

**PAIN ASSESSMENT METHODS AMONG PEDIATRIC PATIENTS IN MEDICAL AND DENTAL RESEARCH**

**Maria Shindova, Ani Belcheva**

*Department of Pediatric Dentistry*

*Faculty of Dental Medicine, Medical University – Plovdiv*

*4000, Plovdiv, Bulgaria*

[mariya.shindova@gmail.com](mailto:mariya.shindova@gmail.com)

[abeltcheva@yahoo.com](mailto:abeltcheva@yahoo.com)

**ABSTRACT**

**Introduction:** In medicine and dental medicine absence or perception of pain is the result of a mixture of subjective and objective factors. Both are variable and make pain a personal experience. Subjective component of pain, the variety of reactions among patients in response to painful stimuli and the lack of accurate and appropriate tools for pain assessment may lead to barriers in diagnosing and proper treatment.

**Aim:** To systematically review the contemporary scientific literature and classify different pain assessment methods that are used among children in dental and medical research.

**Material and methods:** The systematic literature search included only randomized controlled investigations, published in English in the period 1969-2015, using the keywords `pain`, `assessment`, `pain scales`, `children`. The two electronic databases PubMed and Elsevier were systematically searched.

**Results:** Thirty-four pain scales that can be used in children were identified for review. A critical analysis and classification of main pain assessment methods were conducted. This article appraises the advantages and disadvantages, as well as the design of the valid and reliable instruments, used in children.

**Conclusion:** There is no universally recommended method that could be used in all contexts for pain evaluation during treatment among pediatric patients. Recommendations for the choice of proper method and guidelines for further use in clinical research are prepared.

**Keywords:** *pain, assessment methods, clinical research*

**Introduction**

Pain is identified as `unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage` [32].

In medicine and dental medicine absence or perception of pain is the result of a mixture of subjective and objective factors. Both are variable and make pain a personal experience [11]. Among the objective factors, the type and severity of the lesion, the doctor or dentist's knowledge and ability, the treatment technique and instruments, the anxiety management techniques are considered [11]. Among subjective factors the threshold of pain, the limit of pain perception and the threshold of suffering are considered. They depend on the individual cognitive, emotional and behavioural components [11,15]. The perception and analysis of stimuli is reported to occur in a complex system. Once detected, the pain signal travels up the peripheral nerve fibers to the cell body located in the dorsal nerve ganglia. From there, the signal travels to the dorsal horn of the spinal cord where filtration, attenuation or amplification occurs. Nerve fibers carrying processed pain signals excite the dorsal horn and ascend to the brain. In the cephalic section of nervous centre the pain perception is individualized by fibers that connect thalamus with the somatic-sensitive cortex (cognitive component), the limbic system (emotional component) and the hypothalamus (behavioural component) [11].

Pain management during medical and dental procedures is crucial for successful behaviour guidance. Prevention of pain results in strengthening doctor-patient relationship, increased confidence and trust in the doctor and dentist, decreased level of fear and anxiety, improvement in the behaviour during the next medical and dental visits [29,30,31]. Subjective component of pain, the variety of reactions among patients in response to painful stimuli and the lack of accurate and appropriate tools for pain assessment may lead to barriers in diagnosing and proper treatment [30,31,41].

The results of considerable number of studies demonstrate that patient himself or herself most accurately describes his or her pain level [30,41,42]. Thus, patients' self-report is the gold standard of pain assessment [8]. Matsuoka et al. indicate that pain is a subjective inner experience known only to patients themselves and it is difficult for healthcare providers to grasp the intensity of patients directly [25,46]. Menezes et al. conclude that very young children lack the ability or vocabulary to relate or describe their pain and patients under four years of age always report more pain than the older ones, 5- to 7-years-old, after restorative treatment [5]. Von Baeyer indicates that children over five years of age can rate their pain intensity if age-appropriate scales are used [44]. Several studies show that the self-report pain scale can be successfully used in both clinical and research medical contexts [38,41].

The aim of this article is to systematically review the contemporary scientific literature and classify different pain assessment methods that are used among children in dental and medical research.

**Material and methods**

All publications of randomized controlled investigations associated with the use of pain assessment methods were identified for consideration. Studies were entirely found through online searches using Medline and Elsevier databases. The articles reviewed ranged from 1969 to 2015. The search terms included the keywords `pain`, `assessment`, `pain scales`, `children`. The limits were set to include only human populations, English language articles and abstracts, and preschool, childhood and adolescent population (up to 18-years of age). Reference lists of previous reviews were also examined.

Unpublished manuscripts, reviews, guidelines, commentaries, other descriptive articles and articles that described modified versions of original observational measures were excluded.

The goal that guided selection of articles for this review was to obtain articles that reported pain scales with the following psychometric properties: validity, reliability and responsiveness.

**Results**

Thirty-four pain scales that can be used in children are identified for review. However, only six of these scales undergo the psychometric testing and could be used as valid and reliable instruments for assessing children`s pain perception in dental and medical research [43]. There are several principal types of scales that are used to measure pain intensity [43].

Table 1. Types of reviewed pain scales used in pediatric patients

Types of scale	Acronym, Name of Tool	First author (year)	Age range
<b>Numerical rating scale</b>	Visual Analogue Scale, VAS	Atiken (1969)	>6
<b>Faces scales</b>	Wong-Baker Faces Pain Scale	Wong (1998)	>3
	Faces Pain Scale-Revised, FPS-R	Hicks (2001)	
	Faces Pain Scale, FPS	Bieri (1990)	
	Oucher pain scale	Beyer (1992)	
<b>Adjective scales</b>	Verbal Rating Scale, VRS	Tesler (1991)	>9
<b>Pieces of hurt</b>	Pieces of hurt, Poker chip tools	Hester (1979)	>3
<b>Colour scales</b>	Coloured Analogue Scale	McGrath (1996)	>4

<b>Universal pain scale</b>	Universal pain assessment tool	Department of Anesthesiology and Reanimation, California Uni(2005)	All ages
-----------------------------	--------------------------------	--	----------

Table 1 lists scales included in the review, with the name of the first author, year of original publication, appropriate age range. The analysis of the included scales proposes a method of classification based on the type of the tools.

**1. Numerical Rating Scales, NRS**

Numerical Rating Scales, NRS, involve asking for pain perception using numbers that represent increasing pain intensity [23]. They are quick and easy to use in practice, require no equipment or special skills and training. However, these instruments require an ability to think and express oneself in quantitative terms, as well as verbal communication skills. Thus, they are appropriately used in children older than eight years of age [9]. Younger patients have not a developed understanding of the quantitative significance of numbers [9,10].

The most commonly used scale of this type is the Visual analogue scale, VAS. This measurement instrument represents a horizontal 10-cm line, scored from 0 (no pain) to 10 (worst possible pain), (figure 1). During administration patients are asked to put a cross anywhere on the line that best describes their pain perception. Shields et al. determine high sensitivity and validity of this instrument used in children over six years of age [35,36]. Facco et al. describe it as a universal, rapid, simple instrument that is most frequently used for pain assessment [7]. A coloured version of VAS, Coloured analogue scale, has been developed but it has not found wide acceptance in clinical studies and practice [26].



Figure 1. Visual analogue scale, VAS

**2. Faces scales, FS**

Faces scales involve selecting a picture of a face that represents patient`s pain perception. They fall into two categories-drawings and photographs [1,19]. These scales consist of several drawings of faces, arranged in a horizontal row, with a neutral or minimum pain face at the left and the maximum or minimum pain face at the right and the patient chooses the face that best represents the severity or intensity of their current pain. Faces scales do not require numeracy, the ability to seriate or estimate quantities, because the task can be handled by simply matching how one feels to one of the faces, which is presumed to be easier than quantitative estimation. Usually, children prefer this type of assessment instrument when given a choice [3,28]. Champion et al. find that this assessment method could be properly used in children younger than nine years of age or older patients with severe dental fear [3]. According to von Baeyer faces scales are appropriate for children older than four years of age [43]. Hockenberry et al. and Sheller et al. determine high sensitivity and validity of Wong-Baker Faces Pain Scale and Faces Pain Scale-Revised, FPS-R, in children over 3 years of age (figure 2 и 3) [19,20,21,34,44,45].



Figure 2. Wong-Baker Faces Pain Scale



Figure 3. Faces Pain Scale-Revised, FPS-R

In addition to the mentioned faces scales above, another two undergo extensive psychometric testing and are used in the assessment of both acute and disease-related pain in children, Faces Pain Scale, FPS, and Oucher pain scale, (figure 4 and 5) [1,2,40].



Figure 4. Faces Pain Scale

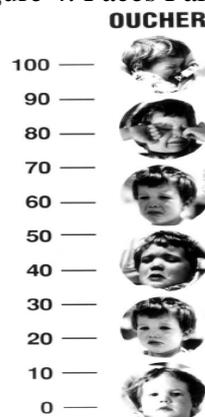


Figure 5. Oucher pain scale

### 3. Adjective scales

Adjective scales involve selecting a word, usually an adjective, out of a set of descriptions of pain intensity [39]. These scales require well-developed verbal skills and are appropriate for application in children older than nine years of age [43]. As in the VAS, two endpoints such as ‘no pain at all’ and ‘extremely intense pain’ are defined. Between these opposite emotional states, different adjectives which describe different pain-intensity levels are placed in the order of pain severity. As an advantage of this scale, some authors find that the respondent’s compliance is often as good or even better compared to other instruments [4,23]. Due to the limited number of possible response categories, some patients may have problems in defining which answer fits best to their pain situation. Moreover, the intervals between different adjectives describing pain may not be equal that may reduce the assessment data level to ordinal data level.

The most frequently used adjective scale is the Verbal Rating Scale [13]. Mostly, four- to six-point VRS are used in clinical trials. Like VAS, VRS has been shown to correlate strongly with other pain-assessment tools [23,24].

### 4. Pieces of Hurt (Poker chip tool)

Pieces of Hurt (Poker chip tool) quantifies pain perception by using one of four red poker chips to represent patient’s pain perception [17,18], (Figure 6).



Figure 6. Pieces of Hurt

Children indicate their pain level by referring one chip, which shows a little bit of hurt, to four chips, which show the most hurt they could ever have (figure 6). Administration of this instrument minimizes the cognitive demands on the patient that makes it a very simple and straightforward pain intensity measure. The Poker Chip Tool has the most utility as a simple clinical assessment tool to identify presence/absence of pain and very gross estimates of pain intensity in young children. It is recommended for use in 3- to 4-year-old patients for acute procedure-related and postoperative pain [37]. Romsing et al. find significant level of parent-child or nurse-child agreement using the poker chip tool [34]. The Pieces of Hurt has been shown to correlate strongly with other pain-assessment tools, such as the Oucher pain scale, word descriptors and with behavioural observations of verbal, vocal, facial, and motor behaviours indicating pain [12,14].

### 5. Colour scales

The colour scales, Coloured Analogue Scale, require child to select exact colour or draw colour choosing a crayon matching different levels of pain intensity. They are time-consuming and rarely used in clinical practice [26].

### 6. Universal pain assessment tool

Universal pain assessment tool is first used in 2005 by the researchers from the Department of Anesthesiology and Reanimation, California University, Los Angeles (figure 7). Later, it becomes popular for application in other American states – Texas, New York, Michigan. This tool combines the advantages of four types of pain assessment instruments – Visual Analogue Scale, adjective scales, Numerical Rating Scales and Faces Scales [6,16,22]. Universal pain assessment tool is translated into 10 languages and its aim is to describe completely the individual's pain experience. The combination of NRS, verbal description, association between pain and facial expression and individual threshold of pain makes this instrument usable in all age groups.

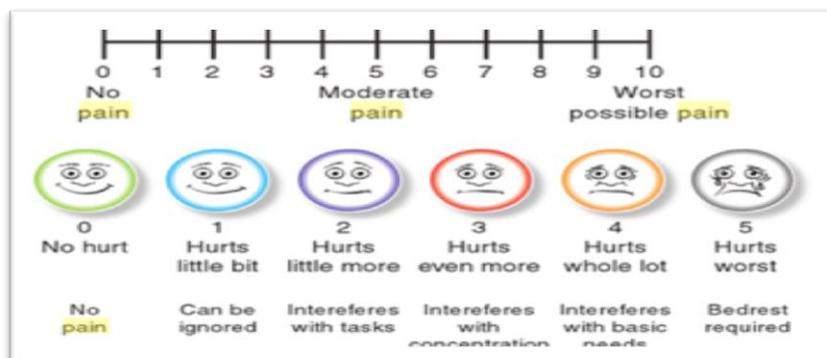


Figure 7. Universal pain assessment tool

### Conclusion

This systematic review identified the psychometric properties and feasibility of the principal types of pain assessment methods in children. There is no universally recommended method that could be used in all contexts for pain evaluation during treatment among pediatric patients. Self-report measures can provide a valuable indication of treatment outcome in both clinical and research contexts and be an effective guidance for pain management practice.

### Reference

1. Beyer JE, Denyes MJ, Villarruel AM. The creation, validation, and continuing development of the Oucher: a measure of pain intensity in children. *J Pediatr Nurs*. 1992;7(5):335-46.
2. Bieri D, et al. The Faces Pain Scale for the self-assessment of the severity of pain experienced by children: development, initial validation, and preliminary investigation for ratio scale properties. *Pain*. 1990;41(2):139-50.
3. Champion GD, et al. Measurement of pain by self-report. In: Finley GA, McGrath PJ, editors. *Measurement of Pain in Infants and Children*. Seattle: IASP Press; 1998:123-60.
4. Closs SJ, et al. A comparison of five pain assessment scales for nursing home residents with varying degrees of cognitive impairment. *J Pain Symptom Manage*. 2004;27:196-205.
5. de Menezes Abreu DM, Leal SC, Frencken JE Self-report of pain in children treated according to the atraumatic restorative treatment and the conventional restorative treatment--a pilot study. *J Clin Pediatr Dent*. 2009;34(2):151-5.
6. Edelen MO, Saliba D. Correspondence of verbal descriptor and numeric rating scales for pain intensity: an item response theory calibration. *J Gerontol A Biol Sci Med Sci*. 2010;65(7):778-85.
7. Facco E, et al. Toward the validation of visual analogue scale for anxiety. *Anesth Prog*. 2011;58(1):8-13.
8. Fink RN. Pain assessment: the cornerstone to optimal pain management. *Proc (Bayl Univ Med Cent)*. 2000 Jul; 13(3): 236-239.
9. Gaffney A, McGrath P, Dick B. Measuring pain in children: Developmental and instrument issues. In: Schechter N, Berde CB, Yaster M, editors. *Pain in Infants, Children and Adolescents*. 2. Philadelphia: Lippincott Williams & Wilkins; 2003:128-41.
10. Gelman R, Meck E. Preschoolers' counting: Principles before skills. *Cognition*. 1983;13(3):343-359.
11. Genovese MD, Olivi G. Laser in paediatric dentistry: patient acceptance of hard and soft tissue therapy. *Eu J Paediatr Dent*. 2008; 9(1):13-7.
12. Gharaibeh M, Abu-Saad H. Cultural validation of pediatric pain assessment tools: Jordanian perspective. *Journal of Transcultural Nursing*. 2002;13:12-18.
13. Glossary. *Spine (Phila Pa 1976)*. 2000;25(24):3200-2.
14. Goodenough B, et al. Pain in 4-6-year-old children receiving intramuscular injections: A comparison of the Faces Pain Scale with other self-report and behavioral measures. *The Clinical Journal of Pain*. 1997;13:60-73.
15. Grassi G, Magnani F. Stomatal, mesophyll conductance and biochemical limitations to photosynthesis as affected by drought and leaf ontogeny in ash and oak trees. *Plant, Cell and Environment*. 2005;28:834-849.
16. Hesselgard K, Larsson S, Romner B, Strömlad LG, Reinstrup P. Validity and reliability of the Behavioural Observational Pain Scale for postoperative pain measurement in children 1-7 years of age. *Pediatr Crit Care Med*. 2007;8(2):102-8.
17. Hester NK. The preoperational child's reaction to immunization. *Nursing Research*. 1979;28(4):250-255.
18. Hester NO, Foster RL, Kristensen K. Measurement of pain in children: Generalizability and validity of the pain ladder and poker chip tool. In: Tyler DC, Krane EJ, editors. *Advances in Pain*

## Science & Technologies

- Research and Therapy, vol 15: Pediatric Plan. New York: Raven Press; 1990;79–84.
19. Hicks CL, von Baeyer CL, Spafford PA, van Korlaar I, Goodenough B. The Faces Pain Scale-Revised: toward a common metric in pediatric pain measurement. *Pain*.2001;93(2):173-83.
  20. Hockenberry HJ. *Wong's Essentials of Pediatric Nursing*. London: Mosby; 2008.
  21. Hockenberry MJ, Wilson D. *Wong's Essentials of Pediatric Nursing*. 8th ed. St. Louis, Mo: Mosby, Inc; 2009: 162.
  22. Hockenberry MJ, Wilson D, Wilkenstein ML. *Wong's Essentials of Pediatric Nursing*.7th ed.St Louis: Mosby, 2005.
  23. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods.*Pain*. 1986;27(1):117-26.
  24. Kremer E, Atkinson JH, Ignelzi RJ. Measurement of pain: patient preference does not confound pain measurement. *Pain*. 1981;10:241–248.
  25. Matsuoka Y, Fukai K. Face Scales and Facial Expression Analysis to Assess Clinical Pain Intensity.2008; 8(1).
  26. McGrath PA, Seifert CE, Speechley KN, Booth JC, Stitt L, Gibson MC. A new analogue scale for assessing children's pain: An initial validation study. *Pain*.1 27. 996;64:435–43.
  28. McGregor AJ,et al.*Sex and Gender in Acute Care Medicine*. Cambridge University Press.2016
  29. Miró J, Castarlenas E, Huguet A. Evidence for the use of a numerical rating scale to assess the intensity of pediatric pain.*Eur J Pain*. 2009;13(10):1089-95.
  30. Nakai Y, Milgrom P, Mancl L, Coldwell SE, Domoto PK, Ramsay DS. Effectiveness of local anesthesia in pediatric dental practice. *J Am Dent Assoc*. 2000;131(12):1699–1705.
  31. Nutter DP. Good, clinical pain practice for pediatric procedure pain: neurobiologic considerations.*J Calif Dent Assoc*. 2009;37(10):705-10.
  32. Ohnhaus EE, Adler R. Methodological problems in the measurement of pain: a comparison between the verbal rating scale and the visual analogue scale. *Pain*. 1975;1(4):379-84.
  33. *Pain*. 1979 Jun;6(3):249. Pain terms: a list with definitions and notes on usage. Recommended by the IASP Subcommittee on Taxonomy
  34. Romsing J, Moller-Sonnergaard J, Hertel S, Rasmussen M. Postoperative pain in children: Comparison between ratings of children and nurses. *Journal of Pain and Symptom Management*.1996;11(1):42–46.
  35. Sheller B. Challenges of managing child behavior in the 21st century dental setting. *Pediatr Dent* 2004;26(2): 111-3.
  36. Shields BJ, Cohen DM, Harbeck-Weber C, Powers JD, Smith GA. Pediatric pain measurement using a visual analogue scale: A comparison of two teaching methods. *Clin Pediatr (Phila)* 2003;42:227–34.
  37. Shields BJ, Palermo TM, Powers JD, Grewe SD, Smith GA. Predictors of a child's ability to use a visual analogue scale. *Child Care Health Dev*. 2003;29:281–90.
  38. St-Laurent-Gagnon T, Bernard-Bonnin AC, Villeneuve E. Pain evaluation in preschool children and by their parents. *Acta Paediatr*. 1999 Apr;88(4):422-7.
  39. Stinson JN, Kavanagh T, Yamada J, Gill N, Stevens B. Systematic review of the psychometric properties, interpretability and feasibility of self-report pain intensity measures for use in clinical trials in children and adolescents.*Pain*. 2006;125(1-2):143-57.
  40. Tesler MD, Savedra MC, Holzemer WL, Wilkie DJ, Ward JA, Paul SM. The word-graphic rating scale as a measure of children's and adolescents' pain intensity. *Res Nurs Health*. 1991;14:361–71.
  41. Tomlinson D, von Baeyer CL, Stinson JN, Sung L. A systematic review of faces scales for the self-report of pain intensity in children.*Pediatrics*. 2010;126(5).

## Science & Technologies

42. Versloot J, Craig KD. The communication of pain in paediatric dentistry. Epub 2007 Nov 26. *Eur Arch Paediatr Dent.* 2009;10(2):61-6.
43. Versloot J, Veerkamp JS, Hoogstraten J. Assessment of pain by the child, dentist, and independent observers. *Pediatr Dent.* 2004;26(5):445-9.
44. von Baeyer CL. Children's self-reports of pain intensity: Scale selection, limitations and interpretation. *Pain Res Manag.* 2006;11(3):157-162.
45. Wong DL, Baker C. Pain in children: comparison of assessment scales. *Pediatr Nurs.* 1998;14:9-17.
46. Zhou H, Roberts P, Horgan L. Association between self-report pain ratings of child and parent, child and nurse and parent and nurse dyads: meta-analysis. *J Adv Nurs.* 2008;63(4):334-42.