Slovenian Medical Journal

Measurement properties of the numerical pain rating scale in patients with musculoskeletal impairments of the limbs – a systematic literature review

Merske lastnosti številske lestvice za oceno intenzivnosti bolečine pri pacientih z mišično-skeletnimi okvarami na udih – sistematični pregled literature

Ivana Hrvatin, Urška Puh

Abstract

Background: Pain intensity is often assessed using the numerical rating scale, with scores ranging from 0 to 10. It can be administered verbally or in a written format. The purpose was to review its measurement properties in patients with musculoskeletal impairments of the limbs.

Methods: A systematic literature review was conducted in PubMed, CINAHL and the Cochrane library.

Results: Thirteen studies were included. Very good to excellent test-retest reliability of the numeric pain rating scale was found in patients with musculoskeletal disorders of the limbs. Correlations with the visual analogue scale and verbal rating scale were very good to excellent, which confirms the construct validity. Minimal important difference is 2 points.

Conclusion: The numerical rating scale is a reliable and valid tool for pain assessment in patients with musculoskeletal impairments of the limbs. We cannot confirm better measurement properties for written or verbal version. The evaluation should follow detailed patient instructions.

Izvleček

Izhodišča: Za oceno intenzivnosti bolečine je pogosto v uporabi številska lestvica z ocenami od 0 do 10. Ocenjevanje je lahko ustno ali pisno. Namen pregleda literature je bil povzeti njene merske lastnosti pri pacientih z mišično-skeletnimi okvarami na udih.

Department of Physiotherapy, Faculty of Health Sciences, University of Ljubljana, Ljubljana, Slovenia

Correspondence / Korespondenca: Urška Puh, e: urska.puh@zf.uni-lj.si

Key words: NRS; pain intensity; validity; reliability; musculoskeletal disorders

Ključne besede: številska lestvica; intenzivnost bolečine; veljavnost; zanesljivost; mišično-skeletni sistem

Received / Prispelo: 10. 6. 2020 | **Accepted / Sprejeto:** 16. 11. 2020

Cite as / Citirajte kot: Hrvatin I, Puh U. Measurement properties of the numerical pain rating scale in patients with musculoskeletal impairments of the limbs – a systematic literature review. Zdrav Vestn. 2021;90(9–10):512–20. **DOI:** https://doi.org/10.6016/ZdravVestn.3108

Metode: Sistematično so bile pregledane podatkovne zbirke PubMed, CINAHL in Cochrane library.

Rezultati: V pregled je bilo vključenih 13 raziskav. Pri pacientih z mišično-skeletnimi okvarami na udih ima številska lestvica zelo dobro do odlično zanesljivost ponovnega ocenjevanja. Povezanost z vidno analogno lestvico in z lestvico za besedno ocenjevanje bolečine je zelo dobra do odlična, kar potrjuje veljavnost konstrukta. Najmanjša pomembna sprememba je dve oceni.

Zaključek: Številska lestvica je zanesljiva in veljavna za oceno bolečine, ki je posledica mišično-skeletnih okvar na udih. Ne moremo potrditi boljših merskih lastnosti ocenjevanja na ustni ali pisni način. Ocenjevanje mora slediti natančnim navodilom, posredovanim pacientu.

1 Introduction

Musculoskeletal impairments include a variety of conditions involving disorders or injuries of bones, muscles, cartilage, tendons, ligaments, joint capsules and other connective tissues. The WHO classification of diseases lists more than 150 diagnoses. Symptoms can appear as early as childhood and their incidence increases with age (1-3). Most common are lower limbs joint osteoarthrosis, lower back pain, neck pain and inflammatory disorders such as rheumatoid arthritis. Joint and back pain are by far the most common self-reported problems in Slovenia and other developed nations (1,2). Upper and lower extremity injuries represent 59% of all musculoskeletal injuries treated in the emergency department (4). Fall is the most common mechanism of musculoskeletal system injury, however the most common causes of physician visits are sprains (31%), followed by fractures (16%), open wounds (14%), contusions (14%) and luxations (5%) (5). Musculoskeletal disorders are characterized by pain and limitations of movement, skills and functional abilities or activities, which affects the ability to work and integrate into society as well as the individual's mental health (2). The use of the International Classification of Functioning, Disability and Health (ICF) is recommended for a comprehensive assessment of health status (6). It is suitable for promoting appropriate clinical reasoning, classification of measuring tools by ICF sections, enables a structured assessment and treatment of all aspects of human functioning and improves communication (7) between experts in individual disciplines and between disciplines. Sensory functions and pain are included (6) in the second chapter of the Physical Functions section of the ICF.

Reducing pain is often the main treatment goal and the most commonly assessed result of patient management (8). As patients cite pain as their most common problem, its assessment is crucial. Pain is a complex experience, therefore a comprehensive assessment needs to assess five characteristics of pain: location, intensity, quality, duration, and triggers (9). If possible, the assessment should always include self-report of pain intensity, as only the subjects themselves can rate the characteristics of their pain (10). The other two common ways to assess pain are by observing and measuring physiological responses (10,11).

Assessing the intensity of pain gives us a quantitative score of its severity and intensity. The latter is most commonly assessed with three scales: the numerical rating scale (NRS), visual analogue scale (VAS) and verbal rating scale (VRS) (10). In VRS, the subject reads the list of pain intensity descriptors given in graded order and indicates the appropriate category. A number belonging to this category indicates his or her level of pain (10). For research purposes, the 4-point VRS is often used, which contains the following descriptors: no pain, mild pain, moderate pain and severe pain with numbers from 0 to 3 (10). The 6-point VRS is also in use with two additional categories: very severe pain and worst pain imaginable. The easiest to use and most widespread of these scales is the NRS with an 11-point scale. Its scale ranges from 0 (representing "no pain") to 10 (representing "the worst pain imaginable") (12). There is also the 21-point NRS with numbers from 0 to 20 and the 101-point NRS with numbers from 0 to 100, in which both endpoints are marked with same anchor descriptors as in the 11-point NRS (10).

NRS can be administered verbally or in written format. It is important to explain the procedure and give detailed instructions to the subject on how to rate pain and for which period they are being asked before assessing the pain intensity with NRS (see Supplement 1). The verbal version of NRS is simple to use and does not require any aids. In written format, all grades should be written in ascending order and the endpoints should also be described. The subject rates the pain by indicating a number that represents the intensity level of

the pain. Written version of NRS is similar to the VAS as the numbers follow sequentially from left to right, helping the subject with visual representation (10,12). The VAS and NRS scores usually correlate. Despite this, some researchers claim that VAL is more sensitive for detecting small but not necessarily clinically significant changes (11,12).

The validity and reliability of NRS are well represented in the literature. High or excellent validity and reliability have been confirmed in many literature reviews: in the healthy population (13), children and teenagers (14,15), adults (16-18), the elderly (19), for assessing pain in the lower back (20) and neck (21), chronic musculoskeletal pain (22), in patients with arthritis (23), cancer (24) and endometriosis (25), in the prehospital unit (26), post-surgery (27) and in palliative care (28).

The purpose of our literature review was to systematically review studies of the NRS measurement properties in subjects with musculoskeletal disorders of the upper or lower limbs and to determine whether verbal or written version has better measurement properties.

2 Methods

We searched for the literature through the internet databases PubMed, CINAHL and the Cochrane library. The literature search in PubMed was conducted with the following search string: (((numeric[Title/Abstract] OR numerical [Title/Abstract]) AND rating scale*[Title/Abstract]) AND pain intensity[Title/Abstract]) AND psychometric [Title/Abstract] OR reliability [Title/Abstract] OR validity [Title/Abstract]. In other databases the search string was adapted but used the same keywords. All databases were last searched at the end of March 2019. English-language studies were included if reliability, validity, or other measurement properties of NRS to assess pain intensity were analysed in patients over 18 years of age with musculoskeletal disorders of the upper or lower limb. Studies were excluded if assessing pain in the emergency department or ambulance, studies in patients with communication difficulties, and studies in which pain was intentionally induced.

The degree of reliability estimated by calculating the intraclass correlation coefficient (ICC) was determined according to published criteria (29): ICC values below 0.50 indicate poor reliability, between 0.50 and 0.75 the reliability is moderate, between 0.75 and 0.90 it is good and above 0.90 it is excellent. Validity was evaluated with the Pearson or Spearman correlation coefficient: values below 0.25 indicate that there is little or no relationship,, between 0.25 and 0.5 it is fair, between 0.5 and 0.75 moderate to good and above 0.75 very good to excellent (29). The threshold for presence of notable floor or ceiling effects was set at 15% (30).

3 Results

The article selection strategy is presented in the PRISMA flowchart (31) (Figure 1). Thirteen studies that met the criteria were included in the review.

In all the included studies the 11-point NRS was used and patients rated the pain intensity with a whole number from 0 to 10 (32-44). The authors of all studies described the value 0 with the phrase "no pain". For value 10 they used different descriptors. In seven studies it was described as "worst pain imaginable" (32,36,38-42), in two studies they used the phrase "strongest possible pain" (35,37), and in two "pain as bad as it could be" (33,43). In one study (34) they used the phrase "worst pain ever" and in another study (44) "unbearable pain".

Four studies involved patients with upper limb impairments, three of which included patients with shoulder pain (33,38,40) and one included patients with different upper limb musculoskeletal impairments (39). Six studies involved patients with lower limb impairments: knee osteoarthrosis (32,34), ankle sprains (35), patellofemoral pain (37), non-pathologic fractures in the elderly (42) and lower limb musculoskeletal pain of various causes (43). Three studies involved patients with rheumatoid arthritis (36,41,44). In two of these studies, they assessed intensity of acute pain (35,42), chronic pain in five (32,34,36,41,44), and in the remaining six studies, the authors did not identify pain in terms of duration, or patients with acute and chronic pain participated (33,37-40,43).

The test-retest reliability of NRS was tested in nine studies (32-40,42). Excellent reliability ((ICC = 0.92–0.95) was found in three studies with subjects with lower limb impairments (32,37,42), in four studies (33,34,36,38) the test-retest reliability was good (ICC = 0.84–0.89) and in three studies (35,39,40) it was moderate (ICC = 0.72–0.74). The minimal detectable change was between the NRS score 1.33 and 2.6 (Table 1).

The validity of NRS was studied in 12 studies (32-41,43,44). Between NRS in written format and VAS (36,41,43) the correlation was very good to excellent (r = 0.89–0.92). Between verbal NRS and VAS the correlation was very good to excellent (r = 0-94) in two studies (32,34), while one study (44) reported a good correlation (r = 0.75). In all five studies excellent correlations between verbal NRS (32,34) and VRS (r = 0.92–0.93),

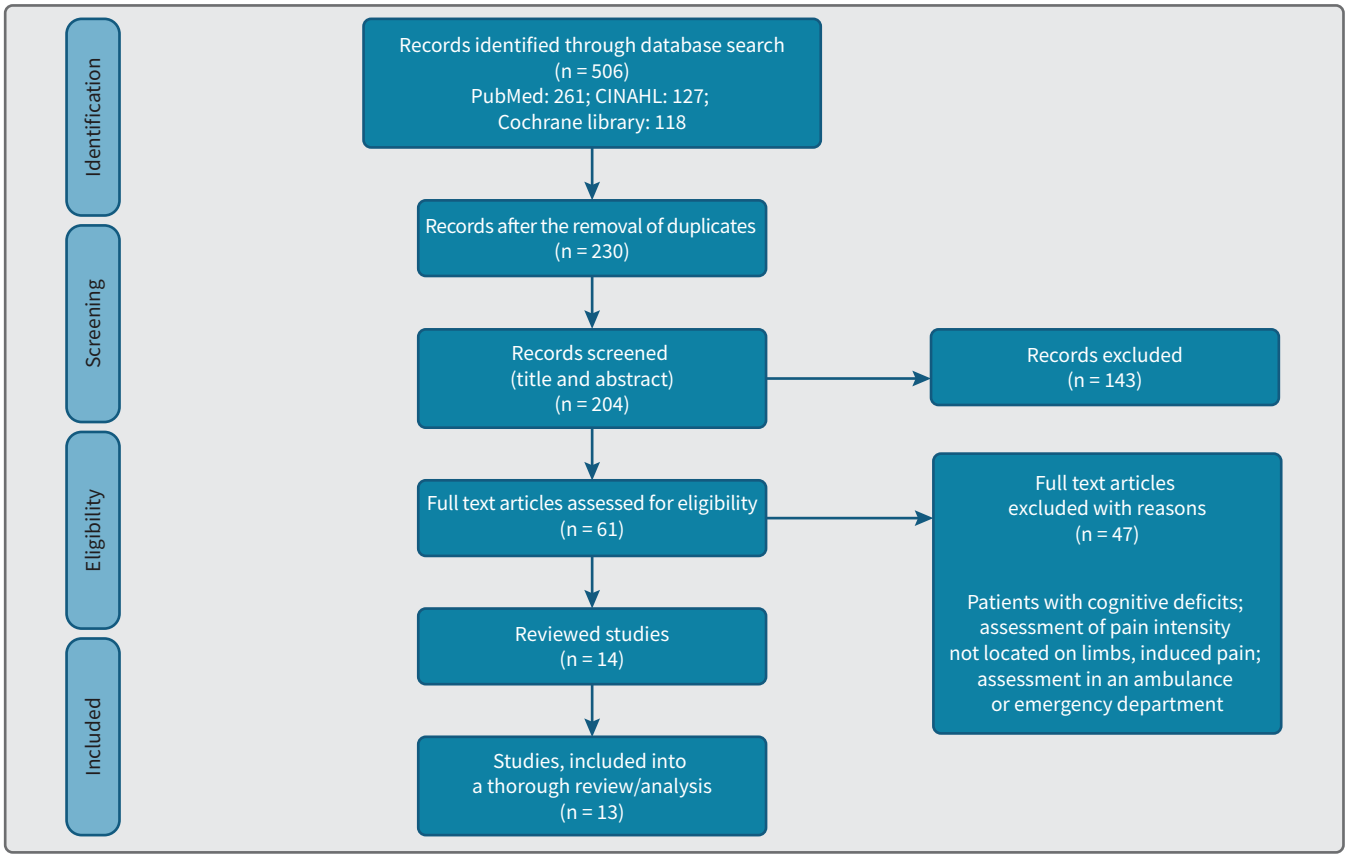

Figure 1: The PRISMA flow diagram. Summarized after Moher D, 2009 (31).

and between written NRS (36,41,43) and VRS (r = 0.80–0.91) were reported (Table 2).

Four studies (38-40) examined the validity of NRS with the functional ability scales. The correlation with the Patient Specific Functional Scale was moderate (r = 0.51) in one study (39) and little (r = 0.15) in another (38). Fair negative correlation (r = -0.26) was reported between the NRS and the Functional Index Questionnaire (37), and between the NRS and the Short Form of the Disabilities of the Arm, Shoulder and Hand Outcome Measure (Quick DASH) (r = 0.26) (40). Little or fair correlation (r = 0.12–0.37) was also reported between the NRS and the Fear-avoidance Beliefs Questionnaire-physical Activity (33), with Global Rating of Change (35), and with Anterior Knee Pain Scale and the Pain Severity Scale for Patellofemoral Pain Syndrome (37).

Three studies examined the presence of the floor and ceiling effects (35,37,38). In none of the studies did more than 15% of subjects rate pain with grade 0 or 10, so they found that no floor and ceiling effect was present.

4 Discussion

Pain assessment is an important part of assessing and monitoring the course of treatment. Pain intensity is probably the most important information about a patient's pain experience, regardless of impairment or illness, and often influences treatment decision-making. (16).

In all 13 studies reviewed (32-44), the 11-point NRS was used, which is the most commonly used scale to assess pain intensity in both clinical practice and research (15). Two important questions remain open with NRS use: what instructions to give to the subject before the assessment and which descriptor to use for the number 10. The results of our literature review show that "worst pain imaginable" is its most commonly used descriptor (32,36,38-42). We propose the descriptor "no pain" for the number 0 and "worst pain imaginable" for the number 10 (see Supplement 1), the same as we suggested for VAS (11).

There were no differences in reliability or validity between the verbal (32-34,40,44) or written (36-39,41-43) format of NRS. Therefore, we cannot confirm that either of these two versions would be more appropriate. Pasero and McCaffery (45) proposed that the written format is more appropriate as its grades would be more reliable because the subject also had visible information

Table 1: Test-retest reliability of the numerical raiting scale for pain intensity for pain intensity assessment in patients with upper or lower limb impairments.

Authors	N	NRS version	ICC	95% CI	SEM	MDC
Alghadir et al., 2018 (32)	121	Verbal	0.95	0.93–0.96	0.48	1.33
Riley et al., 2018 (33)	206	Verbal	0.88	0.77–0.94	/	/
Alghadir et al., 2016 (34)	121	Verbal	0.89	0.84–0.92	0.71	1.96
Da Cunha et al., 2016 (35)	18	Verbal	0.72	0.51–0.84	1.37	/
Sendbeck et al., 2015 (36)	236	Written	0.86	0.89–0.98	/	/
Da Cunha et al., 2013 (37)	83	Written	0.92	0.87–0.95	0.75	/
Puga et al., 2013 (38)	100	Written	0.84	0.77–0.89	0.9	2.6
Hefford et al., 2012 (39)	180	Written	0.74	0.55–0.86	0.7	2.5
Mintken et al., 2009 (40)	101	Verbal	0.74	0.08–0.92	/	/
Herr et al., 2007 (41)	97	Written	/	/	/	/
Bergh et al., 2001 (42)	53	Written	0.95	/	/	/
Herr in Mobily, 1993 (43)	49	Written	/	/	/	/
Downie et al., 1978 (44)	100	Verbal	/	/	/	/

Legend: N – number of subjects, NRS – numerical rating scale for pain intensity, ICC – interclass correlation coefficient, CI – confidence interval, SEM – standard error of measurement, MDC – minimal detectable change, / – no data.

during the assessment, therefore better showing his or her condition. We agree that this format is clearer for the subject as the endpoints and possible grades are clearly shown on the form, thus avoiding invalid scores. We have not found in the literature whether it is recommended that the subject, upon reassessment, has the previously administered scale on hand, as is recommended for VAS (12,46). Nevertheless, the advantage of the verbal NRS is that it is easier to use and does not require any aids or forms (45).

Four reviewed studies (33,38-40) included patients with upper limb impairments and six studies (32,34,35,37,42,43) with lower limb impairments. The test-retest reliability of pain intensity with NRS was moderate to excellent and did not differ substantially between the body parts (upper limbs: ICC 0.74–0.88; lower limbs: ICC 0.72–0.95).

Two studies (35,42) involved patients with acute musculoskeletal system impairments, and five studies (32,34,36,41,44) patients with chronic impairments. No differences in the test-retest reliability with respect to this description of pain were found (acute pain: ICC 0.75–0.95; chronic pain: ICC 0.86–0.95). According to the authors of the previous systematic review (17), all three scales, NRS, VAS and VRS, are valid and reliable and suitable for the assessment of acute pain, but NRS is the easiest to use and is therefore recommended in the guidelines for the assessment of acute pain (47). According to the Initiative on Methods, Measurements and Pain Assessment in Clinical Trials (IMMPACT) guidelines both the verbal and written formats of NRS are appropriate for the assessment of chronic pain intensity (48).

The minimal detectable change in the assessment of pain intensity with NRS was from 1.33 (32) to 2.6 (38). Similarly, a difference of 2 points was found as the minimal clinically important difference in patients with diabetic neuropathy, neuralgia, chronic lower back pain, fibromyalgia and osteoarthrosis (49), chronic musculoskeletal pain (50), lower back pain (51) and shoulder pain (52), which were not included in our literature review.

Good (44) or very good to excellent (32,34,36,41,43) relationship with VAS and very good to excellent relationship with VRS (32,34,36,41,43) was reported in determining the validity of NRS with other pain intensity scales (Table 2). The very good to excellent relationship is expected as the same construct is assessed with these scales. VAS is supposedly the least popular and least used scale among patients and evaluators (53), which could be the consequence of the NRS being simpler to use, especially the verbal version (48). Another literature review (18) found VRS to be the least sensitive of the scales. Its disadvantage is that the number belonging to the adjective

Table 2: Correlations of the numerical raiting scale for pain intensity with other pain intensity assessment scales confirming construct validity in patients with upper or lower limb impairments.

Authors	Visual analogue scale (VAS) (r)	Verbal rating scale (VRS) (r)
Alghadir et al., 2018 (32)	0.94	0.92
Alghadir et al., 2016* (34)	0.94	0.93
Sendbeck et al., 2015 (36)	0.89	0.80
Herr et al., 2007 (41)	0.92	0.91
Herr, Mobily, 1993* (43)	0.92	0.91
Downie et al., 1978 (44)	0.73	/

Legend: r – Pearson correlation coefficient, * – Spearman correlation coefficient, / – no data.

can be misleading for the evaluator. Numerous authors (13,54,55) states that VRS is more useful in the elderly and patients with cognitive deficits, while the use of NRS is most widespread in adults without cognitive deficits.

The correlation between the NRS and the functional abilities scales is little or fair. These results are expected as NRS only assesses pain intensity and not how pain affects the patient's functioning (37). A positive correlation between NRS and functional ability scales suggests that the more intense the pain, the lower the individual's functional ability. However, other factors besides pain intensity affect functioning. It should be noted that NRS only gives us information about pain intensity, which is not adequate for a complete assessment of the patient's pain and its effect on functioning and quality of life.

In future studies, it would be sensible to compare assessment with NRS in verbal and written format in patients with acute musculoskeletal disorders. It would also be sensible to establish inter-tester reliability, particularly of the verbal NRS, as the explanation given and the assessment process are very important. A unified descriptor of the number 10 would also allow comparability of findings between studies.

5 Conclusion

In adults without cognitive deficits, the 11-point NRS is most commonly used for pain intensity assessment, mainly because of its ease of use. The findings of our literature review show that this scale is reliable and valid for use in patients with musculoskeletal disorders of the limbs, regardless of whether it is administered verbally or in written format.

Despite this, the assessment result may be affected by the implementation process. It is important to present the scale (measuring tool) to the subject and clearly explain what the numbers 0 and 10 represent. We propose the descriptor "no pain" for the number 0 and "worst pain imaginable" for the number 10 for use in Slovenia (see Supplement 1). The question should also clearly define in which time the subject should assess the pain.

Conflict of interest

None declared.

Supplement 1: Numerical rating scale for pain intensity (NRS)

Before assessing the intensity of pain, it is important to give the subject detailed instructions and present the measuring tool. With NRS, we can assess the intensity of current pain, usual (average) pain, the most severe pain or the least severe pain in a certain period, which must be clearly stated in the instructions and written next to the score (10,12).

Verbal NRS

Instruction for the subject: "I ask you to rate the intensity of your current / usual / most severe / least severe pain in _____ (specify the period). Rate it with a number from 0 to 10 with 0 meaning "no pain" and 10 meaning "worst pain imaginable". Did you understand?"

If the subject has understood the procedure, he or she state the number representing the score of pain intensity. If the subject did not understand the explanation, ask what he or she didn't understand and explain the procedure again so that he or she will understand.

Written NRS

The numbers must be written in ascending order from 0 to 10 from left to right, and both endpoints are described (10), as represented by Figure 2.

Instruction for the subject: "Before you is a numerical scale with which you will rate the intensity of your pain. On the left side is the number 0, which represents no pain, as is written. On the right side is the number 10, which represents the worst pain imaginable. With a pencil, circle the number representing the intensity of your current / usual / most severe / least severe pain in _____ (specify the period). Did you understand?"

If the subject understood the procedure, he or she will circle the number representing the score of pain intensity. If he or she did not understand the explanation, ask what he or she didn't understand and explain the procedure again so that he or she will understand.

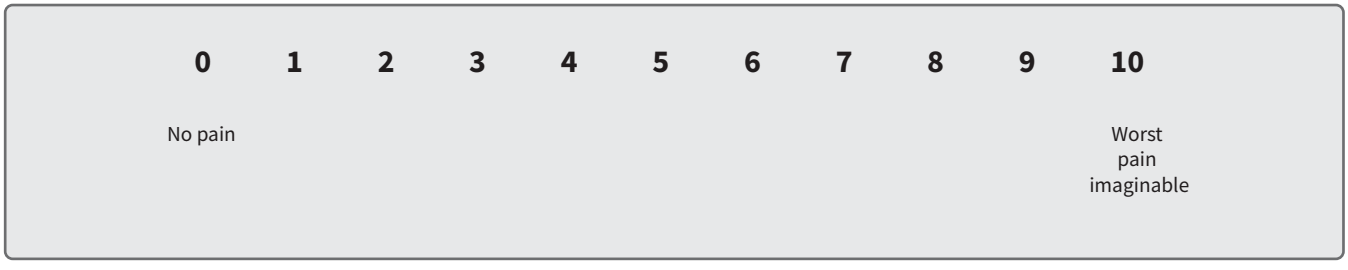

Figure 2: Numerical rating scale (NRS), written format.

References

1. Bolezni kostno-mišičnega sistema. Ljubljana: Nacionalni inštitut za javno zdravje; 2018 [cited 2019 May 30]. Available from: https://www.nijz.si/sl/bolezni-kostno-misicnega-sistema.
2. Musculoskeletal conditions. Geneva: World Health Organization; 2018 [cited 2019 May 30]. Available from: https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions.
3. Barr KP. Review of upper and lower extremity musculoskeletal pain problems. Phys Med Rehabil Clin N Am. 2007;18(4):747-60. DOI: 10.1016/j.pmr.2007.07.009 PMID: 17967363
4. Banerjee M, Bouillon B, Shafizadeh S, Paffrath T, Lefering R, Wafaisade A; German Trauma Registry Group. Epidemiology of extremity injuries in multiple trauma patients. Injury. 2013;44(8):1015-21. DOI: 10.1016/j.injury.2012.12.007 PMID: 23287554
5. National Center for Health Statistics. National Health Interview Survey 2017 Data Release. Atlanta: Centers for Disease Control and Prevention (CDC); 2017 [cited 2019 May 30]. Available from: https://www.cdc.gov/nchs/nhis/nhis_2017_data_release.htm.
6. Mednarodna klasifikacija funkcioniranja, zmanjšane zmožnosti in zdravja. Geneva: World Health Organization; Ljubljana: Inštitut za varovanje zdravja Republike Slovenije; Inštitut Republike Slovenije za rehabilitacijo; 2006.
7. Allet L, Bürge E, Monnin D. ICF: clinical relevance for physiotherapy? A critical review. Adv Physiother. 2008;10(3):127-37. DOI: 10.1080/14038190802315941
8. Scherer M, Schaefer H, Blozik E, Chenot JF, Himmel W. The experience and management of neck pain in general practice: the patients' perspective. Eur Spine J. 2010;19(6):963-71. DOI: 10.1007/s00586-010-1297-x PMID: 20151163
9. Champion GD, Goodenough B, von Baeyer CL, Thomas W. Measurement of pain by selfreport. In: Finley GA, McGrath PJ. Measurement of pain in infants and children: Progress in pain research and management. ;Vol. 10. Seattle: IASP Press; 1998.
10. Jensen MP, Karoly P. Self-report scales and procedures for assessing pain in adults. In: Turk DC, Melzack R. Handbook of pain assessment. 3rd ed. New York: Guilford Press; 2011. pp. 21-44.
11. Jakovljević M, Puh U. Ocenjevanje intenzivnosti bolečine z vidno analogno lestvico. Fizioterapija. 2014;22(2):46-55.
12. Halfaker DA, Akeson ST, Hathcock DR, Mattson C, Wunderlich TL. Psychological aspests of pain. In: Lennard TA, Walkowski SA, Singla AK, Vivian D. Pain procedures in clinical practice. 3rd ed. Philadelphia: Saunders; 2011. pp. 13-22. DOI: 10.1016/B978-1-4160-3779-8.10003-X
13. Herr KA, Spratt K, Mobily PR, Richardson G. Pain intensity assessment in older adults: use of experimental pain to compare psychometric properties and usability of selected pain scales with younger adults. Clin J Pain. 2004;20(4):207-19. DOI: 10.1097/00002508-200407000-00002 PMID: 15218405
14. Birnie KA, Hundert AS, Lalloo C, Nguyen C, Stinson JN. Recommendations for selection of self-report pain intensity measures in children and adolescents: a systematic review and quality assessment of measurement properties. Pain. 2019;160(1):5-18. DOI: 10.1097/j.pain.0000000000001377 PMID: 30180088
15. Castarlenas E, Jensen MP, von Baeyer CL, Miró J. Psychometric properties of the numerical rating scale to assess self-reported pain intensity in children and adolescents: A systematic review. Clin J Pain. 2017;33(4):376-83. DOI: 10.1097/AJP.0000000000000406 PMID: 27518484

16. Hjermstad MJ, Fayers PM, Haugen DF, Caraceni A, Hanks GW, Loge JH, et al.; European Palliative Care Research Collaborative (EPCRC). 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):1073-93. DOI: 10.1016/j.jpainsymman.2010.08.016 PMID: 21621130
17. Karcioglu O, Topacoglu H, Dikme O, Dikme O. A systematic review of the pain scales in adults: which to use? Am J Emerg Med. 2018;36(4):707-14. DOI: 10.1016/j.ajem.2018.01.008 PMID: 29321111
18. Safikhani S, Gries KS, Trudeau JJ, Reasner D, Rüdell K, Coons SJ, et al. Response scale selection in adult pain measures: results from a literature review. J Patient Rep Outcomes. 2018;2(2):40. DOI: 10.1186/s41687-018-0053-6 PMID: 30238085
19. Kim YS, Park JM, Moon YS, Han SH. Assessment of pain in the elderly: A literature review. Natl Med J India. 2017;30(4):203-7. DOI: 10.4103/0970-258X.218673 PMID: 29162753
20. Chiarotto A, Maxwell LJ, Ostelo RW, Boers M, Tugwell P, Terwee CB. Measurement properties of visual analogue scale, numeric rating scale, and pain severity subscale of the brief pain inventory in patients with low back pain: A systematic review. J Pain. 2019;20(3):245-63. DOI: 10.1016/j.jpain.2018.07.009 PMID: 30099210
21. Lemeunier N, da Silva-Oolup S, Olesen K, Shearer H, Carroll LJ, Brady O, et al. Reliability and validity of self-reported questionnaires to measure pain and disability in adults with neck pain and its associated disorders: part 3-a systematic review from the CADRE Collaboration. Eur Spine J. 2019;28(5):1156-79. DOI: 10.1007/s00586-019-05949-8 PMID: 30879185
22. Goldsmith ES, Taylor BC, Greer N, Murdoch M, MacDonald R, McKenzie L, et al. Focused evidence review: psychometric properties of patient-reported outcome measures for chronic musculoskeletal pain. J Gen Intern Med. 2018;33(S1):61-70. DOI: 10.1007/s11606-018-4327-8 PMID: 29633142
23. Englbrecht M, Tarner IH, van der Heijde DM, Manger B, Bombardier C, Müller-Ladner U. Measuring pain and efficacy of pain treatment in inflammatory arthritis: a systematic literature review. J Rheumatol Suppl. 2012;90(0):3-10. DOI: 10.3899/jrheum.120335 PMID: 22942322
24. Caraceni A. Evaluation and assessment of cancer pain and cancer pain treatment. Acta Anaesthesiol Scand. 2001;45(9):1067-75. DOI: 10.1034/j.1399-6576.2001.450903.x PMID: 11683654
25. Bourdel N, Alves J, Pickering G, Ramilo I, Roman H, Canis M. Systematic review of endometriosis pain assessment: how to choose a scale? Hum Reprod Update. 2015;21(1):136-52. DOI: 10.1093/humupd/dmu046 PMID: 25180023
26. Jennings PA, Cameron P, Bernard S. Measuring acute pain in the prehospital setting. Emerg Med J. 2009;26(8):552-5. DOI: 10.1136/emj.2008.062539 PMID: 19625547
27. Coll AM, Ameen JR, Moseley LG. Reported pain after day surgery: a critical literature review. J Adv Nurs. 2004;46(1):53-65. DOI: 10.1111/j.1365-2648.2003.02965.x PMID: 15030442
28. Caraceni A, Cherny N, Fainsinger R, Kaasa S, Poulain P, Radbruch L, et al. Pain measurement tools and methods in clinical research in palliative care: recommendations of an Expert Working Group of the European Association of Palliative Care. J Pain Symptom Manage. 2002;23(3):239-55. DOI: 10.1016/S0885-3924(01)00409-2 PMID: 11888722
29. Portney LG, Watkins MP. Foundations of clinical research: applications to practice. 3rd ed. Philadelphia: F.A. Davis Company; 2015.
30. Terwee CB, Bot SD, de Boer MR, van der Windt DA, Knol DL, Dekker J, et al. Quality criteria were proposed for measurement properties of health status questionnaires. J Clin Epidemiol. 2007;60(1):34-42. DOI: 10.1016/j.jclinepi.2006.03.012 PMID: 17161752
31. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009;339:b2535. DOI: 10.1136/bmj.b2535 PMID: 19622551
32. Alghadir AH, Anwer S, Iqbal A, Iqbal ZA. Test-retest reliability, validity, and minimum detectable change of visual analog, numerical rating, and verbal rating scales for measurement of osteoarthritic knee pain. J Pain Res. 2018;11(11):851-6. DOI: 10.2147/JPR.S158847 PMID: 29731662
33. Riley SP, Tafuto V, Cote M, Brismee JM, Wright A, Cook C. Reliability and relationship of the fear-avoidance beliefs questionnaire with the shoulder pain and disability index and numeric pain rating scale in patients with shoulder pain. Physiother Theory Pract. 2018;20:1-7. PMID: 29558227
34. Alghadir AH, Anwer S, Iqbal ZA. The psychometric properties of an Arabic numeric pain rating scale for measuring osteoarthritis knee pain. Disabil Rehabil. 2016;38(24):2392-7. DOI: 10.3109/09638288.2015.1129441 PMID: 26733318
35. da Cunha RA, Hazime FA, da Silva Martins MC, Ferreira M, de Castro Pochini A, Ejnisman B. Translation, cross-cultural adaptation, and clinimetric testing of instruments used to assess patients with ankle sprain in the brazilian population. J Orthop Sports Phys Ther. 2016;46(12):1042-50. DOI: 10.2519/jospt.2016.6218 PMID: 27825293
36. Sendlbeck M, Araujo EG, Schett G, Englbrecht M. Psychometric properties of three single-item pain scales in patients with rheumatoid arthritis seen during routine clinical care: a comparative perspective on construct validity, reproducibility and internal responsiveness. RMD Open. 2015;1(1):e000140. DOI: 10.1136/rmdopen-2015-000140 PMID: 26719815
37. da Cunha RA, Costa LO, Hespanhol Junior LC, Pires RS, Kujala UM, Lopes AD. Translation, cross-cultural adaptation, and clinimetric testing of instruments used to assess patients with patellofemoral pain syndrome in the Brazilian population. J Orthop Sports Phys Ther. 2013;43(5):332-9. DOI: 10.2519/jospt.2013.4228 PMID: 23485881
38. Puga VO, Lopes AD, Shiwa SR, Alouche SR, Costa LO. Clinimetric testing supports the use of 5 questionnaires adapted into Brazilian Portuguese for patients with shoulder disorders. J Orthop Sports Phys Ther. 2013;43(6):404-13. DOI: 10.2519/jospt.2013.4441 PMID: 23508329
39. Hefford C, Abbott JH, Arnold R, Baxter GD. The patient-specific functional scale: validity, reliability, and responsiveness in patients with upper extremity musculoskeletal problems. J Orthop Sports Phys Ther. 2012;42(2):56-65. DOI: 10.2519/jospt.2012.3953 PMID: 22333510
40. Mintken PE, Glynn P, Cleland JA. Psychometric properties of the shortened disabilities of the arm, shoulder, and hand questionnaire (quickDASH) and numeric pain rating scale in patients with shoulder pain. J Shoulder Elbow Surg. 2009;18(6):920-6. DOI: 10.1016/j.jse.2008.12.015 PMID: 19297202
41. Herr K, Spratt KF, Garand L, Li L. Evaluation of the Iowa pain thermometer and other selected pain intensity scales in younger and older adult cohorts using controlled clinical pain: a preliminary study. Pain Med. 2007;8(7):585-600. DOI: 10.1111/j.1526-4637.2007.00316.x PMID: 17883743
42. Bergh I, Sjöström B, Odén A, Steen B. Assessing pain and pain relief in geriatric patients with non-pathological fractures with different rating scales. Aging (Milano). 2001;13(5):355-61. DOI: 10.1007/BF03351503 PMID: 11820708
43. Herr KA, Mobily PR. Comparison of selected pain assessment tools for use with the elderly. Appl Nurs Res. 1993;6(1):39-46. DOI: 10.1016/S0897-1897(05)80041-2 PMID: 8439177
44. Downie WW, Leatham PA, Rhind VM, Wright V, Branco JA, Anderson JA. Studies with pain rating scales. Ann Rheum Dis. 1978;37(4):378-81. DOI: 10.1136/ard.37.4.378 PMID: 686873
45. Pasero C, McCaffery M. Assessment. In: Pasero C. McCaffery M. Pain assessment and pharmacologic management. St. Louis: Mosby Elsevier; 2011. pp. 13-176.
46. Sindhu BS, Shechtman O, Tuckey L. Validity, reliability, and responsiveness of a digital version of the visual analog scale. J Hand Ther. 2011;24(4):356-63. DOI: 10.1016/j.jht.2011.06.003 PMID: 21820864
47. Helfand M, Freeman M. Assessment and management of acute pain in adult medical inpatients: a systematic review. Pain Med. 2009;10(7):1183-99. DOI: 10.1111/j.1526-4637.2009.00718.x PMID: 19818030

48. Dworkin RH, Turk DC, Farrar JT, Haythornthwaite JA, Jensen MP, Katz NP, et al.; IMMPACT. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. Pain. 2005;113(1-2):9-19. DOI: 10.1016/j.pain.2004.09.012 PMID: 15621359

49. Farrar JT, Young JP, LaMoreaux L, Werth JL, Poole MR. Clinical importance of changes in chronic pain intensity measured on an 11-point numerical pain rating scale. Pain. 2001;94(2):149-58. DOI: 10.1016/S0304-3959(01)00349-9 PMID: 11690728

50. Salaffi F, Stancati A, Silvestri CA, Ciapetti A, Grassi W. Minimal clinically important changes in chronic musculoskeletal pain intensity measured on a numerical rating scale. Eur J Pain. 2004;8(4):283-91. DOI: 10.1016/j.ejpain.2003.09.004 PMID: 15207508

51. Childs JD, Piva SR, Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. Spine. 2005;30(11):1331-4. DOI: 10.1097/01.brs.0000164099.92112.29 PMID: 15928561

52. Michener LA, Snyder AR, Leggin BG. Responsiveness of the numeric pain rating scale in patients with shoulder pain and the effect of surgical status. J Sport Rehabil. 2011;20(1):115-28. DOI: 10.1123/jsr.20.1.115 PMID: 21411827

53. Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. J Clin Nurs. 2005;14(7):798-804. DOI: 10.1111/j.1365-2702.2005.01121.x PMID: 16000093

54. Pereira LV, Pereira GA, Moura LA, Fernandes RR. Pain intensity among institutionalized elderly: a comparison between numerical scales and verbal descriptors. Rev Esc Enferm USP. 2015;49(5):804-10. DOI: 10.1590/S0080-623420150000500014 PMID: 26516751

55. Ware LJ, Epps CD, Herr K, Packard A. Evaluation of the revised faces pain scale, verbal descriptor scale, numeric rating scale, and Iowa pain thermometer in older minority adults. Pain Manag Nurs. 2006;7(3):117-25. DOI: 10.1016/j.pmn.2006.06.005 PMID: 16931417