



VALIDITY AND RELIABILITY OF VISUAL ANALOGUE SCALE (VAS) FOR PAIN MEASUREMENT

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Abstract:

Aim: The aim of the study was to find out the validity and reliability of visual analogue scale in pain measurement.

Methodology: A critical review was done for this study. Total ten studies are included in this study. The majority of study designs are cross sectional study. In analyses most of the studies used spearman correlation was used to see the strength of the study. The participants' age was more than 18 years. The most of the studies seen the post-operative pain by pain measurement scale. The used scales were visual analogue scale, numeric rating scale, color analogue scale and faces pain scales.

Conclusion: The majority of the studies showed that visual analogue scale is a valid and reliable scale. Also, it is an interval scale. So, in clinical practice we can use this scale in case of pain measurement as an outcome measure tool.

Key words: Validity, Reliability, Visual Analogue Scale, Pain.

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Introduction:

Pain is appearing a common phenomenon that accompanies a variety of conditions. In clinical research the intensity of pain is assessed widely.

The pain assessment in systematically is essential for correct diagnosis. This pain is a subjective part for both patient and health care

professionals. So, require a valid and reliable tool for measurement of pain [1].

Recently, there are different type of scale are used for assessing pain but without any valid (accurate) and reliable (reproducible) instruments it is very difficult to find real effect of treatment. The intensity of pain is a quantitative estimation and the most commonly used pain scales are the Visual Analogue Scale (VAS), the Numerical Rating Scale (NRS) the Verbal Rating Scale (VRS) [2].

VAS is widely used as a measure of pain intensity in globally. It has been shown that VAS is valid, reliable and interval scale [3]. VAS has high test-retest reliability and repeatability [4]. In this VAS, it has a continuous scale consist of a horizontal and vertical line that called vertical VAS and horizontal visual analog scale. There is good correlation between vertical and horizontal VAS. But the score of horizontal have slightly lower than the vertical VAS [5].

VAS is used in epidemiological and clinical research to measure the intensity or frequency of a variety of clinical symptoms. In randomized controlled trials, clinical trials VAS is frequently used to determine the effectiveness of treatment as an outcome measure. VAS is also very much popular in the gynecological area. In post-operative pain this scale is applied in measurement of pain. After caesarean section the VAS is used to assessing pain [6]. The VAS is a ratio scale though it has a zero point. In a study it is shown that VAS reflected accurate ratios or proportions of pain intensity and demonstrated a zero point [7].

It is mentioned that to use the VAS need to require at least a minimum level of motor

abilities to use the scale because it is more difficult to understand [8]. In daily clinical practice there is critical need of reliable and valid scale for assessing pain. It is found that internationally 7% to 11% people are unable to rate their pain at VAS scale. Because some patients had difficulty to interpreting their pain intensity and some had complexity to think. In this circumstance Numeric Pain Rating Scale (NPRS) is quite easy to administering the score [9]. This scale is a simple and has a subjective measure that consists of an eleven-point numerical scale [10]. The aim of this study was to find out the recent available evidence on validity and reliability of Visual Analogue Scale (VAS) for pain measurement.

Methodology:

A critical review was done to conduct this study. A limited search of Google Scholar and PubMed was undertaken in search strategy.

Results:

Total ten studies are included in this study. The majority of study designs are cross sectional study. In analyses most of the studies used spearman correlation was used to see the strength of the study. The participants' age was more than 18 years. The most of the studies is seen the post-operative pain by pain measurement scale. The used scales were visual analogue scale, numeric rating scale, color analogue scale and faces pain scales. All studies are shown in the table 1. These studies are presented briefly in below:

Table 1 Summary of included studies

Authors	Aim	Study design	Sample size	Age in years	Used Scales	Outcome measures	Analyzes	Results	Conclusion
1. Ismail, et al. (2015)	On acute pain	Cross sectional study	133	18-30	VAS, NRS	VAS, NRS	Spearman's correlation test, Bland-Altman analysis and Cohen's k test	1. VAS and verbal NRS are strongly correlated	VAS and verbal NRS is reliable
2. Bahreini, et al. (2015)	On acute pain	Cross sectional study	150	≥18	NRS, VAS and CAS	NRS, VAS and CAS	Spearman's correlation test and Bland-Altman analysis	1. Strong correlation between NRS, VAS and CAS. 2. Statistically significant all scales (p<0.05)	NRS, CAS and VAS can be applied for acute pain measurement in adult patients.
3. Noback, et al. (2015)	On long term effect on pain	Retrospective review	74	Mean age 54 years	VAS	DASH, SF-36, VAS	Spearman's correlation test	1. Weak correlation between VAS and change in pain	VAS has a poor correlation in changing pain in long term effect
4. Mandysova and Kadleckova (2015)	On caesarean women with acute postoperative pain	Cross sectional study	75	Mean age 47.5 years	VAS/NRS, NRS and FPS	VAS/NRS, NRS and FPS	Spearman's correlation test	1. Spearman correlation was high for 3 scales 2. Statistically significant all scale but better significant result in FPS, NRS score than VAS/NRS	VAS, NRS and FPS can be used but NRS and FPS is more effective for postoperative women
5. Boonstra, et al. (2008)	On chronic pain	Cross sectional study	344	Mean age 44 years	VAS	VAS, Roland Morris Disability questionnaire, SF-36.	Spearman's correlation test	1. Spearman correlation indicate weak correlation	Reliability VAS is good but poor validity of VAS.
6. Valente, et al. (2011)	Compare validity of 4 scales	Cross sectional study	109	18-40	VAS, NRS, FPS	VAS, NRS, FPS	ANOVA, correlation	1. NRS and VAS has a higher F test than FPS 2. All scales can impact on temperature. Low temperature showed high pain intensity 3. Also impact on women. Women complain high pain intensity	VAS, NRS and FPS are valid scales
7. Joseph et al. (2016)	On correlation among these scales	Prospective observational design	170	20-65	NDI, VAS and likert scale	NDI, VAS and likert scale	Spearman's correlation of coefficient, Wilcoxon and paired t' test.	1. The VAS and NDI showed positive correlation and statistically significant	All scales are valid
8. Chanques, et al., (2010)	To compare the feasibility, validity and performance of these 5 scales on ICU setting	Psychometric study	111	48-69	VAS-H, VAS-V, VDS, NRS-O and NRS-V	VAS-H, VAS-V, VDS, NRS-O and NRS-V	ANOVA, Regression	1. A good validity and responsiveness for the 5 scales. 2. NRS-V is most valid and feasible	All scales are valid but more validity showed NRS-V
9. Gupta, et al. (2016)	On post caesarian women to measure reliability	Analytical study	100	21-30 y	VAS, FPS	VAS, FPS	Spearman's correlation, independent t' test	1. In between group analysis VAS is highly significant than FPS.	VAS is valid and reliable scale for post operative Caesarian women.
10. Brokelman, et al. (2012)	To assess validity and reliability of VAS after hip	Prospective study	147	Mean age 67.5y	VAS	WOMAC, SF-36, Oxford hip score and Harris hip score (HHS).	Spearman's correlation, intra-class coefficient.	1. Test retest intra class coefficient of 0.95 and higher effect	VAS is a valid scale in patients with hip arthroplasty

N.B: VAS- Visual Analogue Scale, NRS- Numeric Rating Scale, FPS-Facial Pain Scale, CAS-Color Analogue Scale, VDS-Verbal Descriptor Scale, SF- Short Form Health Survey, WOMAC-Western Ontario McMaster Universities Osteoarthritis Index, NDI- Neck Disability Index.

Discussion:

The aim of the study was to find out the validity and reliability of visual analogue scale in pain measurement by this critical review.

A study was conducted on assessment of acute pain by using VAS and verbal NRS. The aim was to compare between two scales on acute pain in prehospital setting. This was a cross sectional study. The data collection was from March to May 2013 by using convenience sampling. Total 133 patients were included in where 96 males and 37 females and age range were between 18 to 30 years. To test the association between VAS and verbal NRS spearman's rank correlation was used. In this study it is proved that VAS and verbal NRS are strongly correlated. Both scales are reliably perfect method for measuring acute pain and can be used as alternatively [11].

On acute pain another study had done on three pain scale in adults with acute pain. The main aim was to the correlation and agreement between pain scores of NRS, VAS and CAS (color analogue scale). The study design was cross sectional study. The participants' age should be ≥ 18 years and not present any cognitive impairment because it can hamper the result. Total 150 patients were included. In 150 participants 53 were asked the NRS and 51 were asked the VAS and 46 were answered the CAS. The Spearman revealed a strong correlation between NRS, VAS, and CAS. All of the correlations were statistically significant ($p < 0.001$). The analyses of agreement are between the three scales indicated that the three pain scales evaluated are in acceptable agreement to measure acute pain intensity. Author concluded that there is strong correlation between NRS, VAS,

and CAS but in this study, researcher used convenient sampling in data collection like previous study so it cannot be generalized [12].

VAS is not only used in short term effect but only showed long term effect. To show the long-term effect of VAS a retrospective review was done of collecting prospective data. The aim was to assess the reliability of using a VAS pain score as a long-term outcome instrument for evaluating pain in orthopedic patients. Spearman correlation coefficient was used to assess the relation between VAS and changing in pain score. This result was calculated by 5 levels Likert scale (1=much less pain, 2=a little less pain, 3=no change in pain, 4=a little more pain, 5=much more pain). A total 74 (54 females and 20 males) participants are participated and their age ranged from 19 to 82 years. The result found weak correlation between VAS and change in pain. In paired t test analysis, there is not statistically significant differences between VAS and change in pain ($p > 0.05$). From this study it is concluded that VAS may poor to compare the correlation with change in pain as a long-term outcome measure [13].

The VAS is now examined with NRS by other study was performed by a cross-sectional study. This cross-sectional study was on caesarean women with acute postoperative pain in Obstetrics & Gynecology Intensive Care Unit. The purpose was to compare the performance of three pain intensity scales the combined VAS/NRS, NRS and FPS (facial pain scale) and pain scales preference ranking. Before data collection a pilot study was done that is helpful for instruction of participants. This data was not included in this study. Purposive sampling was

done and 75 participants were recruited in the study and one was drop out. So finally, 74 participants were included in this analysis. Their age ranged from 19 to 80 years. For comparison Spearman rank order correlation coefficient was used and correlation was high for 3 scales. It is lastly found that there was statistically significant result in all parameter and better significant result in FPS, NRS score than VAS/NRS in caesarean women with acute postoperative pain [14].

Another study was performed on lower caesarean section. The aim was to find out the sensitivity correlation in pain measurement scales between VAS and Facial pain rating scale (FPS). 100 women are recruited in this study. There two groups included; one group used VAS and 2nd group used FPS. Then women are requested to rate their pain in this scale. After analysis it is investigated that VAS is a sensitive and reliable scale for post-operative lower caesarian women when compared to facial pain rating scale. So, it is evident that VAS is valid and reliable scale [3].

To measure the caesarian pain previous study found that used scale; VAS, NRS and FPS showed significant result with better findings in NRS and FPS [14]. In this study, there was no randomization. But in another found that on same population VAS is a sensitive and reliable scale for pain measurement. This study randomized these two scales in equal patients' number in both groups. And also, participants were large than previous study. It is also more evident than previous study VAS is reliable and valid scale [3].

To see the change of postoperative pain in rural patients a study was conducted by a cross sectional study. The purpose was on utility of

numerical and visual analogue scales for evaluating post-operative pain in rural patients that was a hospital based cross sectional study. The pain is scored from participants with 24 hours. In total 105 patients met the criteria. The study duration was 3 months. A chi square test and regression analysis are used to determine the association and correlation among this scale. The 105 participants were recruited in the study. The 41% participants were illiterate 78.1% participants were able to rate their pain on VAS and 77.1% were able to rate their pain on NAS. The outcome measures tools were VAS, NRS and McGill questionnaires. There were no significant association with the ability to rate pain on VAS between age, sex and literacy and ability to rate pain on NAS ($p > 0.05$). The correlation coefficient in between the scales was 0.693 that proved there was a moderate strength. The both scales are used as pain assessment in like interchange even though illiterate persons because these 2 scales didn't impact on literacy. Lastly, the author concluded that VAS and NAS are easy tools for postoperative acute pain management in rural population [15].

To assess the changes of the chronic pain there was conducted a study in where aim was to determine the reliability and concurrent validity of a VAS in patients with chronic pain. The design of study was test-retest design of cross-sectional study. The study population had two groups. The patients of Group 1 (n=52) were in chronic nonmalignant musculoskeletal pain and group 2 (n=344) consisted of patients with nonspecific chronic low back pain. Group 1 participated in one rehabilitation center and other group in one University hospital. Though this study assesses the chronic pain so patients had a musculoskeletal pain last 3 months. As a data

collection instrument, they used a Roland Morris Disability questionnaire. The participants filled their questionnaire at 1st week and 2 weeks after treatment. In analysis non parametric test was used for skewness of data and parametric test for the distribution of data. In result the spearman correlation coefficient was from 0.60 to 0.77 and there were no systematic differences found between two assessments. For validity the Spearman's correlation coefficients between the VAS scores were respectively 0.16 to 0.51 which indicate weak correlation. So, in conclusion it is said that in patients with chronic musculoskeletal pain the reliability for VAS for chronic pain is good but not for validity of the VAS for pain [16]. VAS is the most frequent outcome tools in musculoskeletal pain assessment. A systematic review was done and the aim was to identify the most frequently used pain assessment measures for quantifying chronic musculoskeletal pain in clinical trials. From 1476 original research articles were examined and 50 studies met the selection criteria. They selected chronic musculoskeletal pain, non-malignant pain to prevent the heterogeneity of studies VAS as the pain outcome measure was most frequently used (60%) in the 50 studies [17].

A study by Valente, et al. (2011) done a study for validity of four pain intensity rating scales and purpose were to compare the relative validity of Visual Analogue Scale (VAS), Numerical Rating Scale (NRS), Verbal Rating Scale (VRS), and the Faces Pain Scale-Revised (FPS-R). Also want to find out the pain intensity and differences between men and women. ANOVA was used to analysis. Total 109 patients were in analyses. NRS and VAS has a higher F test than other. The four scales showed strong statistically significant inter-scale correlations. Gender effect is statistically

significant in 3 scales except VAS because women reported higher pain intensity in VAS. And post Hoc analyses found that pain changed in temperature for pain measurement means low temperature indicate high pain and high temperature indicate low pain. This finding is important for us because this result help during treatment of patients. So finally, this study there is strong support for the validity of these four scales [18].

Another study was performed by a study was conducted on neck disability index (NDI), VAS and Likert scale in patients with receiving pharmacotherapy for neck pain. The NDI is frequently used as an outcome measurement tool to find out disability in persons with neck pain. Their aim was to correlation of these scales. The people who were pregnant, lactating, presence of epileptic symptoms and cognitive problem excluded from the study. The study design was prospective observational design. Total participants were 170. In analysis author used correlation of coefficient, Wilcoxon and paired t' test. The paired t' test was used for examine the changing effect of NDI and VAS score after 2 weeks. Participants aged range was from 20 to 65 years. The 74.1 % participants were female and 25.9 % male. Most of diagnosis was cervical spondylosis. Individually VAS, NDI and Likert scale showed statistically significant result in before and after treatment. The VAS and NDI showed positive correlation and statistically significant. So, these 3 scales showed significant result in patients with neck pain that proved the validity of these scales. But methodologically if authors define their data collection procedure, about sampling it will best stronger and also reduces the error of result [19].

Now VAS is measured with other scales. A comparison between 5 scales were investigated by a study in intensive care unit (ICU) setting. The 5 scales are 1. Horizontal line VAS (VAS-H) 2. Vertical line (VAS-V), 3. Verbal Descriptor Scale (VDS), 4. the 0-10 oral Numeric Rating Scale (NRS-O) and 5. the 0-10 visually enlarged laminated NRS (V). The aim was to compare the feasibility, validity and performance of these 5 scales. Total 111 ICU patients were included. After getting treatment there was significantly higher rate for NRS-V (91%) compared with NRS-O (83%), VDS (78%), VAS-H (68%) and VAS-V (66%) for pain measurement. Between before and after treatment pain intensity changed significantly that showed a good validity and responsiveness for the 5 scales. So, it is indicated that for ICU patients though NRS-V is most valid and feasible frequently it can be used [20]. Once more pain is measured at VAS with some questionnaires. A study had done a prospective study with 147 patients who operated at hip arthroplasty. The aim was to assess the validity and reliability of the patients' satisfaction VAS score after total hip arthroplasty. The outcome measures were VAS at rest and during activity, the Western Ontario McMaster Universities osteoarthritis index (WOMAC), the Short Form 36, Oxford hip score and Harris hip score (HHS). The hips were affected with OA, RA and osteonecrosis of femoral head. The study duration was between October 2003 and June 2005. In reliability it is found test retest intra class coefficient of 0.95 and higher ceiling effect. And also found less suitable when satisfaction measured by a VAS scale. This study showed good construct validity and poor content validity in patient with hip arthroplasty. This study used valid and reliable questionnaires [21].

During conduct this review researcher have faced some limitations like, heterogeneity of studies, fewer recent articles and mixed type of pain. Therefore, in this study it has been shown that VAS has a good validity and reliability than other scales for pain management.

Conclusion:

Visual analogue scale is widely used in nationally and internationally. In this study it is scientifically evident that VAS is a reliable and valid scale in aged more than 18 years. In many studies it is proved that VAS is a reliable scale but for validity it showed moderate to strong correlation for pain measurement. From the very beginning VAS is used but now for entering other reliable and valid scale like numeric rating scale (NRS). As a result, it can be applied interchangeably. Evidence based practice is challenging because day by day rapidly expand number of treatment option as well as measurement scale so that need to critically think before using any scale based on patients' need.

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