

PAIN ASSESSMENT TOOLS IN PAEDIATRICS: A SYSTEMATIC LITERATURE REVIEW

Ibitoye Bukola Mary

ABSTRACT

Pain assessment is an integral component of pain management. However, pain assessment remains sub-optimal in many African countries. Lack of knowledge is one of the major reasons for this setback in paediatric pain management. Numerous pain assessment tools have been studied and validated by researchers all over the world. This article presents a summary of the various pain assessment tools in the existing literature. This review aims at critically analyzing and summarizing the findings of existing studies on paediatric pain assessment tools. A systematic literature review was conducted in PubMed, ScienceDirect and Google Scholar. Preliminary search terms were imputed into the various databases, they are: 'pain assessment', 'paediatric', 'assessment tools' and 'pain assessment checklist'. Three main themes emerge from the literature that were reviewed, they are: self-report, observer reported and physiological measures. Tools appropriate for different ages were also presented. To enhance the utilization of pain assessment tools, there is a need for strict policies to necessitate pain assessment. Also, researchers should develop and test electronic versions of these assessment tools.

Keywords: Pain assessment tools: Paediatrics: Pain.

INTRODUCTION

Pain is one of the commonest complaints in children. A Canadian study shows that 2987 children have undergone 18, 929 pain procedures within 24 hours, that implies that averagely each child has approximately 6

painful procedures within 24 hours . A South-African study also indicates that most children on admission experienced moderate-severe pain . Numerous clinical guidelines have been proposed interventions to address the assessment and management of paediatric pain'. However, its recognition remains poor and its management is sub-optimal in many African countries. In describing the challenges of pain assessment and management in Africa, indicate that inadequate training and limited resources are among the reasons for poor paediatric pain management within the region. Researchers have indicated that there is paucity of research data on paediatric pain with the region . This may be because it is not considered a research priority; it is not done often or the practice is so common it is not considered necessary. The reason is unclear but it is unlikely to be the latter. Hence, it is important to provide research evidence to guide pain management practices in Africa. This review focuses on pain assessment tools which are an integral component of pain management.

Pain assessment is a crucial foundation to the research and implementation of pain management techniques; nevertheless it is challenging and age-dependent in paediatric research . This is basically due to the subjectivity and complexity of the nature of pain . For neonates and infants (children less than 3 years old), it is very challenging to assess their pain because of developmental and language limitations which prevent them from adequately comprehending and self-reporting their pain (Drendall, et al., 2011). Therefore, others (such as their parents and healthcare providers) have to infer their pain from behavioural and physiological indicators .

opine that these indicators are not easily interpreted because they are modified by social (e.g. culture and ethnicity), contextual factors (e.g. previous experience with pain), and individual child characteristics (e.g. gender and health status). Also, the interpretation of these indicators is influenced by individual characteristics (e.g. observational skills, knowledge and beliefs) of person interpreting their pain.

From the age of three, children rapidly develop the ability to self-report their pain. However, their self-reported pain can also be influenced by contextual factors and their individual characteristics. In line with the challenges of pain measurement in children, argue that there is no “gold standard” pain indicator or measure in children. Nevertheless, various developmentally-appropriate pain assessment tools have been developed and are used for research and practice. This review seeks to summarize and critique existing literature on pain assessment tools in children. This will serve as a guide for healthcare professionals on the available assessment tools they can use in clinical practice and research.

METHODOLOGY

A systematic literature review was conducted. A search was conducted in PubMed. Preliminary search terms were imputed into the various databases, they are: 'pain assessment', 'paediatric', 'assessment tools' and 'pain assessment checklist'. Google Scholar and ScienceDirect were also search engines using the aforementioned keywords. Relevant textbooks on paediatric pain were also reviewed. The identified studies were imported into Mendeley referencing software. Duplicates were removed and subsequently, the titles and abstracts were screened against the inclusion and exclusion criteria. The full texts of the remaining relevant studies were retrieved.

Existing studies have shown that there are three approaches to the measurement of pain in children. It is usually recommended that two or more of these measures are used in research; this is to account for each of their limitations. Also, various pain tools have been developed for specific types of pain and disease conditions. Hence, researchers have suggested that these tools should be used only after proper consideration of the characteristics of the tool and its reliability in assessing the type of pain being measured. The three measures of pain discovered in literature are discussed below.

Self-report measures

Self-report involves an oral, written or non-verbal account or portrayal of an individual's thoughts, feelings or actions. It is the basic source of information on pain intensity and other characteristics in children age 3 years and older. Various age-appropriate self-report tools have been developed and are used for research as well as practice. For children age 3-7 years, face scales are often recommended. This is because they require less cognitive demands: basically they require that the child matches his/her distress to a particular picture. Other tools such as the numerical rating scale (NRS) tend to require some competence in seriation, counting and magnitude estimation; however, these abilities are not developed until a child is about 8 years (von Baeyer, 2014).

Dozens of face scales have been developed however; submit that only three emerged as the predominant and best validated tools. They are; the Faces Pain Scale-Revised (FPS-R); the Oucher; the Wong-Baker FACES Pain Rating Scales. See Table 1 for description of some common pain assessment tools used in paediatrics. highlighted that there is a debate over the psychometric properties, utility and preference among these scales.

Therefore, these tools are used based on their appropriateness to specific situations. For instance: FPS-R is the most often used tool for research, due to numerous reasons (for example: it has been validated in several countries and its explicit interval scale properties). Another self-report tool which has been recommended for this age group is the Poker Chip tool (or Pieces of Hurt)(McGrath et al., 2008).

For children age 8 years and above, the visual analogue scale (VAS), numerical rating scales and faces scales have been recommended for their self-report pain assessment. von Baeyer (2014) claim that the NRS is the most commonly used tool for this age-group and it is well supported by recent studies (such as: . When it is administered verbally, it is referred to as the verbal numeric scale (VNS). One of the limitations of this scale is that the intermediate numbers have no fixed meaning to different individuals (for instance: 6 can mean moderate pain to some people, and severe pain for others). The VAS has also been extensively validated and it is often used in research . Variants of the VAS such as the colour analogue scale (CAS) has been developed as well (McGrath et al., 1996).

Furthermore, through an international consensus project called PedIMMPACT, McGrath et al. (2008) suggested the use of the FPS-R for children aged 4-12. There are other self-report tools which have been proposed but have not been adequately validated by research (Stinson et al., 2006). There are numerous limitations associated with the use of self-report measures in children, a typical one is that children may not understand how to use the scale as such they may respond inaccurately (von Baeyer et al., 2009). Thus, von Baeyer (2014) suggests that children should be adequately educated on the use of the tool when they are not in acute distress. Chorney & McMurtry (2014) claim that self-report measures are considered to be the 'gold standard' of pain assessment, however, von Baeyer (2014) refutes this statement and considers it to be misleading. It is argued that self-reports can be biased by contextual factors (such as the person asking about their pain; as a result a child in severe pain under-reports his/her pain so that he/she can be considered as a brave person) (Chorney & McMurtry, 2014; Craig, 2009; von Baeyer, 2014). Nevertheless, self-reports appears to be the most reliable pain assessment tools available; and it can be used in conjunction with other pain measures to account for its limitations (Huguet, Stinson, & McGrath, 2010; von Baeyer & Spagrud, 2007).

Figure 1: Description of some common pain scales used in paediatrics

Pain scale	Use(s)	Rater	Format of items on the scale	Indicators that are being measured	Strengths
Children’s Hospital of Eastern Ontario pain scale (CHEOPS) (McGrath et al., 1985)	It is used to measure observer-report on procedural and post-operative pain. It is used in children aged 4 months to 17 years.	Health-care professional Researcher	Indicators are scored on a four-point scale, ranging from 0-3. Total score ranges from 4-13.	Crying, facial expressions, torso activity, whether and how child touches the injection site and leg position	Based on well-established evidence, it is considered as being reliable and valid. Also, it has the ability to detect change (von Baeyer and Spagrud, 2007)
Visual analogue scale (VAS) (Scott, Ansell and Huskisson, 1977)	It is used to measure self-reported pain and to obtain global reports of pain. It can be used in children age 2-17 years.	Child Parent Health-care professional Researcher	It is a vertical or horizontal line where the extreme ends define the extreme limits of the intensity of pain.	Pain intensity	Based on well-established evidence, it is considered as being reliable and valid. Many versions (such as CAS) have been created to improve its reliability.
Colour Analogue scale (CAS) (McGrath, Seifert, Speechley et al., 1996)	It is used to measure self-reported pain and to obtain global reports of pain. It can be used in children age 2-17 years.	Child	It is a variant of the VAS. The black lines in VAS are replaced with colours. This is such that there are vivid gradations in colour, area, and length, so that children could vividly see how different scale positions would reflect different values in their pain intensity (McGrath et al., 1996).	Pain intensity	Based on well-established evidence, it is considered as being reliable and valid.
Numerical rating Scales (NRS)	It is used to measure self-reported pain in children over 8 years old. It is used to measure global reports of pain.	Child Parent Health-care professionals Researcher	It consists of a range of numbers (e.g. 0-10 or 0-100). The lowest number represents ‘no pain’ and the highest number represents the ‘highest pain possible’.	Pain intensity	There is evidence demonstrating that it is reliable and valid. It can also be administered verbally; in this case it is called the Verbal Numeric Scale (VNS)
Wong-Baker faces pain scale (Wong and Baker, 1988)	It is used to measure self-reported procedural pain in children aged 3-18 years.	Child	Six hand-drawn faces ranging from smiling to crying. It is scored from 0 to 5 or 0 to 10.	Pain intensity	There is well-established evidence demonstrating that it is reliable, valid and it is able to detect changes in pain intensity (Tomlinson, et al., Stinson 2010). It is quick and simple to use; and it requires minimal instruction. It is available in more than ten languages (Stinson and Jibb, 2014).

Behavioural measures of pain

Behavioural (or observational) measures of pain are based on the observation of specific and expressive distress behaviours (such as facial expression, and body movement) which have been identified to be associated with pain in children (Huguet et al., 2010; Stinson & Jibb, 2014). The observation can be conducted by a healthcare provider, parents and/or researcher; often behavioural measures are developed for specific observers/raters (Chorney & McMurtry, 2014). They are often used in situations where the child is unable to

use self-reports tools (for example: children less than three years old) (Stinson & Jibb, 2014). Also, they are used, in situations, where self-report ratings are considered to be exaggerated, or minimized (von Baeyer & Spagrud, 2007).

Behavioural measures tend to measure either pain intensity or frequency or both (Chorney & McMurtry, 2014). von Baeyer & Spagrud (2007) classify the types of behavioural measures into three groups; they are: behavioural checklists, behavioural rating scales and global rating scales. Behavioural

checklists present a list of behaviours associated with pain, and the rater is supposed to indicate whether they are present or absent. An example is the Pain Observation Scale for Young Children (POSYC) (Boelen-van der Loo, Scheffer, de Haan, & de Groot, 1999). Behavioural rating scales are much detailed than checklists: they include a rating of the intensity, frequency and/or duration of each of the behaviours. An example is the Children's Hospital Pain of Eastern Ontario Pain Scale (CHEOPS) (McGrath, Johnson, Goodman, & Schillinger, 1984). Global reports are used to provide a rating of the observer's overall impression of a child's pain. In this case, any tool can be used; for instance: NRS, VAS and faces scales have all been used as a basis to achieve a global report of a child's pain (Chambers, Hardial, Craig, & Montgomery, 2005). Some of these tools have been extensively validated and are commonly used, examples include; CHOEPS and face, legs, activity, cry and consolability scale (FLACC) (Jaskowski, 1998).

All these tools have their strengths and weaknesses; nevertheless, this review will focus on the general limitations of behavioural measures (Chorney & McMurtry, 2014; von Baeyer & Spagrud, 2007). A major limitation of behavioural measures is the high risk of misinterpretation of the child's behaviour by the observer. Moreover, the observer's interpretation can be biased by his/her individual characteristics (e.g. past experiences with pain, observational skills, knowledge and beliefs) (Lee & Stevens, 2014). Moreover, not all these behaviours (for example: crying) are necessarily specific to pain. Although, it is often assumed that behaviours before a painful procedure are indicative of distress and those during and after the procedure are due to experience pain. Notwithstanding, Bird & McMurtry (2012) suggest that the ability to identify behaviours

specific to pain should be explored in the future. Despite these limitations, behavioural measures remain an integral to thorough pain assessment, in some instances; they may be the most valid tool available (Chorney & McMurtry, 2014).

Physiological measures of pain

Physiological measures of pain involve the use of bio markers, which are characteristics that can be objectively measured as an indicator of a biological, pathological or pharmacological process (Atkinson et al., 2001). Biomarkers are common in clinical practice and health research (Brummelte, Oberlander & Craig, 2014). In relation to pain, the biomarkers which have been identified include: heart rate, respiratory rate and pattern, blood pressure and oxygen pressure (Stinson & Jibb, 2014). These physiological responses are indicative of the activation of the sympathetic nervous system, which is also responsible for the stress (fight or flight) response. As a result, these indicators are not specific to pain responses; rather they engage all the physiological systems reactive to both pain and stress (Brummelte, Oberlander, & Craig, 2014). Therefore, as von Baeyer & Spagrud (2007) explain, these responses can be elicited due to fever or exertion. This is a major limitation of physiological measures of pain. As a result, Brummelte, Oberlander, Craig (2014) opines that there is an urgent need for specific pain biomarkers. Nevertheless, Stinson & Jibb, (2014) suggest that physiological measures should not be used alone in children, rather, they should be used with self-report and/or behavioural measures.

CONCLUSION AND RECOMMENDATIONS

There are various age-dependent assessment tools that are available for use in both research and clinical practice. This review has presented

the various pain assessment tools and concluded that there is a need for studies to investigate the use of these assessment tools in Africa. Digital-based pain assessment should be developed and incorporated into practice. Students in medical and nursing schools should be educated on the importance of incorporating assessment into their pain management practices.

REFERENCES

- Albertyn, R., Rode, H., Millar, A. J. W., & Thomas, J. (2009). Challenges associated with paediatric pain management in Sub Saharan Africa. *International Journal of Surgery*, 7(2), 91–93. <https://doi.org/10.1016/J.IJSU.2009.01.005>
- Association of Paediatric Anaesthetists. (2012). Good Practice in Postoperative and Procedural Pain. *Paediatric Anaesthesia*, 22, 1–79.
- Atkinson, A. J., Colburn, W. A., Degruittola, V. G., Demets, D. L., Downing, G. J., Hoth, D. F., ... Zeger, S. L. (2001). Biomarkers and surrogate endpoints: Preferred definitions and conceptual framework. *Clinical Pharmacology & Therapeutics*, 69(3), 89–95. <https://doi.org/10.1067/mcp.2001.113989>
- Bailey, B., Daoust, R., Doyon-Trottier, E., Dauphin-Pierre, S., & Gravel, J. (2010). Validation and properties of the verbal numeric scale in children with acute pain. *Pain*, 149(2), 216–221. <https://doi.org/10.1016/j.pain.2009.12.008>
- Besenski, L., Forsyth, S., & von Baeyer, C. (2007). Screening young children for their ability to use self-report pain scales. *Screening*, 9(1). Retrieved from http://ppl.childpain.org/issues/v9n1_2007/v9n1_besenski.shtml
- Beyer, J. E., Denyes, M. J., & Villarruel, A. M. (1992). The creation, validation, and continuing development of the Oucher: a measure of pain intensity in children. *Journal of Pediatric Nursing*, 7(5), 335–346. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/1479552>
- Bird, L., & McMurtry, C. M. (2012). Fear in pediatric acute pain: role and measurement. *Pain Management*, 2(6), 527–529. <https://doi.org/10.2217/pmt.1256>
- Boelen-van der Loo, W. J., Scheffer, E., de Haan, R. J., & de Groot, C. J. (1999). Clinimetric evaluation of the pain observation scale for young children in children aged between 1 and 4 years after ear, nose, and throat surgery. *Journal of Developmental and Behavioral Pediatrics*. Retrieved from <https://psycnet.apa.org/record/2015-34547-001>
- Brummelte, S., Oberlander, T. F. and Craig, K. D. (2014). Biomarkers of pain: physiological indices of pain reactivity in infants and children. In W. T. McGrath, P.J, Stevens, B.J., Walker, M. S., and Zempsky (Ed.), *Oxford textbook of paediatric pain*. (pp. 391–400). Oxford: Oxford University Press.
- Chambers, C., Hardial, J., Craig, K., & Montgomery, C. (2005). Faces scales for the measurement of postoperative pain intensity in children following minor surgery. *The Clinical Journal of Pain*, 21(3), 277–285. Retrieved from https://journals.lww.com/clinicalpain/Fulltext/2005/05000/Pain_in_4_to_6_Year_Old_Children_Receiving.11.aspx
- Chorney, J. M., & McMurtry, C. M. (2014). Behavioural measures of pain. In P.J McGrath, B. J. Stevens, M. S. Walker, &

- W. T. Zempsky (Eds.), *Oxford textbook of paediatric pain* (pp. 379–390). Oxford: Oxford University Press.
- Craig, K. D. (2009). The social communication model of pain. *Canadian Psychology*, 50(1), 22.
- Drendel, A. L., Kelly, B. T., & Ali, S. (2011). Pain assessment for children: overcoming challenges and optimizing care. *Pediatric Emergency Care*, 27(8), 773–781. <https://doi.org/10.1097/PEC.0b013e31822877f7>
- Hicks, C., von Baeyer, C., Spafford, P., van Korlaar, I., & Goodenough, B. (2001). The Faces Pain Scale–Revised: toward a common metric in pediatric pain measurement. *Pain*, 93(2), 173–183. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0304395901003141>
- Huguet, A., Stinson, J. N. and McGrath, P. J. (2010). Measurement of self-reported pain intensity in children and adolescents. *Journal of Psychosomatic Research*, 68(4), 329–336.
- Huguet, A., Stinson, J. N., & McGrath, P. J. (2010). Measurement of self-reported pain intensity in children and adolescents. *Journal of Psychosomatic Research*, 68(4), 329–336. <https://doi.org/10.1016/j.jpsychores.2009.06.003>
- Jaskowski, S. (1998). The FLACC: A behavioral scale for scoring postoperative pain in young children. *AACN Nursing Scan In Critical*, 8(1), 16. Retrieved from <http://search.proquest.com/openview/4edfd6f11e215f6361fbb73658c12155/1?pq-origsite=gscholar&cbl=31779>
- Lee, G. Y. and Stevens, B. J. (2014). Neonatal and infant pain assessment. In W. T. McGrath, P.J, Stevens, B.J., Walker, M. S., and Zempsky (Ed.), *Oxford textbook of paediatric pain*. (pp. 353–369). Oxford: Oxford University Press.
- McGrath, P. A., Seifert, C. E., Speechley, K. N., Booth, J. C., Stitt, L., & Gibson, M. C. (1996). A new analogue scale for assessing children's pain: an initial validation study. *Pain*, 64(3), 435–443. [https://doi.org/10.1016/0304-3959\(95\)00171-9](https://doi.org/10.1016/0304-3959(95)00171-9)
- McGrath, P. J., Johnson, G., Goodman, J. T., & Schillinger, J. (1984). The development and validation of a behavioral pain scale for children: The children's hospital of eastern ontario pain scale (CHEOPS). *Pain*, 18, S24. [https://doi.org/10.1016/0304-3959\(84\)90167-2](https://doi.org/10.1016/0304-3959(84)90167-2)
- McGrath, Patrick J., Walco, G. A., Turk, D. C., Dworkin, R. H., Brown, M. T., Davidson, K., ... Zeltzer, L. (2008). Core Outcome Domains and Measures for Pediatric Acute and Chronic/Recurrent Pain Clinical Trials: PedIMMPACT Recommendations. *The Journal of Pain*, 9(9), 771–783. <https://doi.org/10.1016/J.JPAIN.2008.04.007>
- Miró, J., Castarlenas, E., & Huguet, A. (2009). Evidence for the use of a numerical rating scale to assess the intensity of pediatric pain. *European Journal of Pain*, 13(10), 1089–1095. <https://doi.org/10.1016/j.ejpain.2009.07.002>
- Registered Nurses' Association of Ontario. (2013). *Assessment and management of pain* (3rd ed.). Toronto: Registered Nurses' Association of Ontario.
- Soyannwo, O. A. (2010). Obstacles to Pain Management in Low-Resource Settings. In B. N. Kopf, A. and B. Patel (Ed.), *Guide to Pain Management in Low-Resource Settings*. (pp. 9–12).

- Seattle: International Association for the Study of Pain.
- Stevens, B. J., Harrison, D., Rashotte, J., Yamada, J., Abbott, L. K., Coburn, G., ... Pain, C. T. in C. (2012). Pain assessment and intensity in hospitalized children in Canada. *The Journal of Pain*: Official Journal of the American Pain Society, 13(9), 857–865. <https://doi.org/10.1016/j.jpain.2012.05.010>
- Stinson, J. N., Kavanagh, T., Yamada, J., Gill, N. and Stevens, B. (2006). 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*, 125(1), 143–157.
- Stinson, J., & Jibb, L. (2014). Pain assessment. In A. Twycross, S. Dowden, & J. Stinson (Eds.), *Managing pain in Children: A clinical guide for nurses and health professionals*. (2nd ed., pp. 112–139). West Sussex: Wiley Blackwell.
- Tomlinson, D., von Baeyer, C. L., Stinson, J. N., & Sung, L. (2010). A systematic review of faces scales for the self-report of pain intensity in children. *Pediatrics*, 126(5), e1168–e1198. <https://doi.org/10.1542/peds.2010-1609>
- Velazquez Cardona, C., Rajah, C., Mzoneli, Y. N., Friedrichsdorf, S. J., Campbell, F., Cairns, C., & Rodseth, R. N. (2019). An audit of paediatric pain prevalence, intensity, and treatment at a South African tertiary hospital. *PAIN Reports*, 4(6), e789. <https://doi.org/10.1097/PR9.0000000000000789>
- von Baeyer, C. L. (2014). Self-report: the primary source in assessment after infancy. In P.J McGrath, B. J. Stevens, M. S. Walker, & W. . Zempsky (Eds.), *Oxford textbook of paediatric pain* (pp. 370–378). Retrieved from <https://books.google.com/books?hl=en&lr=&id=xWyrAAAAQBAJ&oi=fnd&pg=PA370&dq=Self-report:+the+primary+source+in+assessment+after+infancy.+&ots=kHt21-aMrW&sig=xBqNf7C8cvvgCK7jOiX3GDHNd7Jo>
- von Baeyer, C. L., & Spagrud, L. J. (2007). Systematic review of observational (behavioral) measures of pain for children and adolescents aged 3 to 18 years. *Pain*, 127(1–2), 140–150. <https://doi.org/10.1016/J.PAIN.2006.08.014>
- von Baeyer, C. L., Spagrud, L. J., McCormick, J. C., Choo, E., Neville, K., & Connelly, M. A. (2009). Three new datasets supporting use of the Numerical Rating Scale (NRS-11) for children's self-reports of pain intensity. *PAIN*, 143(3), 223–227. <https://doi.org/10.1016/J.PAIN.2009.03.002>
- Whaley, L. F., & Wong, D. L. (1991). *Nursing care of infants and children*. Louis: Mosby