Visual Analogue Scale for Stress Overload: a validation assessment to support occupational health surveillance in South Africa

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ABSTRACT

Background: Clinicians and researchers increasingly require short, efficient methods for assessing distress, in both applied research and clinical settings. Available questionnaires may be unsuitable due to language constraints or time burdens. The Visual Analogue Scale for Stress Overload (VAS-SO) is brief and may lessen the risk for semantic misinterpretation.

Objectives: The validity of the VAS-SO to screen for stress overload was assessed in the context of occupational health screening, in a South African sample of skilled workers.

Methods: Employees (N = 428) participating in occupational health assessments completed the VAS-SO and other mental health measures. Correlation, linear regression, and receiver operating/operator characteristic curve analysis were conducted to determine criterion validity and scale thresholds for clinical application.

Results: Negligible socio-demographic effects were observed. The VAS-SO appeared to be as effective as the longer scales in identifying stress overload. Practically useful lower and upper thresholds (> 4 and > 7) were identified to guide clinical decision-making. The VAS-SO scores were associated with a history of recent experience of workplace trauma, as well as with the severity of depression and anxiety symptoms.

Conclusion: The study provided evidence that the VAS-SO is a good alternative to longer questionnaires to identify high stress overload and risk for common psychiatric disorders. It further highlights the importance of locally developed thresholds to guide clinical decision-making.

INTRODUCTION

Recent reports have revealed that workers in sub-Saharan Africa are suffering from extremely high levels of stress, with 48% of the workforce reporting excessive stress daily.[1] Worldwide, stress has steadily increased over the past decade.[2] Psychological stress is typically described from a transactional perspective,[3] where individuals evaluate both the demands they face (referred to as primary appraisal) and the resources available to them (referred to as secondary appraisal). In the transactional definition, stress may occur when individuals appraise the demands of their environments as exceeding their personal resources – a state termed 'overload'. When overload is experienced, wellbeing is negatively affected.[3] Stress is generally understood as part of daily life. Stress overload refers to a person's perception that the demands of life are overwhelming his or her available resources.[4]

Surveillance of psychological stress is not specifically addressed in the Occupational Health and Safety Act (Act No. 85 of 1993, and as amended) or its Regulations. However, given the deleterious effect of stress overload on both general health and workplace safety,[4] some form of basic screening within the occupational health environment may be beneficial.

Several tools are available to measure stress, such as the older 14-item Perceived Stress Scale (PSS)[5] and the more modern 10-item Stress Overload Scale-short form (SOS-S).[6] Scores on the SOS-S indicate respondents' perceptions that the demands of their lives are overwhelming their available resources.[6] Evidence of its validity in the South African context exists, as well as its utility to predict the presence of major depressive disorder (MDD) and general anxiety disorder (GAD).[7] The Patient Health Questionnaire (PHQ-9) and the Generalized Anxiety Disorder Scale (GAD-7) are commonly used to screen for depressive and generalised anxiety symptoms; for both, scores ≥ 10 indicate cases of probable MDD or GAD.[8-10] In spite of the widespread use of stress measurement scales such as the PSS or SOS-S, they are often impractical for routine clinical use in occupational medicine due to their length or language requirements.[11-13] A simpler and more feasible alternative is the single-item Visual Analogue Scale for Stress Overload (VAS-SO).

Visual analogue scales (VASs), first described by Hayes and Patterson in 1921,[14,15] were initially used to measure subjective pain, but have since become more widely used for the measurement of other subjective characteristics that cannot easily be measured directly, such as mood, distress, or attitudes.

Typically, VASs comprise a continuous or dashed horizontal line with a descriptive phrase, or anchor text, at each end. The scale commonly ranges from 0 or 1 on the left (least extreme) to 10 on the right (most extreme). Respondents specify their level of agreement with a statement by indicating a position along the line. Horizontal scales are the most common and are generally more sensitive than vertical ones.[16]

VASs are particularly useful when assessing single constructs with multiple gradations, and evidence suggests that unipolar VASs ('not at all anxious' to 'extremely anxious') are more easily understood than bipolar VASs ('extremely calm' to 'extremely anxious').[17] A VAS can be presented in several ways, including a straight line with anchor texts at start and end, the inclusion

of other elements such as additional anchors, incorporating a numeric index (e.g. 1 through to 10), the use of colour to represent graduations, or 'box-scales' with equidistant markers.

Evidence supports VASs as having superior metrical characteristics compared to discrete scales, allowing a broader range of statistical analyses.[18] When compared with other discrete linear scales such as Likert or Borg scales, VASs have similar sensitivity and reproducibility, but often outperform these tools in specific scenairos.[18,19]

VASs offer several advantages over other types of scales.[20] Their analogue nature provides higher sensitivity to small changes, particularly when measuring variations within individuals.[21] It is brief, and the visual presentation lessens the risk of semantic misinterpretation due to literacy or language concerns. Additionally, data from some VASs can be converted parametrically to an interval-scale, enabling a greater range of statistical analyses. The VAS has some limitations in that it may not be appropriate for very young and very old respondents, and photocopying may distort the line, making manual measurement difficult.[21,22] Despite these drawbacks, its overall simplicity and effectiveness make it a compelling choice in occupational health settings – it is easy to administer, quick to complete, and readily understood by respondents. In response, occupational physicians have, over the past two decades, increasingly used a 10-point VAS to assess stress among workers.[11,23,24] This tool enables rapid identification of individual or collective distress within a workgroup, paving the way for timely interventions at both the individual and organisational levels.[12]

The VAS-SO is an application of a visual analogue scale to assess specifically for stress overload. It comprises a 150-mm horizontal line with anchors at 1 and 10, accompanied by descriptive phrases and equidistant numerical guides (see Figure 1). Workers are asked to *"indicate how stressed and overwhelmed you have felt over the past two months"*. The inclusion of dashes between the numerical guides allows for scoring to one decimal through visual inspection, enhancing precision.

The single-item VAS-SO to measure perceived stress has demonstrated satisfactory stability and high inter-rater reliability, and has been shown to be correlated strongly with results from the PSS-14 ($r = 0.69$; Lin's CCC = 0.66).[11,12,25,26] Additionally, studies have found moderate to strong correlations between VAS-SO scores and measures of depression and anxiety.[11] These findings underscore the tool's validity as a measure of psychological distress in occupational settings.

Linear regression and receiver operating/operator characteristic (ROC) curve analysis have previously identified a VAS-SO score of 7 as the optimal cut-off to indicate 'high stress' in occupational environments.[12] Other researchers advocate for a more nuanced approach, using a 'grey-zone' model to account for variability, whereby lower and upper cut-offs are established to balance sensitivity and specificity.[13] Previous reports suggested that a score of 5 may delineate the 'at-risk' threshold – interpreted as requiring closer surveillance, and that a score of 8.2 or higher may delineate the 'intervention' threshold – interpreted as requiring urgent action.[13]

In this study, the validity of the VAS-SO to screen for stress overload was assessed in the context of occupational health screening, in a South African sample of skilled workers with at least grade 12 education. The specific objectives were 1) to describe the VAS-SO responses and possible socio-demographic associations in a group of workers, 2) to compare VAS-SO and SOS-S responses, using criterion validity analysis, and 3) to investigate the practical usefulness of the VAS-SO for identifying cases of high stress overload and other common mental disorders.

METHODS

This was a retrospective record review of data collected from September to November 2022, from records maintained by an occupational health practice in Cape Town, South Africa. The data came from the occupational health assessments of 428 skilled workers, and included age, sex, occupational field, home language, and the occurrence (yes or no) of a traumatic experience at work in the past two years. A description of the 'traumatic event' was not provided. The workers were employed by companies that provide technical support to the maritime, aviation, and associated security industries, or were employed directly within those industries. The majority of workers were based in the Western Cape. The workers represented a wide range of vocational backgrounds, detailed in Table 1. Workers also completed four psychometric measures, in pen-and-paper format, namely the VAS-SO, the SOS-S, the Patient Health Questionnaire (PHQ-9), and the Generalized Anxiety Disorder Scale (GAD-7). The SOS-S was used as the reference standard for stress overload, while the PHQ-9 was used to assess depressive symptoms, and the GAD-7 to assess generalised anxiety.

Data analysis

Statistical analyses were conducted using Statistical Package for Social Sciences (IBM SPSS for Windows, version 27). The VAS-SO responses were described using score means, standard deviations, and ranges. Pearson's correlation was used to assess the association of VAS-SO scores with age, while t-tests for independent samples were used to compare VAS-SO scores across sex and language categories.

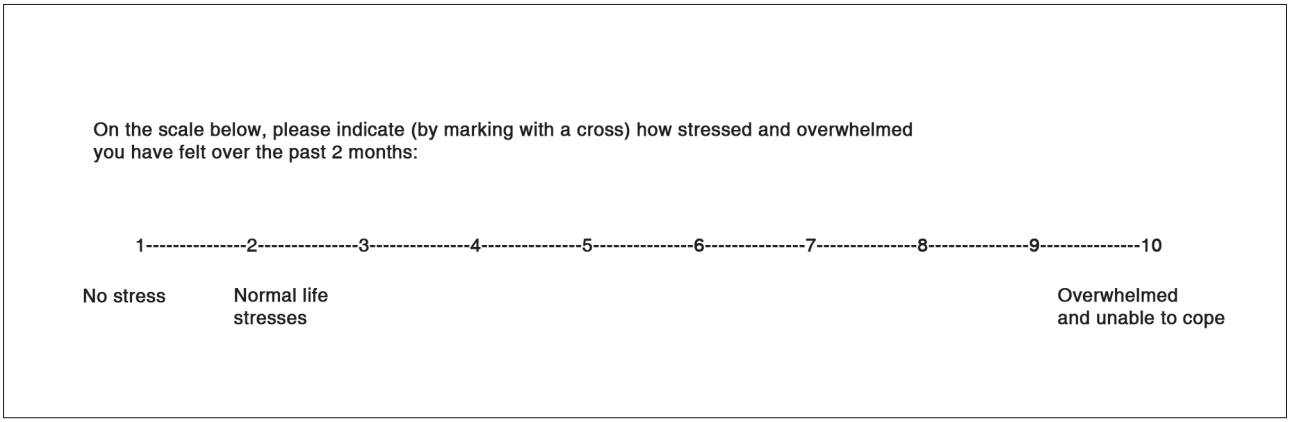

Figure 1. Visual Analogue Scale for Stress Overload

Table 1. Socio-demographic characteristics of the study participants (N = 428)

Characteristic	n	%
Sex		
Female	114	26.6
Male	314	73.4
Language		
English	90	21.0
Afrikaans	67	15.7
Setswana	62	14.5
isiXhosa	49	11.4
Sesotho	41	9.6
Sepedi	40	9.3
isiZulu	39	9.1
Tshivenda	17	4.0
Tsonga	10	2.3
siSwati	7	1.6
Ndebele	6	1.4
Vocational background		
Technical/engineering	96	22.4
Maritime	59	13.7
Clerical/administrative	58	13.6
Security	28	6.6
Catering/hospitality	24	5.5
Other*	163	38.1

* Vocational groups comprising ≤ 3% of the study sample were categorised as 'other', e.g. surveyors, radar operators, data analysts.

Table 2. Scores from, and internal consistency measures of, the different stress measurement scales

Stress measurement scale	Score			Internal consistency	
	Mean	SD	Range	Cronbach's α	McDonald's ω
VAS-SO	3.31	1.69	1–10		
SOS-S	3.24	1.44	1–10	0.926	0.929
PHQ-9	2.06	3.38	0–23	0.836	0.846
GAD-7	1.40	2.78	0–20	0.881	0.885

GAD-7: Generalized Anxiety Disorder Scale, PHQ-9: Patient Health Questionnaire-9, SD: standard deviation, SOS-S: Stress Overload Scale–short form, VAS-SO: Visual Analogue Scale for Stress Overload

Criterion validity: The same descriptive analyses were conducted for the SOS-S responses, to allow for comparison of the data from the two scales. Further analysis of the relationship between the two tools was conducted using Pearson's correlation, and Lin's concordance correlation. T-tests for independent samples were conducted, for both measures, to explore score differences between workers with, and without, histories of recent traumatic experience at work.

Practical utility: An optimal VAS-SO single cut-off score as well as lower and upper grey-zone thresholds, for the purpose of identifying high stress overload during occupational health screening, were determined by replicating earlier studies that used a linear regression equation and ROC curve analysis.[12,13] The equation of the linear regression to determine the cut-off score for high stress overload was: VAS-SO = 0.658 + 1.171 x South African SOS-S score reference of 4.4.[7,12] The correlation of VAS-SO scores with PHQ-9 and GAD-7 scores was also calculated. Optimal cut-off VAS-SO scores to identify cases of MDD and GAD were determined by means of an ROC curve analysis, using probable cases as state variables, with results reported as area under the curve (AuC) and sensitivity/specificity ratios.

The Health Research Ethics Committee of Stellenbosch University approved the analysis of the psychometric data (clearance certificate #N20/07/078).

RESULTS

The mean age of the participants was 34.2 years (± 10.5, range 20–64), and English as first language was spoken by 90 (21.0%), as shown in Table 1. All workers had at least a Grade 12 education, as well as vocational training qualifications (which were reportedly obtained in English).

The means, standard deviations, and ranges of the VAS-SO, SOS-S, PHQ-9, and GAD-7 scores are shown in Table 2. As may occur with unipolar scales, the VAS-SO scores were not normally distributed, as shown in Figure 2 (skewness = 1.351, SE = 0.118; kurtosis = 2.357, SE = 0.235).

Both the VAS-SO and the SOS-S scores showed very weak but statistically significant correlations with age (Table 3). There was also a negligible but statistically significant difference between the VAS-SO scores of women and men (women scored < 0.5 points higher than men, $p < 0.001$). There was no significant effect of sex on the SOS-S scores ($p = 0.096$), and no significant language-related differences were observed for either the VAS-SO or the SOS-S mean scores ($p = 0.485$ and $p = 0.429$, respectively).

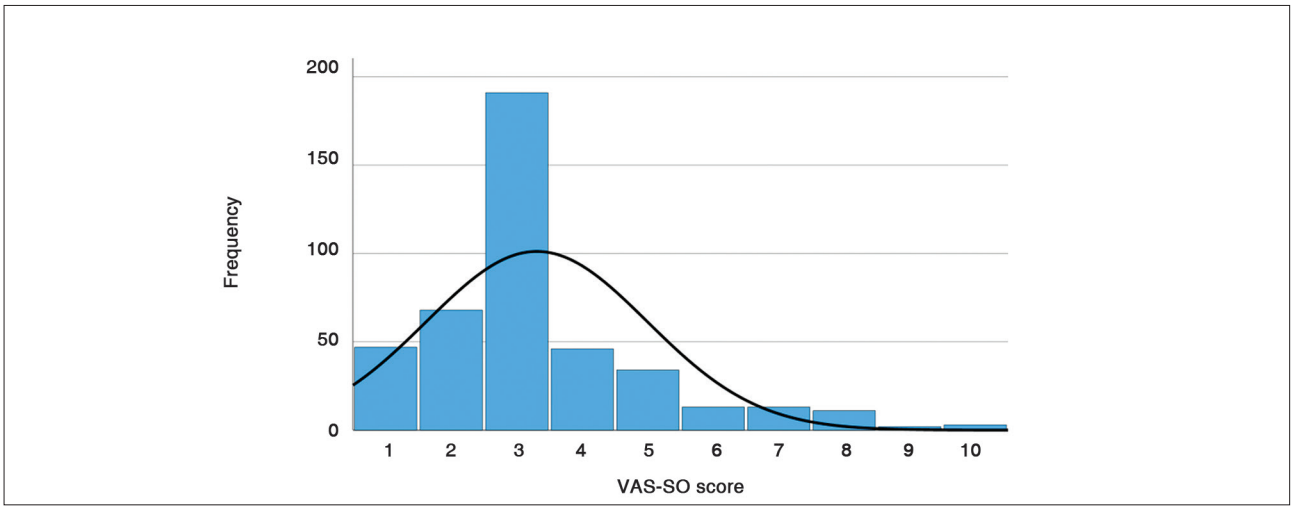

Figure 2. Distribution of Visual Analogue Scale for Stress Overload scores

The VAS-SO scores were strongly correlated with the SOS-S, the PHQ-9, and the GAD-7 scores (see Table 3). Lin's concordance correlation was 0.611. Scores from both the VAS-SO and the SOS-S differentiated between workers with, and without, history of recent traumatic experience at work ($p < 0.001$ for both). Workers with a recent history of traumatic experiences scored 1.0 point higher on the SOS-S, and 3.5 points higher on the VAS-SO, which provides substantially stronger differentiation than the SOS-S.

The linear regression equation yielded a VAS-SO cut-off score > 6 for the identification of high stress overload. The same score to identify high stress overload was observed in an ROC curve analysis. This process to locate grey-zone lower and upper thresholds for clinical use identified a score of > 4 as the lower threshold ('at risk'), and a score of > 7 as the upper threshold ('urgent action').

VAS-SO scores likewise identified cases of probable MDD (AuC = 0.908, sensitivity = 84%, specificity = 94%) and probable GAD (AuC = 0.953, sensitivity = 78%, specificity = 92%) at an optimal cut-off point of > 6 for both conditions.

DISCUSSION

This analysis was conducted to assess the validity of the VAS-SO in the context of occupational health screening, in a South African sample of skilled workers. The novelty of the study was the validation of the VAS-SO against the more modern but lengthier and language-dependant SOS-S instrument, and to investigate its utility in identifying high stress overload by reporting South African cut-off values for stress overload. The absence of significant differences in the mean VAS-SO and SOS-S scores, as well as their strong correlation, provides evidence of criterion validity (i.e. that both scales measure the same construct). As such, the findings suggest that the simpler VAS-SO is as good as other existing scales for measuring stress overload, similar to previous findings from comparable measures like the PSS.[12] The VAS-SO outperformed the SOS-S in differentiating workers with recent histories of traumatic experience at work from those without. The large difference of 3.5 points could be clinically useful in this regard, and alert practitioners to potential maladaptive post-trauma distress. The absence of a significant language effect provided support for the use of the VAS-SO in multilingual populations with similar education as the current sample.

A colour-coded VAS-SO (Figure 3) may be of benefit for workers with low literacy levels. The colours could support interpretation for health personnel, although colour blindness in participants would limit the usefulness of such a tool. As such, its potential benefits would need to be rigorously tested before any widespread use in southern Africa's multicultural and multilingual populations.

The ability of VAS-SO scores to track the severity of depressive and anxiety symptoms is similar to previous reports.[11] Its accuracy in identifying cases of probable MDD and GAD has application in clinical practice. Specifically, a score > 6 was clinically useful to indicate high stress overload and risks for MDD and GAD in this sample of workers. This cut-off score for a South African worker population was 1.0 point lower than reported for European workers in a study published by Lesage and Berjot (2011).[12] The description of the 'grey-zone' is useful to indicate if workers should be more closely monitored (score > 4 = 'at risk') or if there should be immediate intervention (score > 7 = 'urgent action'). It is noteworthy that both the lower and upper thresholds were 1.0 point lower than those reported in an occupational medicine environment in France,[13] emphasising the importance of using locally developed thresholds for decision-making. It should be cautioned that the VAS-SO is not a case-finding tool for MDD or GAD.[11] While high chronic stress levels may constitute a major risk factor for common mental disorders, the aetiology of mood and anxiety disorders is located in complex intersections of biological, environmental, social, and psychological factors, and their occurrence cannot necessarily be attributed to specific experiences of stress.

The study sample was limited to skilled workers with some English proficiency, which restricts generalisability to less educated or non-English-speaking populations. Further, 'recent experience of trauma in the workplace' was not defined and, although the occurrence of trauma was reflected in higher mean scores, it is not clear whether this would be practically useful to identify individuals at risk for post-traumatic psychological distress – at least not until more clearly assessed in future research.

Given the hypothesised advantage of the visual (versus verbal) nature of the tool, future studies need to evaluate the VAS-SO in more diverse groups and consider user feedback to refine its design. A colour-coded version could enhance usability for workers with low literacy, although this requires further testing in multilingual settings.

Table 3. Correlations between the stress measurement scales, age, and mental health measures

Stress measurement scale	Age		SOS-S		PHQ-9		GAD-7	
	r	p value	r	p value	r	p value	r	p value
VAS-SO	- 0.165	< 0.001	0.604	< 0.001	0.634	< 0.001	0.666	< 0.001
SOS-S	-0.102	0.035			0.587	< 0.001	0.602	< 0.001

GAD-7: Generalized Anxiety Disorder Scale, PHQ-9: Patient Health Questionnaire-9, SOS-S: Stress Overload Scale–short form, VAS-SO: Visual Analogue Scale for Stress Overload

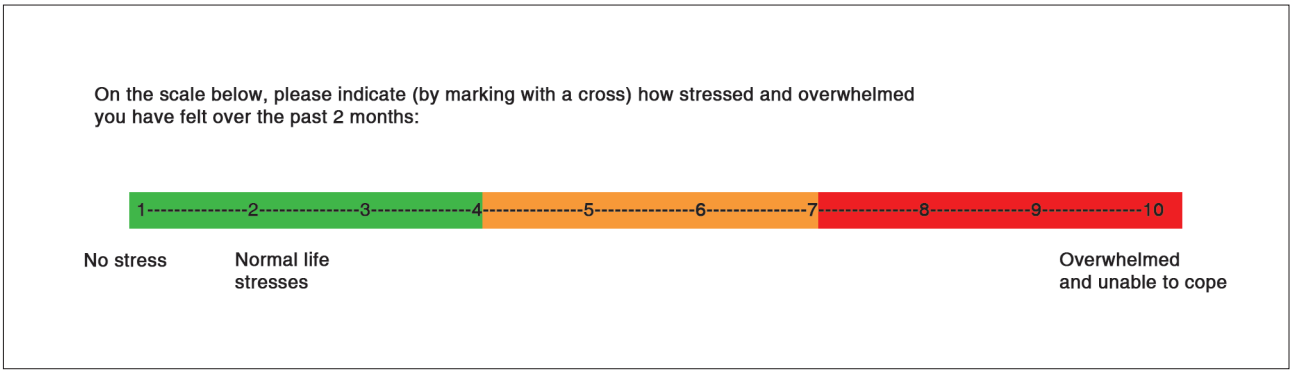

Figure 3. Colour-coded Visual Analogue Scale for Stress Overload

CONCLUSION

The VAS-SO appears to be a good alternative to lengthier perceived stress overload questionnaires. Good criterion validity and practical utility, and negligible age, sex, and language effects, were observed. It displays good accuracy in identifying high stress overload, and can also identify possible risks for MDD and GAD. The grey-zone approach is clinically useful in that it allows for both a lower threshold, to support sensitivity ('at risk'), and an upper threshold, to support specificity ('urgent intervention'), which could be visually represented in colour for easy interpretation. In this regard, the study also highlighted the importance of locally developed thresholds to guide clinical decision-making.

KEY MESSAGES

1. The Visual Analogue Scale for Stress Overload (VAS-SO) is useful to identify high stress overload and other mental health risks in occupational settings.
2. The VAS-SO is brief, visually intuitive, and minimises language barriers, making it suitable for diverse, multilingual workplaces.
3. South African workers reported lower VAS-SO thresholds than European counterparts, emphasising the importance of locally derived norms to support decision-making regarding monitoring or intervention of workers' stress.

DECLARATION

The author declares that this is his own work, that all the sources used in this paper have been duly acknowledged, and that there are no conflicts of interest.

AUTHOR CONTRIBUTIONS

CHvW was responsible for all aspects of the study, from conception and design to writing of the manuscript.

REFERENCES

1. State of the Global Workplace, 2024 Report. Washington, D.C.: Gallup; 2024. Available from: https://www.gallup.com/workplace/349484/state-of-the-global-workplace.aspx? (accessed 2 December 2024).
2. Gallup 2024 Global Emotions Report. Washington, D.C.: Gallup; 2024. Available from: https://www.gallup.com/analytics/349280/gallup-global-emotions-report.aspx (accessed 2 December 2024).
3. Lazarus RS, Folkman S. Stress, appraisal, and coping. New York, NY: Springer; 1984.
4. Amirkhan JH, Urizar GG, Clark S. Criterion validation of a stress measure: The Stress Overload Scale. Psychol Assess. 2015; 27:985–996. doi: 10.1037/pas0000081.
5. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav. 1983; 24(4):385-396. doi: 10.2307/2136404.
6. Amirkhan JH. A brief stress diagnostic tool: the Short Stress Overload Scale. Assessment. 2018; 25(8):1001-1013. doi: 10.1177/1073191116673173.
7. Van Wijk CH. Usefulness of the English version Stress Overload Scale in a sample of employed South Africans. Afr J Psychol Assess. 2021; 3:a41. doi: 10.4102/ajopa.v3i0.41.
8. Gilbody S, Richards D, Barkham M. Diagnosing depression in primary care using self-completed instruments: UK validation of PHQ-9 and CORE-OM. Br J Gen Pract. 2007; 57(541):650-652.
9. Van Wijk CH, Martin JH, Maree DJF. Clinical validation of brief mental health scales for use in South African occupational healthcare. SA J Ind Psychol. 2021; 47:a1895. doi: 10.4102/sajip.v47i0.1895.
10. Löwe B, Decker O, Müller S, Brähler E, Schellberg D, Herzog W, et al. Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. Med Care. 2008; 46(3):266-274. doi: 10.1097/mlr.0b013e318160d093.
11. Lesage F-X, Berjot S, Deschamps F. Clinical stress assessment using a visual analogue scale. Occup Med (Lond). 2012; 62(8):600-605. doi: 10.1093/occmed/kqs140.
12. Lesage F-X, Berjot S. Validity of occupational stress assessment using a visual analogue scale. Occup Med (Lond). 2011; 61(6):434-346. doi 10.1093/occmed/kqr037.
13. Dutheil F, Pereira B, Moustafa F, Naughton G, Lesage F-X, Lambert C. At-risk and intervention thresholds of occupational stress using a visual analogue scale. PLoS One. 2017; 12(6):e0178948. doi: 10.1371/journal.pone.0178948.
14. Hayes MHS, Patterson DG. Experimental development of the graphic rating method. Psychol Bull. 1921; 18:98-99.
15. Yeung AWK, Wong NSM. The historical roots of Visual Analog Scale in psychology as revealed by reference publication year spectroscopy. Front Hum Neurosci. 2019; 13:86. doi: 10.3389/fnhum.2019.00086.
16. Wewers ME, Lowe NK. A critical review of visual analogue scales in the measurement of clinical phenomena. Res Nurs Health. 1990; 13(4):227-236. doi: 10.1002/nur.4770130405.
17. Revill SI, Robinson JO, Rosen M, Hogg MI. The reliability of a linear analogue for evaluating pain. Anaesthesia. 1976; 31(9):1191-1198. doi: 10.1111/j.1365-2044.1976.tb11971.x.
18. Reips U-D, Funke F. Interval-level measurement with visual analogue scales in Internet-based research: VAS Generator. Behav Res Methods. 2008; 40(3):699-704. doi: 10.3758/brm.40.3.699.
19. Grant S, Aitchison T, Henderson E, Christie J, Zare S, McMurray J, et al. A comparison of the reproducibility and the sensitivity to change of visual analogue scales, Borg scales, and Likert scales in normal subjects during submaximal exercise. Chest. 1999; 116(5):1208-1217. doi: 10.1378/chest.116.5.1208.
20. Klimek L, Bergmann KC, Biedermann T, Bousquet J, Hellings P, Jung K, et al. Visual analogue scales (VAS): measuring instruments for the documentation of symptoms and therapy monitoring in cases of allergic rhinitis in everyday health care: Position Paper of the German Society of Allergology (AeDA) and the German Society of Allergy and Clinical Immunology (DGAKI), ENT Section, in collaboration with the working group on Clinical Immunology, Allergology and Environmental Medicine of the German Society of Otorhinolaryngology, Head and Neck Surgery (DGHNOKHC). Allergo J Int. 2017; 26(1):16-24. doi: 10.1007/s40629-016-0006-7.
21. Briggs M, Closs JS. A descriptive study of the use of visual analogue scales and verbal rating scales for the assessment of postoperative pain in orthopedic patients. J Pain Symptom Manage. 1999; 18(6):438-446. doi: 10.1016/S0885-3924(99)00092-5.
22. Byrom B, Elash CA, Eremenco S, Bodart S, Muehlhausen W, Platko JV, et al. Measurement comparability of electronic and paper administration of visual analogue scales: a review of published studies. Ther Innov Regul Sci. 2022; 56(3):394-404. doi: 10.1007/s43441-022-00376-2.
23. Dutheil F, Boudet G, Perrier C, Lac G, Ouchchane L, Chamoux A, et al. JOBSTRESS study: comparison of heart rate variability in emergency physicians working a 24-hour shift or a 14-hour night shift – a randomized trial. Int J Cardiol. 2012; 158(2):322-325. doi: 10.1016/j.ijcard.2012.04.141.
24. Dutheil F, Trousselard M, Perrier C, Lac G, Chamoux A, Duclos M, et al. Urinary interleukin-8 is a biomarker of stress in emergency physicians, especially with advancing age – the JOBSTRESS* randomized trial. PLoS One. 2013; 8(8):e71658. doi: 10.1371/journal.pone.0071658.
25. Lesage F-X, Chamoux A, Berjot S. [Stability of the visual analogue scale in stress assessment]. Arch des Mal Prof et de l'Environnement. 2009; 70:619-622. doi: 10.1016/j.admp.2009.10.016.
26. Lesage F-X, Berjot S, Deschamps F. [Inter-judge reliability of stress measurement using a visual analogue scale]. Psychol du Trav et des Organ. 2011; 17(1):85-90.