Measurement of self-reported pain intensity in children and adolescents

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Abstract

Acute and chronic pain is a common experience in children and youth. A thorough assessment is fundamental to understand this experience and to assess and monitor treatment responses. The intensity of pain is the parameter most commonly assessed. In this article, we describe the different methods employed to assess pediatric pain intensity and review well-validated and commonly used self-report measures of pain. This review is based on the recent systematic reviews conducted for the Pediatric Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials Consensus Group and the Society of Pediatric Psychology. Amongst the several types of pediatric pain measures, self-report, when available, is regarded as the primary source of information about pain intensity, to be complemented by observation and knowledge of the context. There is a large number of self-report measures of pediatric pain intensity; and there is some agreement that professionals in the clinical and research practice should assess pain intensity using the Pieces of Hurt Tool, the Faces Pain Scale, the Oucher, or Visual Analogue Scales because these measures have shown to have sound psychometric properties and clinical utility. Despite the increased number of age-appropriate self-report measures of pediatric pain intensity over the last years, we report several research gaps and priorities of future research.

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Introduction

Pain is defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” by the International Association for the Study of Pain (IASP [1] p. 210). Such a definition parallels, to some extent, the widely accepted and used biopsychosocial model of pain [2]. It goes beyond the biomedical perspective which dominated the field years ago. Pain is much more than a simple, straightforward, sensory experience. Pain results from the interaction of multiple factors, physical, as well as emotional, cognitive, behavioral, and contextual [3].

Pain is unpleasant but necessary. Pain has biological value, it can be a sign that something dangerous is occurring in the body. That is, pain can warn us of actual or impeding tissue damage and motivate the individual to escape or avoid further harm. Indeed, acute pain is defined by the IASP as pain that usually has an identifiable relationship to injury or disease and it has a recent onset and probable limited duration [1]. However, there are times when the pain experience is unnecessary, it happens when pain has lost its value as a signal of danger. This is true of most painful medical procedures and is typical in chronic pain problems. Chronic pain is defined by the IASP as pain that persists beyond normally expected healing [1]; however, it might also occur without a physical injury [4]. It is experienced as recurrent (i.e., repeated) or continuous (i.e., persistent) in nature [4].

Pain, either acute or chronic, is a very common experience in children and youth. Many children are exposed to acute painful procedures (e.g., needles for immunization and blood sampling, and surgery) with immunizations being the most frequently performed procedure in pediatric setting.
On the other hand, the prevalence of chronic pain is estimated to range from 15% to 30% with headache and abdominal pain the most common recurrent pain problems (e.g., Ref. [6] and [7]).

Both acute and chronic pain are often under-recognized and not treated appropriately, which may lead to both short and long-term negative consequences [8]. Accurate pain assessment using reliable and valid measures is the cornerstone of effective treatment. The purpose of this article is to (a) provide an overview of the measurement of pain intensity in children and youth, (b) outline the approaches to assessment of pediatric pain, (c) describe single item self-report measures with well-established reliability and validity for clinical and research use, and (d) discuss future areas for research.

Pain intensity

When assessing pediatric pain (acute and chronic) there are multiple dimensions that can be assessed. These dimensions include: (a) sensory (e.g., intensity, word descriptors, duration, location, and frequency), (b) affective/cognitive (pain unpleasantness), and (c) impact of pain in aspects of every day life (physical, social, emotional, and role functioning). While it is important to assess each of these domains, the most commonly used parameter in clinical and research practices is the measurement of the intensity of pain or how much it hurts [9]. Moreover, pain intensity has been recently suggested as being a primary outcome domain to be used in pediatric pain clinical trials by the Pediatric Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials Consensus Group (Ped-IMMPACT [10]).

Several systematic reviews of pediatric pain measures have been published over the past few years [11–13]. These reviews were commissioned by two independent working groups: Ped-IMMPACT group and the Society of Pediatric Psychology (SPP). In general terms, both groups summarize and describe the most relevant measures to assess the key domains in the field of pediatric pain based on empirical evidence as well as experts’ opinions. The Ped-IMMPACT group was an initiative that included academic researchers, government funding and regulatory agencies, and the pharmaceutical industry. The aim of this group was to determine which domains and measures should be used in clinical trials for pediatric pain. This consensus group commissioned two systematic reviews of pain intensity measures for children 3–18 years of age in line with their recommendations to use pain intensity as a primary outcome measures in pediatric clinical trials. These two systematic reviews aimed to identify self-report pain intensity [12] and observational measures of pain intensity [13] with well-established psychometric properties that could be recommended for use in clinical trials. On the other hand, the SPP commissioned reviews of measures used by pediatric psychologists working as scientist-practitioners to assess several areas of interest, including pain. The SPP review of pediatric pain measures, unlike the previous systematic reviews commissioned by Ped-IMMPACT, did not only focus on identifying pain intensity measures, but also measures intended for assessing other pain-related domains. The goal of this review was to identify measures with well-established psychometric properties that could be used in clinical practice.

The results derived from these three reviews are relevant as they focused on pain intensity but they approached the reviews from different perspectives (research versus clinical practice). The Ped-IMMPACT was focused more heavily on reliability and validity of pain intensity measures, whereas the SPP recommendations were more focused on clinical utility. Clinical utility refers to the applicability of the measure within clinical context [14].

Second, the two groups used different methodologies to review and develop recommendations about pain intensity measures. On one hand, the Ped-IMMPACT group used a two-stage process. In the first phase they conducted a Delphi Survey and held a 2-day consensus conference regarding the core domains to be assessed in clinical pain trials. The second phase was the commissioning of two independent systematic reviews to identify reliable and valid pain intensity measures; one on self-report measure and the other on behavioral observation measures for children 3–18 years of age (Refs. [12 and 13] respectively). On the other hand, the SPP results were based on the Society Pediatric Pain Assessment Task Force recommendations, a survey of members of the Society Pediatric Pain listerv, and a search of literature. Despite these methodological differences in selecting scales for review, both groups used the same criteria to evaluate the quality of measures included in the reviews. These criteria combine appropriate demonstration of the psychometric properties of the measure with more practical considerations (i.e., accurate and precise presentation of the measure) in an attempt to operationalize evidence-based assessment. These criteria were suggested by Cohen et al. [15].

Finally, PedIMMPACT excluded from their reviews measures designed and tested exclusively for children younger than three years, and Cohen et al. [15] did not.

Table 1 lists all single item pain intensity measures identified by both groups with some descriptive information. However, we will describe in more detail those measures that receive ratings of “well established” by both working groups at this time. For a review of well-validated disease-specific pain intensity measures, see Ref. [11].

Type of pain intensity measures

Before describing pain intensity measures with well-established psychometric properties recommended by both groups it is important to mention that there are three main approaches to the assessment of intensity of pain in children: physiological, behavioral, and self-report (for other previous extended reviews, see Refs. [48,49]). There are a number of
physiological measures of pain, for example: heart and respiratory rate, blood pressure, and oxygen saturation. Despite the lack of response bias and the apparent objectivity, no physiological measures have been shown to be very useful. Many physical measures are not specific to pain intensity, in that they simply cannot discriminate well between the responses to pain and other forms of stress in the body, and vary according to extraneous factors. Furthermore, these physiological indices habituate over short periods of time and are thus not appropriate for the measurement of acute pain that may last over several days (e.g., post-operative) or chronic pain.

Behavioral measures of pain are based on the observation of nonverbal clues about specific types of distress behaviors (e.g., vocalization, facial expression, and body movement) that have been associated with pain to estimate the intensity of the child’s pain. Although these measures provide very valuable information, they are not very appropriate for assessing recurrent and chronic pain because they are vulnerable to habituation, that is, behavioral signs of chronic pain tend to dissipate as time passes, so it is difficult to observe reliably these behavioral signs in cases of chronic pain. Behavioral and physiological measures are most commonly used in preverbal (infants) and young children younger than 3 years of age. They can be used together in composite measures such as the Premature Infant Pain Profile or separately. For a review of observational measures in children 3–18 years old, see Ref. [13], and for infants, see Ref. [50].

Self-report measures of pain are preferred over other types of pain measures for use with children capable of verbal communication. There are several advantages in using self-report measures. Pain is a subjective experience and self-report measures ask for the individual to articulate their pain verbally. There are several advantages in using self-report measures for use with children capable of verbal communication. There are several advantages in using self-report measures. Pain is a subjective experience and self-report measures ask for the individual to articulate their pain verbally. There are several advantages in using self-report measures for use with children capable of verbal communication. There are several advantages in using self-report measures. Pain is a subjective experience and self-report measures ask for the individual to articulate their pain verbally.

Table 1
Details of single item self-report measures of pediatric pain intensity identified by both working groups

<table>
<thead>
<tr>
<th>Name of the scale (acronym)</th>
<th>Evidence of reliability and validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analogue Chromatic</td>
<td>++</td>
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<tr>
<td>Continuous Scale</td>
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<tr>
<td>Body Outline</td>
<td>-</td>
</tr>
<tr>
<td>Children’s Anxiety</td>
<td>-</td>
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<tr>
<td>Pain Scales</td>
<td></td>
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<tr>
<td>Children’s Global</td>
<td>-</td>
</tr>
<tr>
<td>Rating Scale</td>
<td></td>
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<tr>
<td>Colour Analogue Scale</td>
<td>++</td>
</tr>
<tr>
<td>Eland Colour Tool</td>
<td></td>
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<tr>
<td>Facial Expression Scale</td>
<td>-</td>
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<tr>
<td>Faces Scale</td>
<td>++</td>
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<tr>
<td>Faces Scale</td>
<td>-</td>
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<tr>
<td>Faces Scale</td>
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<tr>
<td>Faces Scale</td>
<td>-</td>
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<tr>
<td>Faces Pain Scale and Faces</td>
<td>+++</td>
</tr>
<tr>
<td>Pain Scale-Revised (FPS, FPS-R)* [27,28]</td>
<td>+++</td>
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<tr>
<td>Finger Span</td>
<td>-</td>
</tr>
<tr>
<td>Graphic Numerical</td>
<td>+</td>
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<tr>
<td>Rating Scale</td>
<td></td>
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<tr>
<td>Glasses Rating Scale</td>
<td>+</td>
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<tr>
<td>Linear analogue pain scale</td>
<td>-</td>
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<tr>
<td>Multiple Size Poker</td>
<td>-</td>
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<tr>
<td>Chip Tool</td>
<td>-</td>
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<tr>
<td>Numerical Rating Scale</td>
<td>-</td>
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<tr>
<td>Thermometer</td>
<td>-</td>
</tr>
<tr>
<td>The Oucher-Photographic and</td>
<td>+++</td>
</tr>
<tr>
<td>Numerical Rating Scale* [34]</td>
<td>-</td>
</tr>
<tr>
<td>Pain Ladder</td>
<td>+</td>
</tr>
<tr>
<td>Pieces of Hurt Tool* [36]</td>
<td>++</td>
</tr>
<tr>
<td>Scheffield Children’s Hospital Pain Tool [37]</td>
<td>+++</td>
</tr>
<tr>
<td>Sydney Animated Facial</td>
<td>-</td>
</tr>
<tr>
<td>Expression Scale</td>
<td>-</td>
</tr>
<tr>
<td>4-point Verbal Descriptor Scale [40]</td>
<td>++</td>
</tr>
<tr>
<td>4-point Verbal Descriptor Scale [39,41]</td>
<td>+</td>
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<tr>
<td>Verbal Numerical</td>
<td>-</td>
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<tr>
<td>Rating Scale</td>
<td>-</td>
</tr>
<tr>
<td>VAS* [43]</td>
<td>+++</td>
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<tr>
<td>VAS of Faces</td>
<td>-</td>
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<tr>
<td>Visual Analogue Toy</td>
<td>++</td>
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<tr>
<td>Wong-Baker FACES</td>
<td>+++</td>
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<tr>
<td>Pain Rating Scale</td>
<td>-</td>
</tr>
<tr>
<td>5-point Word Graphic</td>
<td>+</td>
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<tr>
<td>Rating Scale</td>
<td>+</td>
</tr>
<tr>
<td>6-point Word Graphic</td>
<td>+</td>
</tr>
<tr>
<td>Rating Scale</td>
<td>+</td>
</tr>
</tbody>
</table>

Notes to Table 1:
Rating based on the criteria developed by Cohen et al. [15] to apply to evaluate assessment instruments in pediatric psychology.

+++ , for excellent evidence on psychometric testing (well-established assessment measure). Detailed information indicating good validity and reliability in at least 1 peer-reviewed article.

++, for good evidence on psychometric testing (approaching well-established assessment measure). Validity and reliability information either presented in vague terms (e.g. no statistics presented) or only moderate values presented in at least two peer-reviewed articles which might be presented by the same investigator or research team.

+, for some evidence on psychometric testing (promising assessment measure). Validity and reliability information either presented in vague terms (e.g., no statistics presented) or only moderate values presented in at least one peer-reviewed article.

−, for minimal psychometric testing.

−−, for no research on psychometric testing at all.

* The four well-established tools can be obtained from the following sources: the FPS-R can be found at: http://painsourcebook.ca/docs/pps92.html; the Oucher can be ordered at: http://www.oucher.org/the_scales.html; the instructions on Pieces of Hurt Tool can be found at http://www.painresearch.utah.edu/cancerpain/attachb7.html; a Visual Analogue Scale can be found at: http://cme.medscape.com/content/2003/00/44/96/449675/449675...fig.html.
they are dependent on the child’s social, cognitive and communicative competence such as his/her ability to match items, to place items in a correct series, and to listen to the instructions of the person administering the measure while looking at materials [51,52]. Second, child’s reports are also influenced by their context (whom is asking the question, setting). Therefore, it is possible that children may respond in a biased fashion (e.g., minimize their pain for fear of getting needle). Finally, they may be subject to recall bias when they are used to ask children to recall there pain over prolong periods (weeks to months) [53].

**Self-report measures**

Stinson et al. [12] identified a total of 34 unidimensional self-report measures of pain intensity for children aged between 3 and 18 years old; six of these measures met the criteria of being a “well-established measure” based on the assessment criteria developed by Cohen et al. [15]. Cohen et al. [11] reviewed a total of 8 self-report measures which are commonly used to assess pain intensity in children: 4 unidimensional measures and 4 multidimensional measures. They assigned a rating of “well-established measure” for five of these measures reviewed. Both groups agreed that the Pieces of Hurt Tool, the Faces Pain Scale-Revised, the Oucher, and the Visual Analogue Scale were the best measures available for clinical and research practice.

**Pieces of Hurt Tool (often referred to as the Poker Chip Tool)**

This tool uses four red poker chips. The chips are aligned horizontally in front of the child on the bedside table or any other firm surface. The chips are depicted as equal to pieces of hurt. One chip represents “a little bit of hurt,” and four chips represent “the most hurt the child could ever have.” In other words, the first chip means just a little hurt, the second chip means a little more hurt, the third chip means more hurt, and the fourth chip means the most hurt. The child is asked how many pieces of hurt he/she has and the number of chips selected is recorded.

This tool was initially developed and tested to use with children aged between 4–6 years old [36]. However, after this initial work this tool has been used for a wider age range (i.e., for 3–18 years old) [54].

The Pieces of Hurt Tool has been established to have sound psychometric properties. Test-retest correlations have showed score stability over short period of time in cases of acute pain [45] and [55]. Scores on Pieces of Hurt Tool have also correlated with many other indicators of pain intensity such as the Faces Pain Scale, behavioral reactions to painful stimulus, observers’ global judgments, the Oucher, visual analogue scale, and the Wong-Baker FACES Pain Rating Scale [35,36,39,54–56]. Despite these results in favor of the convergent construct validity of the Pieces of Hurt Tool, by comparing distribution of scores on several self-reports of pain intensity, Goodenough et al. [39] suggested that scores on Pieces of Hurt Tool could be inflated when younger children between 4 and 6 years old rated short sharp (needle) pain. Finally, the Pieces of Hurt Tool has also shown to be sensitive to expected changes in pain levels after surgery [55] and administration of analgesics [56] and [39]. Furthermore, the Pieces of Hurt Tool has been translated and adapted to other languages including Spanish, Thai [22], and Arab [54].

Although this tool is widely recognized as an appropriate to be used for preschool–age children, asking “how many pieces of hurt” presupposes that the child is able to count and estimate quantity and younger children might not have acquired these cognitive skills yet. Therefore, we should further assess the appropriateness of the measure when used for younger children.

**Faces pain scale-revised**

The Faces Pain Scale-Revised [28] (www.painsourcebook.ca) uses facial expressions to assess pain intensity. The child is asked to select the face that best reflects the intensity of the pain he/she has from a series of faces depicting different levels of pain intensity in a horizontal orientation. This measure was adapted from the Faces Pain Scale (FPS) [27]. The FPS was revised in order to make it consistent with the 0–10 common metric [57]. Specifically, the FPS-R is based on six faces instead of seven faces that were the number of faces used in its original version so that a numeric value from 0 to 10 (0–2 4 6–8 10) can be assigned to each face. The end points are explained as “no pain” and “very much pain.” The FPS or FPS-R has several advantages over other existing faces scales (see reviews [18,49,58]). First, it has no smiling and/or tearful faces, which is relevant considering that scales that use a series of faces with expressions from smiling faces (no pain) to tearful (very much pain) can confound the affective component (distress) and the sensory component of pain (pain intensity) [58,59]. Second, it has the advantage of being suitable for use with the most widely used scoring metric (0–10) [28]. Third, besides having a true 0 point, the intervals on the scale are equal [60]. Finally, the instructions have been translated into more than 32 languages (http://painsourcebook.ca).

The psychometric properties of this scale have been widely explored. The FPS-R has shown to be reliable and valid for use in normal and clinical pediatric populations aged between 4 and 16 years old. Stability reliability has been evaluated using test-retest technique with different time interval. For example, Miró and Huguet [61] reported stability coefficients for a month retesting period with a schoolchildren sample to be appropriate. Participating school children were asked to imagine themselves in several hypothetical painful situations and estimate pain intensity. Perrot et al. [62] also reported stability coefficients rather high for one and two days retesting period with a clinical sample who had undergone surgery. The FPS-R has also shown to have moderate to good convergent construct
validity when FPS-R is compared with other well-established self-report pain intensity measures such as visual analogue scales, the Wong-Baker FACES Pain Rating Scale (e.g., Refs. [28,63,64]) and with other well-established observational measures such as Children’s Hospital of Eastern Ontario Pain Scale [65]. The correlation between FPS-R and the Facial Affective Scale, which assess the affective dimension of pain, has also been shown to be sufficiently low as to provide some evidence of the discriminant construct validity of the FPS-R [61]. The criterion-related validity of the FPS-R has also been supported using as a criterion for example affective state [61]. Moreover, the FPS-R has also shown favorable sensitivity in identifying changes in pain intensity for example, after the administration of an anesthetic during a painful procedure [66]. The FPS-R has high clinically utility as it is easy to administer, is available free of charge (www.painsourcebook.ca) and readily photocopied. Furthermore, faces scales are preferred by both children and nurses over other self-report measures such as VAS (e.g., Ref. [45]).

**The Oucher-Photographic And Numerical Rating Scale**

There are two vertical pain scales on the Oucher: (a) a numerical rating scale of 0–10 for older children and (b) a color photographic scale of child’s faces with different pain expressions for younger children. Therefore, this measure can be used with children from 3 to 12 years of age. The Oucher permits older children (from 8 to 12 years old) to rate their pain intensity by picking the number from 0 (“no hurt”) to 10 (“the biggest hurt you could ever have”) that is like the hurt that they are having when they are assessed. The Faces Pain scale also permits younger children (from three to seven years old) to rate their pain intensity by matching it to one of the six photographs of faces depicting increasing levels of pain. A real child (3 years of age) is depicted in the photographs and the child’s face in the bottom photograph shows no hurt and in the top photograph shows the biggest hurt you could ever have.

The original Oucher was initially developed to be used for Caucasian children; however, other ethnic versions of the photographic scale of faces have been developed [67]. Specifically, under the assumption that verbal pain expression may be affected by cultural context (e.g., Ref. [68]), they have used photographs of faces of Caucasian, Hispanic, and African-American children to use this scale for Caucasian, Hispanic, and African-American child population. However, this contrasts with some preliminary evidence in the literature against significant differences in pain expression by ethnicity [69].

There is evidence to support the psychometric properties of the numerical and photographic scales of the Oucher versions. For example, Beyer and Aradine [34] provided evidence supporting the content validity of the photographic scale of the original Caucasian version in children aged between 3 and 7 years recruited from daycare and hospital settings. Overall the participating children were able to discriminate the facial expressions of the photographs. Participating children were able to sequence quite well the six photographs from no hurt to the biggest hurt, although the youngest children displayed a poorer performance. However, as the authors acknowledged the task performance might not only depend upon age, it can be effected by a range of other influences. The African-American and Hispanic versions have also evidence of content validity [70]. The test-retest reliability of the Oucher versions has also been studied by several teams. For example, Luffy and Grove [71] showed high test-retest reliability of the African-American version when children with sickle cell anemia disease were asked to recall and rate the pain intensity of painful procedure/treatment in a minimum of 15 min between the test and retest. Several other groups of researchers have also demonstrated the construct validity of the Oucher using similar methods. Strong positive correlations were found between the Oucher score and other pain intensity measures for children including well-established tools such as Pieces of Hurt Tool, Wong-Baker FACES Pain Rating Scale, and Visual Analogue Scale and through a weak correlation between the Oucher score and fear measures (for validity testing of the African American version; see, e.g., Refs. [56,72], and for validity testing of the African American and Hispanic versions, see, e.g., Refs. [71,73]). Several authors have also demonstrated that the Oucher is able to detect change in pain intensity levels following the administration of analgesics [72,73]. However, the Oucher requires purchase or costly color printing and requires disinfecting between use with patients in a hospital setting, which may diminish its clinical utility in some settings.

**Visual Analogue Scale**

The Visual Analogue Scale (VAS) is usually a horizontal line, 100 mm in length, anchored at each end by nonstandardized verbal descriptors which represent extreme limits of pain intensity (e.g., upper scale anchors: “most pain” [20], “pain as bad as it could be” [33]). The child is asked to place a mark on the line at a point which they feel that represents the intensity of their pain. The VAS is scored by measuring from no pain anchor to the point selected on the scale. Due to the conceptual complexity required to understand VAS, this measure is recommended for children 8 years of age and older. The VAS has also been presented as a vertical scale [74] and, less often, as a chromatic scale (e.g., Color Analogue Scale, [20]).

The psychometric properties of the VAS have been the most widely explored. Several authors have showed the reliability and validity of the VAS by means of test-retest reliability, construct validity, and criterion-related validity. For instance, in terms of reliability, VAS scores demonstrate to be stable over a 2-week period [75]. In terms of construct validity, VAS scores correlate well with other measures of pain intensity such as the standardized color analog scale and
the Faces Pain Scale and Oucher (e.g., [39,56,76,77]). And, in terms of criterion-related validity, the VAS scores also correlate with clinical characteristics typically associated with pain [43,55,78]. The VAS is also sensitive to changes in pain levels during postoperative periods [77] or following administration of analgesics [77,79,80]. However, importantly, there are inconsistent findings in the literature regarding the youngest age at which a child is able to use the VAS. While some authors find the VAS to be an appropriate measure for use by children aged five years and older [33,75], others only advise to use VAS for children aged seven years old onwards [56,81]. As recommended by Shields et al. [81] clinicians and researchers should be cognizant of child’s cognitive abilities which have been found to better predict the successful performance in the use of the VAS than chronological age. There is also controversy surrounds whether the VAS score is ratio or ordinal (see, e.g., [75]). In terms of clinical utility, the Coloured Analogue Scale has to be purchased and cleaned as an appropriate infection control precaution in hospital; however, the article VAS is readily photocopied and free for use.

Conclusions

Particular attention has been paid to the area of pediatric pain assessment over the last years. Several events have contributed to elevate the attention towards the pediatric pain assessment among health care professionals. Among the most important events we must highlight: overcoming several popular beliefs and myths surrounding pediatric pain (e.g., children, especially infants do not feel pain the way adults do, pain builds character), adding pain as the 5th vital sign by the American Pain Society, the declaration of 2000-2010 as the Decade of Pain Control and Research made by the US Congress [82]; and recent advances in our knowledge of pediatric pain including knowledge of the developmental neurobiology of pain processing (e.g., Ref. [83]), knowledge of negative effects that unrecognized and untreated pain can have on the child (e.g., Ref. [84]), and increased availability of evidence-based guidelines for the management of pain in children (e.g., Ref. [85]). All these multiple factors have contributed to the proliferation of age-appropriate measurements of pain intensity.

In this chapter, we have described the best evaluated and commonly used self-report measures of pediatric pain intensity based on the work done by Ped-IMMPACT group and the SPP. In order to assess pain intensity in acute and chronic pain clinical trials, Ped-IMMPACT recommended the use of the Pieces of Hurt Tool for children aged between 3 and 4 years, the Faces Pain Scale-Revised for children aged between 4 and 12 years, and the Visual Analogue Scale for children 8 years of age upwards. However, Stinson et al. [12] also acknowledged the Oucher and Wong-Baker FACES Pain Rating Scale as measures that have well-established evidence of reliability and validity. On the other hand, Cohen et al. [11], on behalf of the Society of Pediatric Psychology recommended to professionals the use the Pieces of Hurt Tool for children between 4 and 7 years old, the Faces Pain Scale-Revised for children aged between 4 and 16 years old, the Visual Analogue Scale for children 3 years of age upwards, and the Oucher for children aged between 3 and 12 years old as single item self-reports. Therefore, in general, the comparison of reviews conducted by both groups lead to similar results with only a few discrepancies which are due to the different approach and methodology they used.

Although it is beyond the scope of this review to exhaustively discuss future research areas, among areas which merit attention for clinical research on self-report pain intensity measures are the following ones (see Ref. [86] for a further discussion of these issues):

* To integrate the utilization of well-established pain assessment tools in the clinical practices in a consistent manner, paying special attention to how pain scores changes over time within individuals.
* To enhance prospective records of pain intensity by creative applications of these well-established existing tools such as the newly developed handheld electronic pain diaries used for recurrent or chronic pain (see Ref. [87,88]).
* To demonstrate the impact of pain intensity assessment in the practice setting.
* To provide culturally appropriate tools, that is, to adapt and test the existing well-established tools in other cultures.
* To evaluate the psychometric properties of existing measures which have not been rated as well-established yet. For example, the numerical rating scale (NRS) is the most commonly used self-report measure in the clinical practice despite the lack of existing evidence on its reliability, validity and ability to detect change [89]. The NRS is administrated by asking the child to verbally estimate his/her pain level on a 0-10 pain scale, with 0 representing no pain and 10 representing the worst pain. The NRS is administered verbally without any printed or physical materials that enhances its clinical utility. Several researchers are working on studies which will provide evidence for the validity and reliability of the point (0–10) numerical rating scale [90].
* To integrate knowledge of the context when we assess pain intensity to make sense of the pain intensity scores.
* To design and validate screening methods which allow professionals identify those children who are able to provide meaningful self-reports and those who are not (see, e.g., Ref. [91]), and to investigate whether those who are not able to provide meaningful self-reports can be trained.
* To learn more about the ability of children with developmental and communicative impairments to use self-reports to guide the work with these children [92].
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