Original article

Pain Threshold, Pain Severity and Sensory Effects of Pain in Fibromyalgia Syndrome Patients: *A new scale study*

Ankarali H[1], Ataoglu S[2], Ankarali S[3] Guclu H[4]

Abstract

Objectives: The aim of this study to develop a new scale to evaluate pain threshold, sensory effects of pain and pain severity in patients with Fibromyalgia Syndrome (FMS). ***Material and Methods:*** This is a cross-sectional survey study and a questionnaire was administered to 52 voluntary patients diagnosed with FMS. In the proposed scale, thereare six questions about severe and less severe pain experience,two questions about the pain severity and sensory effect of FMS. In statistical analysis we used reliability analysis, factor analysis for construct validity, and other statistical tests to compare differences. ***Results:*** Exploratory factor analysis showed construct validity of the scale, and detected three factors. The internal consistency of the items of the scale was statistically significant. The agreement between the scores was good. Based on the answers, the patients were divided into two groups as low and high pain thresholds. There was no significant difference between these two groups in terms of severity of pain and sensory change due to fibromyalgia. In addition, the severity of pain in patients is lower than headache and at the level of stomachache and toothache. ***Discussion and Conclusion:*** The proposed scale allows the assessment of pain severity to be more detailed and paying attention to visually, it allows determining the pain threshold. It is suggested to compare the pain threshold determined by this scale with the pain threshold determined by different methods.

Keywords: Pain threshold; pain severity; fibromyalgia; sensory effects; VAS

Bangladesh Journal of Medical Science Vol. 17 No. 03 July'18. Page : 342-350
DOI: http://dx.doi.org/10.3329/bjms.v17i3.36987

Introduction

International Association for the Study of Pain defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage".[1] Creating a trust between the healthcare personnel and the patient who report to be suffering from pain is a crucial factor in diagnosis and treatment.[2]

Fibromyalgia Syndrome (FMS) is one of the chronic rheumatologic painful diseases. FMS displays a complex clinical disease case associated with distributed body pain and possibly many other symptoms.[3] It has a strong impact on patients' daily life and activities, emotional state and quality of life. One of its leading negative effects is severity of pain and its periodicity. It was also shown that the incidence rate of FMS is between 1-35 cases in every 100 thousand individuals.[4]

Typically clinical evaluation of pain is done through scales that are fast, easy to understand and informs only about the severity of the pain. These scales can be described as one-dimensional because they

1. Handan Ankarali, Department of Biostatistics and Medical Informatics, School of Medicine, Istanbul Medeniyet University, **email:**handanankarali@gmail.com
2. Safinaz Ataoglu, Department of Physical Medicine and Rehabilitation, School of Medicine, Duzce University, **email:**gulnazlisert@gmail.com
3. Seyit Ankarali, Department of Medical Physiology, School of Medicine, Istanbul Medeniyet University, **email:**seyitankarali@hotmail.com
4. Hasan Guclu, Department of Biostatistics and Medical Informatics, School of Medicine, Istanbul Medeniyet University, email**:**gucluh@gmail.com

Correspondence to: Prof. Dr. Handan Ankarali, Department of Biostatistics, Faculty of Medicine, University of Istanbul Medeniyet, 34100, Göztepe, Istanbul, TURKEY, E-mail:handanankarali@gmail.com

measure only the severity of the pain. Some of the most common ones are Verbal Rating Scale (VRS), Numerical Rating Scale (NRS) and Visual Analogue Scales (VAS). Usually, a scoring system out of 5 or 10 is used in these scales and they might give misleading results in patients who are elderly and illiterate or who cannot express themselves. Another important factor these scales are missing is the changes in emotional state of the patients [5-9].

In this study we aim to devise a new scale for patients with FMS to evaluate pain threshold and severity as well as sensory effects of pain. In preparing the scale we used a format that is short and easy to answer yet it can give better details on the level of pain.

Material and Methods

Sample and data

This is a cross-sectional scale study. Individuals included in the study are 52 patients who volunteered and were referred to the Department of Physical Medicine and Rehabilitation at Duzce University School of Medicine between March and June 2017 and diagnosed before or recently with FMS according to the criteria of 1990 American College of Rheumatology (ACR). Before our study we obtained permission from the Ethical Board for Noninvasive Clinical Studies at Duzce University. A nurse was trained for our new scale and employed for data collection through face-to-face interviews with the patients.

Inclusion and exclusion criteria for volunteer patients

The inclusion criteria are being a volunteer for the study, being diagnosed with FMS before or recently, having cognitive capability to answer questions, having signed informed consent form, and being an adult with age between 18-80. The patients who are children or elderly with diminished cognitive capability, referred to hospital for other reasons, who did not sign the informed consent form are excluded.

Measurement tool (SH – pain severity and threshold scale)

In this study we propose a new scale to measure pain severity and pain threshold and named "SH – pain severity and threshold scale". There are in total eight questions in the pain evaluation form. The answers to questions were marked on a 100 mm ruler. The ruler is similar to numeric and verbal VAS but has advantages over it as follows

- 100-mm ruler have 2-mm markings so can contain more details
- Since our patients in the study are usually middle-aged or older and most of them are females we used six faces drawn on the ruler for easier comprehension and evaluation
- In the ruler three phrases ("no pain", "medium-level pain", "very severe pain") were places in their appropriate places.
- The emotions due to FMS such as anxiety and discomfort were also evaluated in this scale. Thus we were able to evaluate not only the severity of the pain but also its sensory effects

Thus the good aspects of VAS scales were combined so that the patients could answer correctly. The new scaled we propose is presented in Appendix. Also, we minimized the possible misunderstandings in face-to-face interviews and got rid of errors due to multiple interviewers.

The first six questions in the scale were used in determining the pain threshold. The seventh question queried about the pain severity due to FMS and the last question was used to measure the level of sensory effects due to FMS.

The first three questions queries about the severity of the pain: the worst headache, the worst stomachache, and the worst toothache. We assumed that the patients who scored all these three questions 50 points or above experienced the pains intensively or to have low pain threshold. Similarly, patients who gave high scores to two of the questions or a high score to one of them and low scores to other two were assumed to have medium pain threshold and not to have intensely experienced the pain to which they gave low score. Also, the patients who gave low scores to all three questions were assumed to possibly have high pain threshold or to have not intensely experienced these pains.

In the second part of the scale questions from 4 to 6 queries about less severe pain: questions about needle in the finger, piece of glass or knife, and drawing blood from arm vein. The patients who gave scores less than 50 to all of them were assumed to have medium pain threshold. The patients who gave low scores to two or one of them were assumed to be afraid of procedures to which they gave high scores. If the patients who gave high scores to all three questions, they are considered to potentially have low pain threshold or afraid of all three procedures.

The individuals who gave high scores to at least two severe pain questions and who gave low scores to at least two less severe pain questions were assumed to have high pain threshold. In this classification the cutoff was assumed to be 50 so the scores 50 or above are considered high and scores less than 50 are considered low. The individuals who gave low scores (under 50) to at least two questions in both severe and

less severe questions are assumed to have high pain threshold or to have not intensely experienced the three severe pains listed.We assumed the individuals to have low pain threshold who gave high scores to at least two of the three questions about severe pain and at least two of the three questions about the less severe pain.

In our data no individual exists who give high scores to questions about the less severe pain and low scores to questions about severe pain.

Statistical Analysis

Appropriate descriptive statistics such as mean, standard deviation, minimum and maximum values, count and percentage frequencies are given in tables. Internal structure of the scale is analyzed by factor analysis. The factorability assumption (Sampling adequacy and Sphericity) of explanatory factor analysis was tested by using Kaiser-Meyer-Olkin test and Bartlett's test respectively. We use Kaiser Criteria that the factor eigen values are greater than one in determining the appropriate number of factors. After this, explanatory factor analysis were performed with the principal component method. Unrotated results from a factor analysis is not easy to interpret, although the plot helps. Varimax rotation was used for clarify and simplify the results of factor analysis.

Cronbach alpha coefficient was used for internal consistency of the questions and interclass correlation coefficient (ICC) was used for reliability of the questions in the scale. Paired samples t-test was used for differences between various pain scores. FMS pain scores of groups with low and high threshold are analyzed by Student t-test for independent groups. We use SPSS (version 18) for statistical analysis and the statistical significance is accepted for $p<0.05$.

Results

Out of 52 patients included in the study with an average age of 47.4±12.43 (21-70), 46 of them are female (88.5%) and 6 are male (11.5%). The duration of disease is 5.4±5.0 years. Of these participants 16.8% are illiterate, 38.8% elementary school graduates, 30.6% graduated from middle or high school and the rest (14.3%) went to college or received higher degrees.

The structure of our scale, which consists of eight questions, was analyzed by explanatory factor analysis and the Kaiser-Meyer-Olkin test value is of 0.60. Since this result is over 0.50 we concluded that the factor analysis could be applied to our scale. Also, sphericity test was performed and it was found that the correlation matrix was not spherical ($p<0.0001$). This shows that the correlation among the questions of the scale is significant and suitable for factor analysis. Since all the diagonal elements of the anti-image correlation matrix are greater than 0.50 there is no need for item elimination in the scale. Analysis showed that three factors were found to be with eigen value greater than one and they could explain 63.4% of the variance. In order to better interpret the factor coefficients they were rotated by Varimax rotation and results are presented in Table 1. The first three questions of the scale are in the third factor, questions 4-5 are in the first factor and the last two questions are in the second factor. We concluded that the scale is coherent with the aim in the preparation phase since the questions in the third factor queries about the severe pain, the ones in the first factor about the less severe pain and the ones in the second factors about the pain severity and sensory effects due to diagnosed illness.

Coefficients of agreements between the questions about the severe pain were as follows: question 1 and 2: 0.571, question 1 and 2: 0.179, question 2 and 3: 0.407. On the other hand the coefficients of agreements between the questions about less severe pain were as follows: question 4 and 5: 0.700, question 4 and 6: 0.565, question 5 and 6: 0.571. Also, the coefficient of agreements between the pain severity and sensory effects due to FMS was found to be 0.525 and significant ($p<0.001$). This shows that if the pain is severe for an individual the sensory effect of the pain is also high.

The internal consistency of the eight questions in the scale querying about the pain severity and pain threshold was found to be 0.623, which shows that the answers to scale questions were consistent and additive. However, not everybody might have experienced the kinds of pain that were questioned as severe pain and pain known as less severe pain and the pain thresholds of the patients might be different. These factors could prevent the internal consistency from being higher. The distributions of the scores given by the patients to scale questions are displayed in Figure 1. There exists individuals who give high and low score to every question but the distributions of the scores given due to FMS. Also, the patients gave low or medium scores to the question about the severe pain "cutting finger by glass or knife" but the other two questions in the same category received low scores.

We compared the patients grouped as the low-threshold and high-threshold by the scores they gave to severe, less severe pain and pain severity and

sensory effects due to FMS (Table 2). We found no significant differences between the patients with low and high pain threshold by the average of the scores given to questions about severe pain. On the other hand, the scores given by low pain threshold patients to questions about less severe pain were significantly higher. There was also no significant difference found when patients with low and high pain threshold were compared by FMS pain severity and the degree of sensory effects. This shows that pain threshold does not affect the FMS pain severity and sensory effects.

The comparisons of the scores for pain severity due to FMS, three kinds of severe pains, three kinds of less severe pains, and sensory changes due to FMS were shown in Table 3. The most severe headache experienced was more severe than the pain due to FMS, however, the most severe stomachache and the most severe toothache were scored similar to pain due to FMS with no significant differences. This results shows that FMS pain has a similar effect on patients to stomachache and toothache. On the other hand, the severity of FMS pain is significantly higher than that of all other less severe pains. Also, the severity of the pain due to FMS was found to be significantly lower than sensory effects due to FMS.

We cannot find significant differences among sexes in terms of severity of different kinds of pain and sensory effects due to FMS. Also, the relationships between age and severity of FMS pain and the effects of sensory changes due to FMS were not found significant.

Our scale was applied to 76 osteoarthritis[10], 61 rheumatoid arthritis[11]and 52 FMS patients in terms of pain severity and the degree of sensory effects and we found that osteoarthritis patients was found to be better in both cases. However, no significant difference has been found between rheumatoid arthritis and FMS (Table 4).

The ratio of patients with less severe pain was found to be 30.8% (n=16) in FMS, 31.6% (n=24) in OA and 23% (n=14) in RA, and not significantly different from each other.

Discussion and Conclusion

Pain is described as a condition experienced subjectively.[3] There are differences not only changes in the expression of pain from person to person but also in its threshold. The more the patient can express himself or herself correctly the more the success in the diagnosis and treatment. This is especially crucial for illnesses with chronic pain that becomes part of patient's daily life.[3-5] Turning complaints into measurable information by a standard technique is very important for the patient to properly express himself or herself. Numerous studies can be found in the literature in this respect and VAS is the most common method to measure pain severity in these studies.[5-7,9,12] The reason for its wide use is its easiness and speed. Different VAS types exist in use today and one very common one is the one with facial drawings designed for children and patients who cannot verbally express themselves. Other types include sentences describing the pain, 10-cm rulers to measure the pain severity or 5-level Likert scale.[5] There are advantages and disadvantages in all of these types. It is possible to combine their advantages to design a more detailed, understandable, fast and accurate scale by increasing the levels on the ruler and making them more visible. Thus, the scale becomes more understandable for patients with low level of education or having low cognitive capabilities.

Determining the severity of the pain along with knowing the pain threshold would be helpful in making better decisions about the disease. Also, it would help to understand and empathize with the patient when the severity of the pain experienced by almost everybody is meaningfully measured.

With this motivation we defined a new scale in this study to measure the pain severity and pain threshold of FMS patients. Most of the studies carrier out until now used a 10-cm VAS ruler for pain severity in FMS patients.[3,4] In the scale we developed there are 8 questions and consistency of the scores for the first three questions about severe pain is at the medium level. We believe that the reason for not having a high consistency could be that all patients felt severe pain. However, the consistency was relatively higher among the next three questions about less severe pain. The reason for this might be that the three kinds of pain listed were thought to be less severe are experienced by almost everybody and perceived as less severe pain. But still the reason for having not too high consistency could be that the fear for needle, knife and piece of glass might have confused perception of the pain.

Various methods and numerical devices such as pressure algometers and Pain Matcher are being used to determine the pain threshold[13,14], however, it is hard to find a fast method to determine pain threshold in clinical settings. The scale proposed in this study has the potential to be a forerunner for similar studies. In any scale designed to determine pain threshold should include severe, less severe and other kinds of pain that might have been experienced by everybody and less severe pain. The list of pain types presented

in this study can be extended or changed. Both severe and less severe pain should be taken into account together to determine the pain threshold. Because a patient would give lower scores if he/she did not experience severe pain. Thus patients who gave high scores to both severe and less severe pain would have lower pain threshold and vice versa. This shows that the patients with high or low pain threshold could not be distinguished for the scores they gave to severe pain. In our study we conclude that the level of pain due to FMS experienced by the patients is similar to severe toothache and severe stomachache, but lower than that of severe headache. We also find that effect of sensory change of FMS pain is greater than that of pain severity. We believe that these problems can be solved by the treatment of the pain or sensory changes that might turn into chronic conditions are possible.

In conclusion, the new proposed scale can be developed even further. Its main advantages can be summarized as follows. It provides a more detailed and visual evaluation of the severity of the pain and its comparison with other experienced pain, an ability to specify pain threshold, and a chance to jointly investigate the threshold and severity of pain. Finally, we recommend this scale to be used for large patient groups.

Conflicts of interest: In this study, potential conflicts do not exist.

Table 1. Rotated factor loadings

Questions	Factors		
	Less severe pain factor	**FMS pain severity and sensory effect**	**Severe pain factor**
Level of worst headache you experienced before	0.005	0.155	0.780
Level of worst stomach ache you experienced before	0.123	-0.066	0.839
Level of worst tooth ache you experienced before	0.300	0.301	0.302
Level of pain you experienced when you jabbed my finger with a needle	0.783	0.041	0.149
Level of pain you experienced when you cut my finger with small pieces of glass or a knife	0.843	0.114	0.155
Level of pain you experience when blood is drawn from your arm vein	0.751	-0.126	-0.129
The level of pain you are experiencing now because of FMS	-0.008	0.769	0.078
How much comfortable/anxious/restless are you in your daily life due to the pain you are experiencing	-0.006	0.883	-0.021

Table 2. Comparison of patients with low and high pain threshold in terms of their scale scores

Questions	High pain threshold			Low pain threshold			p
	N	Mean	SD	N	Mean	SD	
Level of worst headache you experienced before	36	75.03	24.59	16	76.38	22.96	0.853
Level of worst stomach ache you experienced before	36	62.81	27.69	16	65.31	24.45	0.757
Level of worst tooth ache you experienced before	36	65.83	31.18	16	71.69	27.40	0.520
Level of pain I experienced when I jabbed my finger with a needle	36	28.42	18.25	16	61.56	24.06	**0.001**
Level of pain I experienced when I cut my finger with small pieces of glass or a knife	36	40.28	21.27	16	66.75	24.73	**0.001**
Level of pain you experience when blood is drawn from your arm vein	36	27.22	20.90	16	66.13	26.99	**0.001**
The level of pain you are experiencing now because of FMS	36	66.33	23.88	16	69.56	27.93	0.671
How much comfortable/anxious/restless are you in your daily life due to the pain you are experiencing	36	77.86	20.51	16	79.25	16.29	0.812

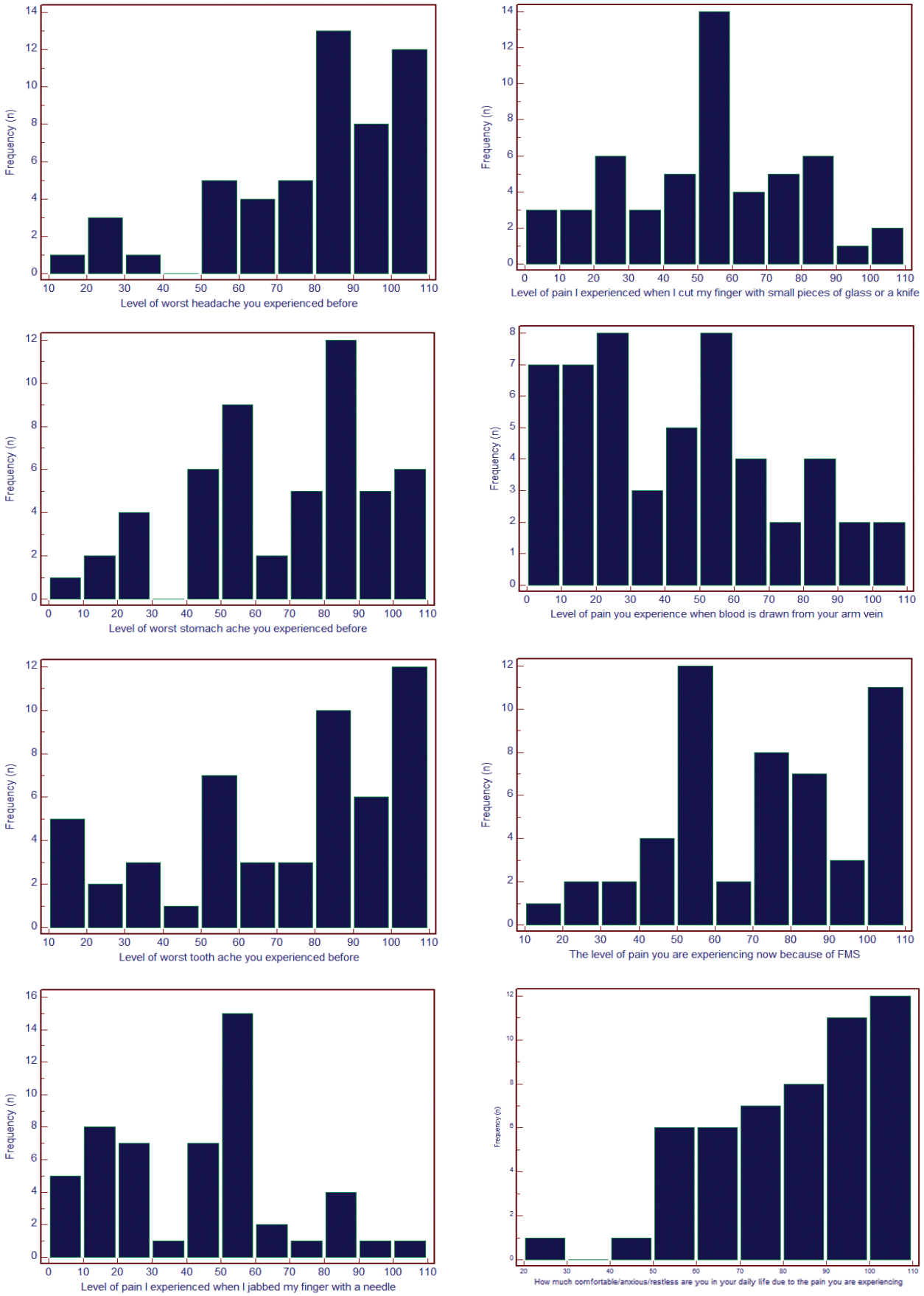


Figure 1. The distribution of scores given by FMS patients

Table 3. Comparison of pain severity and sensory effects of FMS and other pains

FMS pain severity	Mean	SD	Other pain severity	Mean	SD	p
The level of pain you are experiencing now because of FMS	67.33	24.967	Level of worst headache you experienced before	75.44	23.890	**0.049**
			Level of worst stomach ache you experienced before	63.58	26.525	0.451
			Level of worst tooth ache you experienced before	67.63	29.927	0.953
			Level of pain you experienced when you jabbed my finger with a needle	38.62	25.253	**0.001**
			Level of pain you experienced when you cut my finger with small pieces of glass or a knife	48.42	25.354	**0.001**
			Level of pain you experience when blood is drawn from your arm vein	39.19	29.035	**0.001**
			The level of pain you are experiencing now because of FMS	78.29	19.163	**0.002**

Table 4. Comparison of pain severity and sensory pain severity among some disease groups

	FMS (n=52)			OA (n=76)			RA (n=61)			p
	N	Mean	SD	N	Mean	SD	N	Mean	SD	
Level of pain you experience now	52	67.33[a]	24.97	76	53.72[b]	26.48	61	56.28[a]	31.50	**0.021**
How comfortable/anxious/ restless are you due in your daily life to the pain you experience now	52	78.29[a]	19.16	76	60.86[b]	25.34	61	69.36[a]	28.04	**0.001**

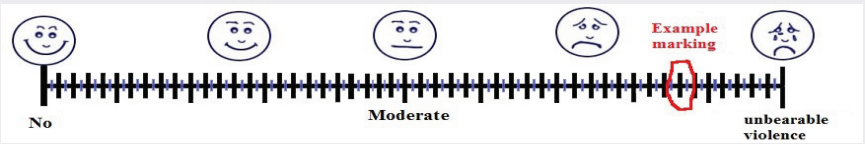
References

1. Pasero C, Mc Caffery M. When patient cant report pain. Am J Nursing. 2000;99(7):13-20.
2. Aslan EF, Badır A. Reality about pain control: The knowledge and beliefs of nurses on the nature, assessment and management of pain. *Agri*.2005;**17(**2):44-51.
3. Ericsson A. Fibromyalgia and chronic widespread pain: Dimensions of fatigue and effects of Physiotherapy, Department of Rheumatology and Inflammation Research, Institute of Medicine Sahlgrenska Academy at University of Gothenburg, Printed in Gothenburg, Sweden 2012.p. 1-105.
4. Dedhia JD, Bone ME. Pain and fibromyalgia. *CEACCP* 2009**;9**(5):162-166.
5. Aslan FE. [Pain assessment methods]. C.U. *Journal of Nursing School*.2002**;6**(1):9-16.
6. Garra G, Singer AJ, Taira BR, Chohan J, Cardoz H, Chisena E et al. validation of the wong-baker faces pain rating scale in pediatric emergency department patients. *Acad Emerg Med*. 2010;**17(**1):50-54.
7. Hjermstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Loge JH, et al.Studies comparing numerical rating scales, verbal rating scales, and visual analogue scales for assessment of pain intensity in adults: A systematic literature review. *J Pain Symptom Manage*.2011;**41**(6):1073-1093.
8. Bayram K, Erol A. Childhood traumatic experiences, anxiety and depression levels in fibromyalgia and rheumatoid arthritis. Arch of Neuropsychiatry. 2014;51:344-349.
9. Kerns RD, Turk DC, Rudy TE. The west haven-yale multidimensional pain inventory (WHYMPI). *Pain*. 1985;**23(**4):345-356.
10. Ataoğlu S, Ankaralı H, Ankaralı S, Koçak S. Pain Severity in Osteoarthritis Patients: A New Scale, P0140, 5th International 16th National Nursing Congress, 5-8 November 2017, Ankara.
11. Ataoğlu S, Ankaralı H, Ankaralı S, Koçak S. Pain Severity in Rheumatoid Arthritis Patients: A New Scale. P0145, 5th International 16th National Nursing Congress, 5-8 November 2017, Ankara.
12. Gracely RH, Kwilosz DM. The descriptor differential scale: applying psychophysical principles to clinical pain assessment. *Pain*. 1988**;35:**279-288.
13. Güldoğuş F, Kelsaka E, Öztürk B. The effect of gender and working conditions on pain threshold in healty volunteers. *Agri*.2013;**25**(2):64-68.
14. Tsao JCI, Myers CD, Craske MG, Bursch B, Kim SC, Zeltzer LK. Role of anticipatory anxiety and anxiety sensitivity in children's and adolescents' laboratory pain responses. *J Pediatr Psychol*. 2004; **29**(5):379–388.

Appendix. SH-Pain Severity and Pain Threshold Scale

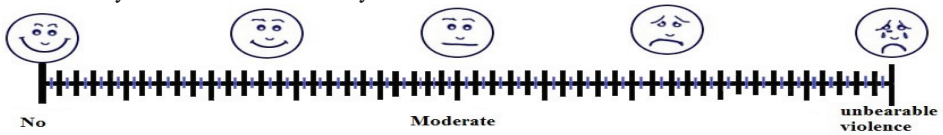
SH – Pain Severity and Pain Threshold Scale

EXAPMLE



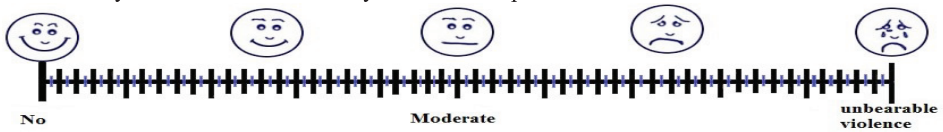
Pay attention to the "face expressions" when answering the following questions

1. What is the severity of the worst headache you ever had



2. What is the severity of the worst abdominal pain you've ever experienced?

3. What is the severity of the worst toothache you've ever experienced?



4.What is the severity of pain when needle is sink to your fingertips?

5.What is the severity of pain when the small glass piece/knife is cut your fingertip?

6.What is the severity of pain you feel when blood was taken from your arm's vein?

7.What is the severity of the pain you are experiencing from the Fibromyalgia Syndrome?

8.Does pain from Fibromyalgia Syndrome make you uncomfortable / uneasy / unhappy / restless in your daily life?