factors	DRS was the risk factor of anxiety DRS and GARS were the risk factor of depression	
Fuad (2015) (41)	237 pre-clinical medical students	Determine risk factors of stress, anxiety and depression	Stress Anxiety	GARS was the risk factor of stress	Consequences
Malaysia	Universiti Putra Malaysia	DASS-21 MSSQ-40 Multiple logistic regression	Depression Stressors Socio-demographic factors	GARS was the risk factor of anxiety DRS and GARS were the risk factor of depression	
Gupta (2015) (42)	83 5th semester medical students	To assess the reliability of MSSQ-40	Internal consistency	Overall Cronbach's alpha was more than 0.8	Internal structure
India	College of Medicine and Sagore Dutta Hospital, Kolkata, West Bengal			ARS, IRS, GARS, SRS within 0.55 to 0.81 SRS and DRS less than 0.5	
Jena (2015)(43)	62 medical students	To find out the changes in EEG waves owing to examination stress (MSSQ-40)	Relationship between mild, moderate, high, severe stress as measured by MSSQ with EEG wave	Mean frequency of EEG (Hz) of the mild and moderate group ranged from 9.30 to 9.94 (baseline EEG). Mean frequency of EEG (Hz) of the high and severe group ranged 20.53 to 24.55 (baseline EEG). MSSQ categories able to differentiate the brain function to a certain degree (EEG)	Consequences
India	V.S.S Medical College	Baseline EEG Examination EEG			
Mehrotra & Devarakonda (2015)(44)	402 year 1 to 4 medical students	Determine the reliability of the MSSQ-20	Internal consistency	The overall Cronbach's alpha value of the MSSQ is 0.813. Cronbach's alpha for each stressor group ranged from 0.73 to 0.90.	Internal structure
India	Armed Forces Medical College				

(continued on next page)

Table 1: (continued)

Study/country	Samples	Methods	Measured outcomes	Results	Form of validity evidence
Upadhayay et al. (2015)(45)	83 year 1 medical students	To determine the relationship of academic stress with the cognitive function, entrance examination marks, and physiology academic performance in first year medical students	Stressor (MSSQ) General health state (GHQ)	ARS, IRS, SRS, TLRS positively correlated with physiology academic performance (r ranged from 0.32 to 0.34)	Relation to other variables
Nepal	BP Koirala Institute of Health Sciences	<p>MSSQ-40</p> <p>MCQ</p> <p>Short Answer Question (SAQ)</p> <p>Emotion and other related stressor (EOS)</p> <p>GHQ28</p>	<p>Cognitive function score was standardized questionnaire prepared Gamezo and Domashenko, 1986</p> <p>Entrance examination (physics, chemistry, biology, English, and health)</p> <p>Physiology academic performance (MCQ & SAQ)</p>		
Fuad et al. (2016)(46)	762 medical students	Determine risk factors of depression	Depression Stressors	One unit change in IRS led to 1.53 times increase in the risk of developing depression [adjusted OR = 1.53, 95%C.I. = (1.15, 2.02), <i>p</i> value = 0.003]	Consequences
Malaysia	Management and Science University	BDI-21 MSSQ-40	Socio-demographic variables	<p>Change in DRS by one unit led to 1.35 times increase in the risk of developing depression [adjusted OR = 1.35, 95%C.I. = (1.09, 1.68), <i>p</i> value = 0.006]</p> <p>GARS also led to increase the risk of developing depression by 1.85 times [adjusted OR = 1.85, 95%C.I. = (1.39, 2.46), <i>p</i> value < 0.001].</p> <p>SRS were found to be protective against developing depression [adjusted OR = 0.65, 95%C.I. = (0.45, 0.95), <i>p</i> value = 0.026]</p>	

Validity Evidence

One study reported on content (26), two studies reported on response process (26, 37), eight studies reported on internal structure (26–29, 34, 37, 42, 44), four studies reported on relations to other variables (36, 38, 39, 45) and six studies reported on consequences (33, 35, 40, 41, 43, 46). The detail of data synthesis was summarised in Table 1.

Pertaining to content (do instrument items completely represent the construct?), MSSQ was developed based on literatures and expert opinions (26), however content validity index was not reported by the study.

With regards to response process (the relationship between the intended construct and the thought processes of subjects or observers), two studies have shown that the MSSQ items were understood by respondents (26, 37).

In terms of internal structure (reliability and factor structure), MSSQ items demonstrated good construct validity and high internal consistency (26–29, 34, 37, 42, 44). The Cronbach's alpha value for the entire MSSQ was more than 0.8, and for its six constructs ranged from 0.55 to 0.97 (26–29, 34, 37, 42, 44), however one study (42) reported SRS and DRS had less than 0.5. The stability of internal consistency of each construct at different time of measurements was good as evident by the ICC values more than 0.4 (29). These results support the internal structure of MSSQ, and its internal consistency ranged from acceptable to high level across the studies.

Pertaining to relations with other variable (correlation with scores from another instrument assessing the same construct), MSSQ scores significantly correlated with personality traits (36), cognitive functions (38), cardiac autonomic drive (39) and academic performance (39, 45).

With regards to consequences of a measurement (do scores really make a difference?), those who scored high

on MSSQ are at higher risk to develop psychological distress (33, 40, 41), anxiety (40, 41) and depression (40, 41, 46), able to differentiate specific stressors between different institutions (35), and able to differentiate brain function to a certain degree based electroencephalogram (EEG) (43).

The above findings provide evidence to support the psychometric credentials of MSSQ for discovering sources of stress in medical students.

DISCUSSION

In general, there are five sources of validity evidence that are content, response process, internal structure, relations to other variables and consequences of a measurement (47). This systematic review reveals MSSQ has all five evidence to support its validity for discovering sources of stress in medical students. Each evidence will be elaborated in the subsequent paragraphs.

First, this systematic review shows that the content of MSSQ is valid as evident by Yusoff et al. (2010) study (26) and that was aligned with the standard guidelines which was construction of measurement items should be based on literatures and judgments of content experts towards the latent constructs (48, 49). In addition, the use of large number of items at the MSSQ development phase was aligned with the content validity estimation recommendation which includes: (a) the number of items should adequately cover the intended outcomes; (b) Items should be properly selected and weighted by relevant attributes to be assessed; and (c) a group of items, should be collectively aligned with the operational definition of a construct (48–50). However, due to its content was only validated by one study, despite the fact that sources of stress might be varied across different countries and institutions, therefore the content might need to be revalidated in

other settings to verify its content validity globally.

Second, this systematic review demonstrate the item response process of MSSQ to be good as the face validity were tested on a group of medical students at its development phase (26) and it was translated into other language such as Romanian (37) – the author believes MSSQ has been translated into other languages as well, however it is suspected not being published thus inaccessible to be referred. Though face validity is usually considered as the weakest form of validity and even occasionally not considered as validity evidence (47, 51), a proper evaluation of face validity would be able to prevent incorrect interpretation of measurement items as the ambiguity elements were corrected after the refinement. The term ‘face validity’ point towards different facets of validity exposition that could be misinterpreted by researchers, which include validity by assumption, validity by definition, validity by hypothesis and the appearance of validity (52). This systematic review reveals the items of MSSQ are clear and intelligible to the students (26). The clarity of language and comprehensibility of sentences used in MSSQ will ensure exclusion of any misperceptions between developers and users on the items structure (53). Likewise, the thought processes of the users while responding to the items are vital to ensure measurement accuracy, and thus demonstrating evidence of response process through items’ appearance will increase measurement validity (47).

Third, eight studies provided evidence to support the internal structure of MSSQ that was represented by construct validity and reliability (26–29, 34, 37, 42, 44). Construct validity of MSSQ was established by exploratory factor analysis (26, 28) and confirmatory factor analysis (27). These studies showed that MSSQ was a multi-dimension inventory that measuring different aspects of sources of stress in medical students. In addition to that, reliability of MSSQ was assessed

by internal consistency and intra-class correlation coefficient (ICC) (26–29, 34, 37, 42, 44). The reliability results showed the overall internal consistency was high and stable across different time intervals. Despite favourable overall reliability, its six constructs showed a range of internal consistency levels from acceptable to high, and unfortunately a study found the SRS and DRS construct showed unfavourable level of internal consistency that was below than 0.5 (42). Despite the one unfavourable finding, majority of the studies suggest MSSQ has good internal consistency of the construct, and thus support its construct validity. Perhaps, a mutli-national validation study should be conducted to verify its internal structure by analysing the construct validity and reliability.

Fourth, only four studies provide evidence on relationship of MSSQ scores and other variables such as personality traits (36), cognitive functions (38), cardiac autonomic drive (39) and academic performance (39, 45). With regards to personality traits, conscientiousness and extraversion negatively correlated with MSSQ scores, while neuroticism and trait anxiety positively correlated with MSSQ scores (36). The obvious reason is that, those with unfavourable personality traits tend to perceived stressors more stressful than those with favourable personality traits (54–56). Interestingly, MSSQ scores positively correlated with examination scores (39, 45), indicating examination performance might be influenced by stressors faced by medical students prior to or during examinations. In addition, cognitive function negatively correlated with stressors related to teaching and learning (38), suggesting that MSSQ scores might have influence on the cognitive ability of medical students for learning. Apart from that, students who are academically stress (as measured by MSSQ) have high sympathetic activity that lead to high heart rate variability (39). These facts suggest the relations of MSSQ scores with important outcomes of medical student wellbeing, and early detection and

intervention might be able to improve the outcomes.

Lastly, pertaining to consequences of a measurement, six studies demonstrated that MSSQ scores able to recognise medical students who at the highest risk to develop psychological distress (33, 40, 41), anxiety (40, 41) and depression (40, 41, 46), which is very important for helping medical schools or authorities to plan preventive measures before their condition worsening. Likewise, MSSQ scores able to differentiate specific stressors between different institutions (35), therefore specific and customised program could be initiated based on the needs of the institutions. Surprisingly, MSSQ scores were found to be able to differentiate brain function to a certain degree based EEG (43), and thus suggesting any efforts to tackle sources of stress experienced by medical students will improve their cognitive ability for learning. These facts suggest that MSSQ scores can be used as a valid screening tool to help medical schools or authorities to discover sources of stress in medical students and plan specific wellness program or intervention to prevent the unwanted consequences of stressors on the wellbeing of medical students. It is worth noting that a meta-analysis showed special program or intervention will be able to improve wellbeing of medical students (57).

This study has several limitations. First, generalisability is bordered by the quality of accessible studies. Many studies had important methodology limitations such as sample size calculation were not explained, the use of non-probability sampling method in most of studies, and majority of studies confined to single centre. Therefore, interpretation of this systematic review should be made within its context. Second, the subgroup narrative synthesis should be interpreted with caution due to small numbers of studies included, heterogeneous educational settings, and different measurement tools used to measure the

outcomes. The positive results could be due to confounding factors (for example, heterogeneous educational setting such as phases of medical training and different types of medical curriculum) that was not appraised in this systematic review. Third, selection bias might be introduced due to the author limited the search only for two languages which were Malay and English. This could lead to unintentional exclusion of relevant studies that were published in other language. Lastly, this systematic review was conducted by a single author, thus limiting its narrative interpretation as compared to multiple authors. Despite the limitations, this study has several strengths that include the comprehensive search (inclusion of relevant studies from published and unpublished resources), inclusion criteria that was specific to validity evidence of MSSQ, confined to a specific group of learners, performed narrative data synthesis based on the recommended guidelines, and the first effort to compile and appraise validity of MSSQ across educational settings.

CONCLUSION

This systematic review supports the validity of MSSQ in relation to content, response process, internal structure, relations to other variables, and consequences of its scores. MSSQ is a valid tool to detect sources of stress in medical students and its results can be utilised as a guide to plan wellness program or intervention to improve medical students' wellbeing.

REFERENCES

1. Yusoff MSB, Abdul Rahim AF, Baba AA, Ismail SB, Mat Pa MN, Esa AR. The impact of medical education on psychological health of students: a cohort study. *Psychology, Health & Medicine* [serial on the Internet]. 2012.

2. Elias H, Ping WS, Abdullah MC. Stress and academic achievement among undergraduate students in Universiti Putra Malaysia. *Procedia-Social and Behavioral Sciences*. 2011;29:646–55. <https://doi.org/10.1016/j.sbspro.2011.11.288>
3. Dyrbye LN, Thomas MR, Shanafelt TD. Medical student distress: causes, consequences, and proposed solutions. *Mayo Clinic Proc*. 2005;80(12):1613–22. <https://doi.org/10.4065/80.12.1613>
4. Yusoff MSB, Rahim AFA. Stress, stressors and coping strategies: first year medical students in Malaysian public universities. Saarbrücken, Germany: VDM Verlag Dr Muller GmbH & Co. KG; 2011.
5. Yusoff MSB, Rahim AFA, Yaacob MJ. Prevalence and sources of stress among Universiti Sains Malaysia medical students. *Malays J Med Sci*. 2010;17(1):30–7.
6. Smith CK, Peterson DF, Degenhardt BF, Johnson JC. Depression, anxiety, and perceived hassles among entering medical students. *Psychol Health Med*. 2007;12(1):31–9. <https://doi.org/10.1080/13548500500429387>
7. World Health Survey. Country report for Malaysia: Mental health condition. Shah Alam, Selangor: Institute for Health System Research; 2002.
8. Yusoff MSB, Mat Pa MN, Esa AR, Abdul Rahim AR. Mental health of medical students before and during medical education: A prospective study. *JTUMED*. in press. <https://doi.org/10.1016/j.jtummed.2013.03.004>
9. Dyrbye LN, Thomas MR, Shanafelt TD. Systematic review of depression, anxiety, and other indicators of psychological distress among US and Canadian medical students. *Acad Med*. 2006;81(4):354–73. <https://doi.org/10.1097/00001888-200604000-00009>
10. Niemi PM, Vainiomaki PT. Medical students' distress-quality, continuity and gender differences during a six-year medical programme. *Med Teach*. 2006;28(2):136–41. <https://doi.org/10.1080/01421590600607088>
11. Linn BS, Zeppa R. Stress in junior medical students: relationship to personality and performance. *J Med Educ*. 1984;59(1):7–12. <https://doi.org/10.1097/00001888-198401000-00002>
12. Dyrbye LN, Thomas MR, Massie F, Power DV, Eacker A, Harper W, et al. Burnout and suicidal ideation among US medical students. *Ann Intern Med*. 2008;149(5):334–41. <https://doi.org/10.7326/0003-4819-149-5-200809020-00008>
13. Akvardar Y, Demiral Y, Ergor G, Ergor A. Substance use among medical students and physicians in a medical school in Turkey. *Soc Psychiatry Psychiatr Epidemiol*. 2004;39(6):502–6. <https://doi.org/10.1007/s00127-004-0765-1>
14. Hays LR, Cheever T, Patel P. Medical student suicide, 1989–1994. *Am J Psychiatry*. 1996;153(4):553. <https://doi.org/10.1176/ajp.153.4.553>
15. Newbury-Birch D, White M, Kamali F. Factors influencing alcohol and illicit drug use amongst medical students. *Drug Alcohol Depend*. 2000;59(2):125–30. [https://doi.org/10.1016/S0376-8716\(99\)00108-8](https://doi.org/10.1016/S0376-8716(99)00108-8)
16. Pickard M, Bates L, Dorian M, Greig H, Saint D. Alcohol and drug use in second-year medical students at the University of Leeds. *Med Educ*. 2000;34(2):148–50. <https://doi.org/10.1046/j.1365-2923.2000.00491.x>
17. Yusoff MSB. Impact of summative assessment on first year medical students' mental health. *Intern Med J*. 2011;18(3):172–5.

18. Yusoff MSB, Esa AR. Stress management for medical students: a systematic review. In: Lopez-Varela MA, editor. *Social Sciences and Cultural Studies - Issues of Language, Public Opinion, Education and Welfare*. Croatia: InTech; 2012. <https://doi.org/10.5772/37095>
19. Kaufman DM, Mensink D, Day V. Stressors in Medical School: relation to curriculum format and year of study. *Teach Learn Med*. 1998;10(3):138–44. https://doi.org/10.1207/S15328015TLM1003_3
20. Kaufman DM, Day V, Mensink D. Stressors in 1st-Year medical school: comparison of a conventional and problem-based curriculum. *Teach Learn Med: An International Journal*. 1996;8(4):188–94. <https://doi.org/10.1080/10401339609539796>
21. Saipanish R. Stress among medical students in a Thai medical school. *Med Teach*. 2003;25(5):502–6. <https://doi.org/10.1080/0142159031000136716>
22. Guthrie EA, Black D, Shaw CM, Hamilton J, Creed FH, Tomenson B. Embarking upon a medical career: psychological morbidity in first year medical students. *Med Educ*. 1995;29(5):337–41. <https://doi.org/10.1111/j.1365-2923.1995.tb00022.x>
23. Guthrie EA, Black D, Bagalkote H, Shaw C, Campbell M, Creed F. Psychological stress and burnout in medical students: a five-year prospective longitudinal study. *J R Soc Med*. 1998;91(5):237–43.
24. Firth J. Levels and sources of stress in medical students. *Br Med J (Clin Res Ed)*. 1986;292(6529):1177–80. <https://doi.org/10.1136/bmj.292.6529.1177>
25. Salazar T. Critical synthesis package: medical student stressor questionnaire (MSSQ). *MedEdPORTAL Publications*. 2015;11:9986. Available from: <https://www.mededportal.org/publication/9986>. http://doi.org/10.15766/mep_2374-8265.9986
26. Yusoff MSB, Rahim AFA, Yaacob MJ. The development and validity of the Medical Student Stressor Questionnaire (MSSQ). *ASEAN Journal of Psychiatry*. 2010;11(1):231–5.
27. Yusoff MSB. A confirmatory factor analysis study on the medical student stressor questionnaire among Malaysian medical students. *Education in Medicine Journal*. 2011;3(1):44–53. <https://doi.org/10.5959/eimj.v3i1.95>
28. Yusoff MSB. A multicenter study on validity of the Medical Student Stressor Questionnaire (MSSQ). *Intern Med J*. 2011;18(1):14–8.
29. Yusoff MSB. The stability of MSSQ to measure stressors among medical students. *Intern Med J*. 2013;20(2):1–3.
30. Yusoff M, editor. *The Medical Student Stressor Questionnaire: a valid screening tool to discover sources of stress of medical students*. 3rd International Innovative Practices in Higher Education Expo 2016; 2016; Skudai: Universiti Teknologi Malaysia.
31. Liberati A, Altman DG, Tetzlaff J, Mulrow C, GÅtzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Annals of Internal Medicine*. 2009;6(7):1–28.
32. Cook DA, Beckman TJ. Current concepts in validity and reliability for psychometric instruments: theory and application. *Am J Med*. 2006;119(2):166. e7–e16.
33. Yusoff MSB, Liew YY, Ling H, Tan C, Loke H, Lim X, et al. A study on stress, stressors and coping strategies among Malaysian medical students. *International Journal of Students Research*. 2011;1(2):45–50. <https://doi.org/10.5549/IJSR.1.2.45-50>

34. Othman CN, Farooqui M, Yusoff MSB, Adawiyah R. Nature of stress among health science students in a Malaysian University. *Procedia-Social and Behavioral Sciences*. 2013;105:249–57. <https://doi.org/10.1016/j.sbspro.2013.11.026>
35. Yen Yee L, Yusoff MSB. Prevalence and sources of stress among medical students in Universiti Sains Malaysia and Universiteit Maastricht. *Education in Medicine Journal*. 2013;5(4):34–41. <https://doi.org/10.5959/eimj.v5i4.190>
36. Alina PC, Mihai B, Dana BA, Veronica J. Stress, coping and psychological adaptation in the Romanian and international first year medical students. Paper presented at The Association for Medical Education in Europe (AMEE) Conference 2014, 30 August-3 September 2014, Milan Italy; 2014.
37. Bob M, Popescu C, Pirlog R, Buzoianu A. Personality factors associated with academic stress in first year medical students. *HVM Bioflux*. 2014;6(1):40–4.
38. Upadhayay N, Khadka R, Paudel BH. Stressors and cognitive functions in medical and dental students. *Journal of Research in Medical Education & Ethics*. 2014;4(2):209–13. <https://doi.org/10.5958/2231-6728.2014.00891.9>
39. Upadhayay N, Khadka R, Paudel BH. Impact of educational stress on cortisol, cardiac autonomic drive and academic performance of medical students. *Asian J of Med Sci*. 2014;5(4):73–8. <https://doi.org/10.3126/ajms.v5i4.9843>
40. Fuad MD, Al-Zurfi BMN, Abdelqader MA, Abu Bakar MF, Elnajeh M, Abdullah MR. Prevalence and risk factors of stress, anxiety and depression among medical students of a private medical university in Malaysia. *Education in Medicine Journal*. 2015;7(2):52–9. <https://doi.org/10.5959/eimj.v7i2.362>
41. Fuad MDF, Lye MS, Ibrahim N, binti Ismail SIF, Kar PC. Prevalence and risk factors of stress, anxiety and depression among preclinical medical students in Universiti Putra Malaysia in 2014. *International Journal of Collaborative Research on Internal Medicine & Public Health*. 2015;7(1):1–12.
42. Gupta S, Choudhury S, Das M, Mondol A, Pradhan R. Factors causing stress among students of a Medical College in Kolkata, India. *Educ Health*. 2015;28(1):92–5. <https://doi.org/10.4103/1357-6283.161924>
43. Jena SK. Examination stress and its effect on EEG. *Int J Med Sci Pub Health*. 2015;11(4):1493–7. <https://doi.org/10.5455/ijmsph.2015.23042015308>
44. Mehrotra S, Devarakonda S. Stress in undergraduate medical education: a cross-sectional study. *International Journal of Recent Scientific Research*. 2015;6(4):3497–500.
45. Upadhayay N, Khadka R, Shakya DR, Paudel BH. Association of entrance examination marks with physiology academic performance in medical students. *Al Ameen Journal of Medical Sciences*. 2015;1(8):28–34.
46. Fuad MDF, Al-Zurfi BMN, Abdalqader MA, Baobaid MF, Elnajeh M, Ariffin IA, et al. Prevalence and risk factors of depression among medical students in a Malaysian private university. *Malaysian Journal of Public Health Medicine*. 2016;16(3):87–92.
47. Cook DA, Beckman TJ. Current concepts in validity and reliability for psychometric instruments: theory and application. *Am J Med*. 2006;119(2):166.e7–.e16.
48. Polit DF, Beck Ct, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendation. *Res Nurs Health*. 2007;30:459–67. <https://doi.org/10.1002/nur.20199>

49. Streiner LD, Norman GR. Health measurement scales: a practical guide to their development and use. 4th ed. New York: Oxford University Press; 2008. <https://doi.org/10.1093/acprof:oso/9780199231881.001.0001>
50. Polit DF, Beck CT. Nursing research: principles and methods. Philadelphia, PA: Lippincott Williams & Wilkins; 2004.
51. Downing SM, Haladyna TM. Validity threats: overcoming interference with proposed interpretations of assessment data. *Med Educ*. 2004;38(3):327–33. <https://doi.org/10.1046/j.1365-2923.2004.01777.x>
52. Mosier CI. A critical examination of the concepts of face validity. *Educ Psychol Meas*. 1947; 7(2): 191–205. <https://doi.org/10.1177/001316444700700201>
53. DeVon HA, Block ME, Moyle-Wright P, Ernst DM, Hayden SJ, Lazzara DJ, et al. A psychometric toolbox for testing validity and reliability. *J Nurs Scholarsh*. 2007;39(2):155–64. <https://doi.org/10.1111/j.1547-5069.2007.00161.x>
54. Yusoff MSB, Pa MNM, Mey SC, Aziz RA, Rahim AFA. A longitudinal study of relationships between previous academic achievement, emotional intelligence and personality traits with psychological health of medical students during stressful periods. *Educ Health*. 2013;26(1):39–47. <https://doi.org/10.4103/1357-6283.112800>
55. Furnham A, Cheng H. Personality as predictor of mental health and happiness in the East and West. *Personality and Individual Difference*. 1999;27:395–403. [https://doi.org/10.1016/S0191-8869\(98\)00250-5](https://doi.org/10.1016/S0191-8869(98)00250-5)
56. Yusoff MSB, Rahim AFA, Esa AR. EQ, academic & personality traits: do they correlate with medical students' future performance? Germany: Lambert Academic Publishing; 2012.
57. Yusoff MSB. Interventions on medical students' psychological health: a meta-analysis. *JTUMED*. 2014;9(1):1–13. <https://doi.org/10.1016/j.jtumed.2013.09.010>