



Menstrual Pain Assessment: Comparing Verbal Rating Scale (VRS) with Numerical Rating Scales (NRS) as Pain Measurement Tools

Evans Paul Kwame Ameade* and Baba Sulemana Mohammed

Department of Pharmacology, School of Medicine and Health Sciences, University for Development Studies, Ghana

*Corresponding author: Evans Paul Kwame Ameade, Department of Pharmacology, School of Medicine and Health Sciences, University for Development Studies, PO Box TL 1350, Tamale, Ghana, Email: sokpesh@yahoo.com

Abstract

Background: Management of pain is optimized if the pain is assessed with the appropriate measuring tool. Verbal rating scale (VRS) and numerical rating scale (NRS) are pain assessment tools. This study was aimed at determining if there is an agreement between VRS and NRS in menstrual pain assessment and the cut-off point of VRS categories on the NRS.

Methods: A semi-structure questionnaire was used to collect data from a cross sectional study involving 236 female undergraduate students of the School of Medicine and Health Sciences of the University for Development Studies, Tamale, Ghana. GraphPad Prism 5.01 and SPSS 21 statistical tools were used to analyze the data in this study. From a receiver operating characteristic (ROC) curve, the cut-off points of VRS categories on NRS were determined.

Results: There was a positive, strong and significant correlation between the NRS - 10 and the VRS - 3 pain assessment instruments (Spearman's rho = 0.81; 95% CI: 0.76 - 0.85; p-value < 0.0001). Agreement between VRS and NRS (kappa = 0.69) was good. The cut-off points for the VRS pain intensity categories of mild, moderate and severe on the NRS were 1 to 3, 4 to 6 and 7 to 10 respectively. Socio-demographic characteristics had no influence on the ability to place VRS category within the cut-off point ranges on the NRS except course of study with medical students scoring best (95.2% vrs 66.7 - 82.1%; $\chi^2 = 10.1$; df = 4; p value = 0.0387). Area under ROC curve scores were close to 1 (0.871, 0.9833, 0.9935; p < 0.0001) which showed that VRS and NRS exhibited a significant discriminatory capability in menstrual pain assessment.

Conclusion: High correlation and discriminatory capability exist between VRS and NRS as tools for the measurement of menstrual pain. A kappa coefficient of 0.69 shows that the agreement between VRS and NRS is good hence both can be used for pain measurement. The cut-off points for the VRS pain intensity categories of mild, moderate and severe on the NRS were 1 to 3, 4 to 6 and 7 to 10 respectively.

Keywords

Dysmenorrhea, Menstrual pain, Cut-off point, Verbal rating scale, Numerical rating scale

Introduction

Puberty in the girl child does not only bring about changes in her physical, emotional and psychological being but for between

15% and 94% of these post-pubertal females, they would have to endure dysmenorrhea, the pain associated with menstruation [1-4]. Menstrual pains affect several activities of the female with enormous socio-economic consequences [3-5]. In coping with this pain, some women resort to bed rest, heat pad, herbal products or self-prescribed medications [6,7]. Some women especially those with severe menstrual pain seek treatment from health facilities. For well-developed health systems, pain measurement is an integral component of routine patient assessment for both inpatients and outpatients which ensures appropriate therapy is selected [8]. Several pain measurement tools exist, but the most common ones are unidimensional visual analogue scale (VAS), verbal rating scale (VRS) and numerical rating scale (NRS) [9,10]. The VAS requires the patient to place a single mark on a 100 mm vertical or horizontal line with one extreme end indicating no pain and the opposite end for the worst imaginable pain [9-11]. Although VAS is a validated ratio measure of pain, the need for additional resources and the requirement that the patient must have intact fine motor skills and visual acuity makes its clinical use difficult [8,12]. The easy to administer NRS, although not a ratio measure, is commonly used clinically and involves patients being asked to indicate verbally or graphically on a scale of 0 to 10, a number which best describes the intensity of the pain with 0 meaning no pain and 10, the worst possible pain [8,10,13]. VRS requires the patient to indicate or mention the level of pain using adjectives such as no pain; mild pain, moderate pain, severe or intense pain [10]. Various studies showed a significant correlation between VAS and NRS in various pain situations including primary dysmenorrhea [8,11-13]. According to McGrath (1994), the perception of, expression of, and reaction to pain are influenced by genetic, developmental, familial, psychological, social and cultural variables [14]. Therefore, any pain assessment study conducted in one country or locality cannot be extrapolated to other places. Although studies on pain assessment tools have been conducted in developed countries, there is limited data on studies in developing countries with none reported from Ghana. Furthermore, most pain assessment tools comparison studies were for diseases such as cancer pain, back pains, and migraine. This study sought to find any agreement between the NRS and VRS, and also to ascertain if socio-demographic and menstrual characteristics of respondents can influence the effective use of these pain measurement tools in assessing menstrual pain. The cut-off points of the various categories of VRS on the NRS were also obtained.

Methods

Study design and setting

This cross sectional study conducted between March and April, 2015 involved 990 female undergraduate students of the School of Medicine and Health Sciences of the University for Development Studies in Tamale. Tamale is the capital of the Northern region of Ghana and the fourth largest city in Ghana which in 2010 had an estimated population of 371,351. (Ghana districts, 2012). The respondents were pursuing degrees in Medicine, Nursing, Midwifery, Health Science Education and Community Nutrition. The instrument for this study was a semi-structured questionnaire. The questionnaire was initially piloted among 20 students which ensured correction of ambiguous and inconsistent questions before it was administered for the actual data collection. Of the 389 questionnaires distributed, 293 were completed well enough and returned, giving a response rate of 75.3%. This study showed that 83.6% (245/293) of respondents experience dysmenorrhea, however, the menstrual pain measuring scales comparison study was on 236 of the respondents who accurately used the verbal rating scale (VRS) and the numerical rating scale (NRS) to evaluate their menstrual pain.

Measurement tools

The measurement tools were included in the questionnaire designed for the study. Because only respondents who reported experiencing dysmenorrhea were asked to assess their pain levels, a 3- point VRS with the adjectives; mild, moderate and severe was used rather than 4 point VRS with a 'no pain' category. The other evaluation tool was a 10-point NRS with 1 indicating the mildest of pains and 10 the worst ever pain experienced. The respondents were asked to indicate their pain level by stating the value in a space provided on the questionnaire.

Ethical consideration

Prior approval for this study was obtained from the Ethics Committee of the School of Medicine and Health Sciences of the University for Development Studies. Verbal consent was obtained based on adequate provision of participant information that enhanced respondents' confidence in the research. Respondents were adequately informed that accepting to participate and completing the questionnaire indicated consent with an option of withdrawing from the research at any point.

Sample size determination and sampling procedure

Sample size was obtained using the Cochran's (1977) correction formula for categorical data. $n_1 = \frac{n_0}{1 + \frac{n_0}{population}}$, n_1 = required return sample size without estimated response rate factor, n_0 = required return sample size calculated based on 5% sampling error ($d = 0.05$), the significant level t-value at alpha level of 0.05 ($t = 1.96$) with an estimated 50% of respondents able to correctly get the VRS category agreeing with the NRS cut-off point ranges ($p = 0.05$). With the study population of 990 students and a possible response rate of 70%, the drawn sample size of 389 was obtained for this study. The number of respondents from each class of the academic programme was obtained using a proportional approach based on the number of female students in the class. In each class, respondents were randomly chosen by picking from an envelope, pieces of paper with name and identity number of each female member of the class printed on it. The respondents were drawn using the sampling with replacement method.

Statistical analysis

Data was entered into Microsoft Excel, and analyzed using GraphPad Prism, Version 5.01 (GraphPad Software Inc., San Diego CA) and SPSS 21.0 software (SPSS Inc, Chicago, IL). Relationships between various variables were evaluated using the chi square test. Association between VRS and NRS was determined using the Spearman's rank correlation coefficient. The VRS measurement was considered as ordinal variable and had the adjectives assigned values

as follows; mild - 1, moderate - 2 and severe - 3. Statistical significance was assumed at $p < 0.05$ and at a confidence interval of 95%. The cut-off points on the NRS in relation to the VRS categories were determined using receiver operating characteristic (ROC) curves obtained from the SPSS software. The points on the ROC where the sensitivity and specificity were closest assuming equal importance of sensitivity and specificity are the cut-off points. The area under the ROC curve (AUC) was calculated to assess the discriminatory ability and values less or equal to 0.5 signifies no discriminatory ability while 1.0 indicates perfect discriminatory accuracy and hence no overlapping of distribution of NRS for the VRS categories. The AUC estimates the probability of correctly ranking a pair of randomly chosen categories from the VRS on the NRS.

The agreement between the VRS and NRS tools was determined using intra-rater agreement methods; percent agreement and Cohen kappa coefficient. Although percent agreement is an easier method of calculating measures of agreement, it does not account for agreement expected by chance hence the use of the Cohen kappa coefficient. To assess the level of agreement of these two ordinal scales, respondents' pain measurement on the NRS was rescaled to the 3 points VRS using cut-off points recorded in three previous studies. Respondents' pain measurement on the VRS was rated against the new VRS measurements obtained from the rescaling of the NRS measurement.

Results

Socio-demographic profile

The socio-demographic profile of the respondents is as shown in Table 1. In this study, majority, 180 (76.3%) were between ages 20 and 25 years, Christians, 175 (74.2%), and live in urban areas of Ghana, 147 (62.3%). At menarche, most respondents, 110 (46.6%) stayed in a self-contained accommodation indicative of their parents and guardians belonging to the middle social class. The age at menarche was between 9 and 20 years (mean \pm standard deviation; 13.7 ± 1.87). Most respondents, 99 (33.8%) were students studying nursing.

Distribution of respondents according to responses on the VRS-3 and NRS-10 measurement instruments

Figure 1 and Figure 2 show the distribution of respondents' pain intensities as measured on VRS - 3 and NRS - 10, respectively. The middle bar indicating moderate pain was the main category of pain intensity experienced on the VRS -3, while 5 was the modal value on

Table 1: Socio-demographic characteristics of the respondents.

Variable	Subgroups	Number of respondents	Percentages
Age (years)	< 20	30	12.7
	20 - 25	180	76.3
	> 25	26	11.0
Age of menarche	< 13	72	30.5
	13 - 15	124	52.5
	> 15	40	16.9
Course of study	Community Nutrition	52	17.7
	Health Science Education	29	9.9
	Medicine	54	18.4
	Midwifery	59	20.1
	Nursing	99	33.8
Religious affiliation*	Christianity	175	74.2
	Islam	59	25.0
Type of accommodation at menarche*	Single room	32	13.6
	Chamber and hall	44	18.6
	Several rooms in a compound house	38	16.1
	Self-contained apartment	110	46.6
	Mansion	8	3.4
Area of residence during vacation*	Urban area	147	62.3
	Sub-urban	71	30.1
	Rural	17	7.2

*There are missing values so percentage does not add up to 100.

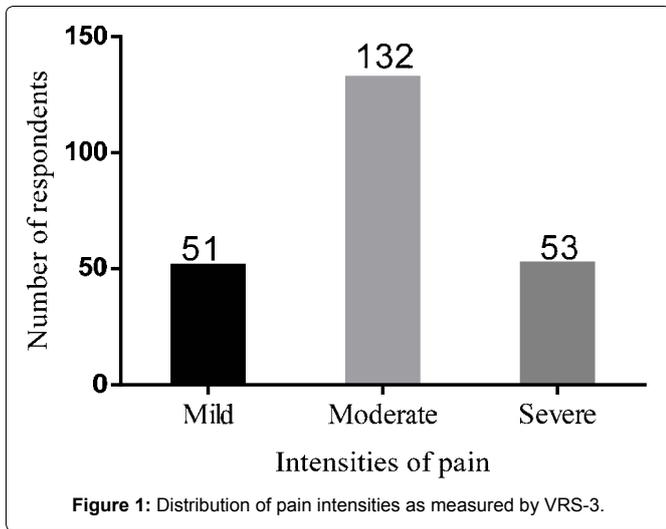


Figure 1: Distribution of pain intensities as measured by VRS-3.

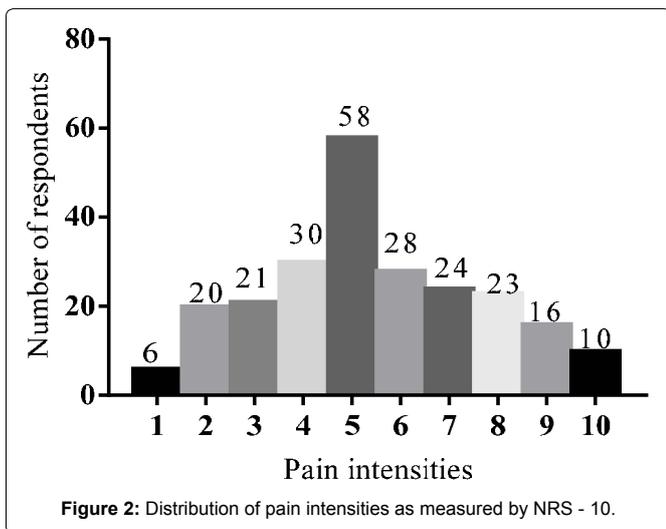


Figure 2: Distribution of pain intensities as measured by NRS - 10.

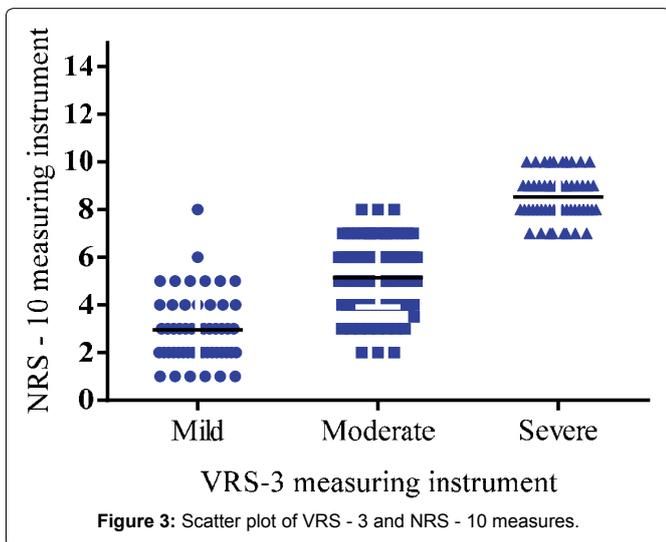


Figure 3: Scatter plot of VRS - 3 and NRS - 10 measures.

the NRS - 10 instruments. Figure 3 describes the relationship between VRS and NRS scores on a scatter plot. There was a high variability of NRS scores against all categories on the VRS with the moderate category showing the greatest variability on the NRS.

Correlation between VRS-3 and NRS-10

Although figure 3 shows a high variability in NRS scores when compared to the pain intensities on the VRS, there was a positive, strong and significant correlation between the NRS - 10 and the VRS - 3 pain assessment instruments (Spearman's rho = 0.81; 95% CI: 0.76 - 0.85; p-value < 0.0001). Table 2 shows the mean and standard deviation values of NRS compared to VRS classifications by the

Table 2: Correlation between VRS-3 and NRS -10.

Verbal Rating Scale	Numerical Rating Scale (mean and standard deviation)	Spearman's rho	p-value
Mild	2.961 ± 1.455	0.810	< 0.0001
Moderate	5.148 ± 1.231		
Severe	8.528 ± 0.973		

respondents. These were; mild (2.961 ± 1.455), moderate (5.148 ± 1.231) and severe (8.528 ± 0.973).

Agreement between VRS and NRS using various cut-off points to obtain their equivalence of mild, moderate and severe pain categories on VRS

Table 3 shows the level of agreement between menstrual pain measurement using the VRS and NRS which had been rescaled to three pain categories on the VRS using the cut-off points obtained in three previous studies. A higher proportion (84.3% vs 70.6%) of respondents were in the mild pain category when cut-off point of 1 - 4 rather than 1 - 3 on NRS was the equivalence of mild pain. The cut-off point of 4 - 6 on the NRS recorded the highest proportion for moderate pain (77.3%) when compared with 5 - 7 (72.0%) and 5 - 6 (59.8%). For the severe pain category, NRS cut-off points of 7 - 10 recorded 100% agreement with the VRS but a lower score of 84.9% with a cut-off point range of 8 - 10. Overall, the Jessen et al. NRS cut-off-point classification of Mild (1 - 3), moderate (4 - 6) and severe (7 - 10) showed the greatest level of percent agreement between VRS and NRS (82.6%) with Serlin et al., and Paul et al., NRS cut-off point classifications recording 81.4% and 80.4% percent agreements respectively [15,16]. There was however no significant differences ($\chi^2 = 3.995$; $df = 4$; p value = 0.407) between the levels of percent agreement between the three VRS categories and NRS cut-off point classifications. The kappa coefficient recorded when respondents' menstrual pain measurement on VRS were compared with another VRS measurement obtained by the rescaling of the NRS measurements with the various cut-off points were; Serlin et al. (0.61), Paul et al. (0.64) and Jessen et al. (0.69). Jessen et al (2001). NRS categorization of pain which was similar to NRS cut-off points recorded in this study again showed the greatest level of intra-rater agreement (kappa = 0.69, $p < 0.0001$) with the VRS measurement of pain by respondents in this study.

Relationship between socio-demographic factors and respondents' ability to place the VRS categories into the corresponding NRS cut-off point ranges# found in this study (Mild - 1 to 3; Moderate - 4 to 6; Severe - 7 to 10)

Respondents older than 25 years, age at menarche greater than 15 years, lived in a single room accommodation at menarche and lived in urban areas of Ghana had better or best percent agreement between VRS and NRS assessment tools. However, the differences between these categories were not statistically significant. Based on the course of study, respondents pursuing medicine scored the highest (95.2% vs 66.7 - 82.1%) percent agreement between VRS and NRS scores. The difference between the percent agreement based on their courses of study was statistically significant ($\chi^2 = 10.1$; $df = 4$; p value = 0.0387). Effect of socio-demographic characteristics on achieving VRS and NRS scores agreement is shown in table 4.

Cut-off points for VRS categories on NRS using receiver operating characteristic (ROC) curves

Figure 4 shows the ROC curves for the determination of the cut-off points separating the various categories on the VRS. Sensitivity of the rating scales, the Area under the ROC curves and the NRS cut-off points vis-à-vis the VRS categories are shown in Table 5. The cut-off point separating various VRS categories were; mild and moderate, 3.25 (≈ 3), moderate and severe, 6.5 (≈ 7), mild and severe, 6.5 (≈ 7). There were excellent and statistically significant discrimination between the respective categories as the calculated AUCs were close to 1 (0.871, 0.9833, 0.9935; $p < 0.0001$).

Table 3: Agreement between VRS and NRS using various cut-off points to obtain their equivalence of mild, moderate and severe pain categories on VRS.

Verbal Rating Scale	Numerical Rating Scale (Serlin et al. cut-off points)			Kappa coefficient	% agreement between VRS and NRS	χ^2 : (df); p-value
	1 - 4 (Mild)	5 - 6 (Moderate)	7 - 10 (Severe)			
Mild	43 (84.3%)	7	1	0.61	81.4	3.995 (4); 0.407
Moderate	34	79 (59.8%)	19			
Severe	0	0	53 (100.0%)			
	Numerical Rating Scale (Jessen et al. cut-off points)					
	1 - 3 (Mild)	4 - 6 (Moderate)	7 - 10 (Severe)			
Mild	36 (70.6)	14	1	0.69	82.6	
Moderate	11	102 (77.3)	19			
Severe	0	0	53 (100.0)			
	Numerical Rating Scale (Paul et al. cut-off points)					
	1 - 4 (Mild)	5 - 7 (Moderate)	8 - 10 (Severe)			
Mild	43 (84.3)	7	1	0.64	80.4	
Moderate	34	95 (72.0)	3			
Severe	0	8	45 (84.9)			

Table 4: Relationship between socio-demographic factors and respondents' ability place the VRS categories into the corresponding NRS cut-off point ranges[#] found in this study.

Variable	Subgroup	Agreement between VRS and NRS		χ^2 , df	p-value
		Yes	No		
Age (years)	< 20	23 (76.7)	7 (23.3)	2.719 (2)	0.257
	20 - 25	143 (79.4)	37 (20.6)		
	> 25	24 (92.3)	2 (7.7)		
Age of menarche (years)	< 13	54 (75.0)	18 (25.0)	2.148 (2)	0.342
	13 - 15	102 (82.3)	22 (17.7)		
	> 15	34 (85.0)	6 (15.0)		
Course of study	Community Nutrition	32 (74.4)	15 (34.9)	10.10 (4)	0.039*
	Health Science Education	14 (66.7)	7 (33.3)		
	Medicine	40 (95.2)	4 (9.5)		
	Midwifery	35 (76.1)	11 (23.9)		
	Nursing	69 (82.1)	15 (17.9)		
Type of accommodation at menarche	Single room	29 (90.6)	3 (9.4)	8.408(4)	0.778
	Chamber and hall	30 (68.2)	14 (31.8)		
	Several rooms in a compound house	32 (82.1)	7 (17.9)		
	Self-contained apartment	89 (80.9)	21 (19.1)		
	Mansion	8 (100.0)	0 (0.0)		
Area of residence during vacation	Urban area	122 (83.0)	25 (17.0)	2.056 (2)	0.358
	Sub-urban	55 (77.5)	16 (22.5)		
	Rural	12 (70.6)	5 (29.4)		

*Statistically significant.

[#]The NRS cut-off points in the VRS were those obtained from this study (Mild - 1 to 3; Moderate - 4 to 6; Severe - 7 to 10)

Table 5: Cut-off points for VRS categories on NRS using receiver operating characteristic (ROC) curves.

VRS categories		NRS cut- off points	ROC curve			
Control	Test		Sensitivity	AUC	p-value	95% CI
Mild	Moderate	> 3.25	91.67	0.871	< 0.0001	0.8079 to 0.9344
Moderate	Severe	> 6.5	100.0	0.9833	< 0.0001	0.97 to 0.9967
Mild	Severe	> 6.5	100.0	0.9935	< 0.0001	0.98 to 1.007

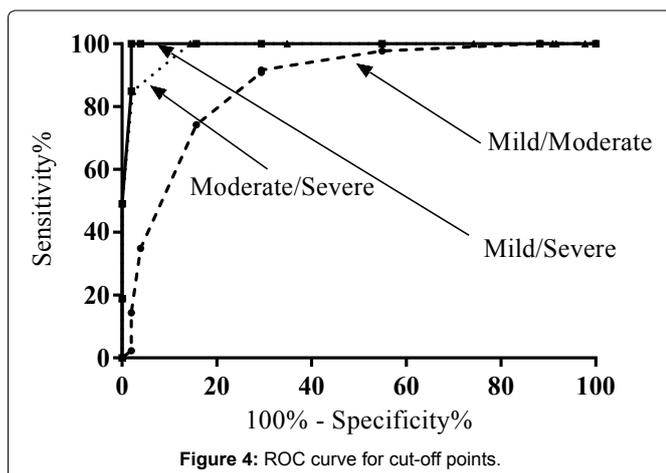


Figure 4: ROC curve for cut-off points.

Discussion

Menstrual pain affects the lives of several post-pubescent women and interventions to manage this public health situation is done most appropriately if the pain can be quantitatively assessed by the clinician. This study showed that majority of the respondents considered their menstrual pain as moderate on the VRS and 5 on the NRS. Although, there was a high positive and significant correlation between NRS and VRS as reported in some previous studies [15,16], there was a wide intra-rater NRS score variability for the VRS moderate category. This variability became clearer when the equivalence of the VRS moderate category was determined using various NRS cut-off ranges in studies conducted by Serlin et al., (1995), Jessen et al., (2001) and Paul et al., (2005) [17-19]. For instance, in the situation where the NRS equivalence range for VRS moderate was just two scores of 5 and 6, there was a low level of agreement between moderate and NRS equivalence. However, when the cut-off range on the NRS was

increased to three scores of 4, 5 and 6, there was great improvement on the agreement between the VRS moderate category and that NRS range. Again, when the NRS cut-off point for severe category on the VRS was decreased from 4 scores of 7, 8, 9 and 10 to three scores of 8, 9, and 10, the agreement between the VRS and NRS categories fell from 100.0% to 84.9%. This means that NRS cut-off point ranges that have a shorter spread affects equivalency between VRS and NRS. This implies that in the clinical situation, there would be the need for greater evaluation of pain when a client describes pain as moderate using the VRS. Despite this variability, the ROC results showed a significant discriminatory capability between these two pain assessment instruments in situations of dysmenorrhea. The construction of the ROC curve assisted in the determination of the cut-off points for the equivalence of the VRS categories on the NRS. The cut-off points are the points on the ROC curve where the optimal sensitivity and specificity interact, therefore in this study, the cut-off points for assessing menstrual pain are as follows; mild (1 to 3), moderate (4 to 6) and severe (7 to 10). These cut-off points were similar to that recorded in previous studies including that by Jessen et al., (2001) although, the pains assessed were not related to menstruation and also NRS - 11 was used not the NRS-10 applied in this study [16,17].

In this study, socio-demographic characteristics such as biological age, age of menarche, socio-economic status and living area did not influence a person's ability to match the VRS categories with the cut-off point ranges on the NRS. The study however found a significant relationship between the course of study of a student and the ability to achieve agreement between VRS and NRS ($\chi^2 = 10.1$; $df = 4$; $p\text{-value} = 0.039$). Medical students scored the highest, 95.2%, followed by nursing students (82.1%) with health education students scoring the least, (66.7%). The agreement scores seem to have a positive correlation with the entry examination aggregate required for admission to pursue a course in this university. Medical students' admission requires the best aggregate scores, followed by nursing with the health science education course admitting students with the least of entry scores. Performance in mathematics impacts on the entry score into the university so there might be the need to conduct further studies to determine if a person's knowledge in mathematics influences the ability to have their VRS and NRS pain scores agreeing.

Results from this study would be useful from both clinical and research perspectives with respect to the management of dysmenorrhea. Communication between clinician and patients about pain intensity on VRS (mild, moderate and severe) can be related easily to its equivalence on the NRS thereby ensuring maximization of therapy. For the researcher, standardization of the equivalence between VRS and NRS would ensure that results from pain and analgesia studies would generate greater confidence.

Some limitations could affect the results obtained from this study. Firstly, the use of self-administered questionnaire rather than interviews makes verification of the answers difficult. Also, respondents scoring their menstrual pain intensity on the VRS and NRS simultaneously could cause an overestimation of the agreement between these two scales since it is possible that scoring on one scale would influence the score for the other pain assessment instrument.

Conclusion

There was a high and significant correlation between VRS and NRS as tools for the measurement of menstrual pain. There was also agreement and a significant discriminatory capability between VRS and NRS hence these two pain measurement tools can be used interchangeably in the assessment of dysmenorrhea. The cut-off points for the VRS pain intensity categories of mild, moderate and severe on the NRS were 1 to 3, 4 to 6 and 7 to 10 respectively.

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piloting, administering and retrieval of the questionnaires.

Authors Contribution

The author, EPKA conceived the idea, prepared the questionnaire, got some students to assist in the piloting and administering of the questionnaire. EPKA and BSM both did the analysis of data and drafting of the manuscript.

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