


REVIEW

Evaluation of Psychometric and Linguistic Properties of the Italian Adolescent Pain Assessment Scales: A Systematic Review

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ABSTRACT

Introduction: Adolescents' pain experiences are complex and multidimensional, and evaluating pain only from a sensory and affective point of view may be in many instances limiting and inadequate; this is the reason why it is of paramount importance to identify the tools which can better assess the pain experienced by young patients. A person-oriented approach is highly encouraged, as it may better investigate the cognitive and behavioral development typical of this age group. The aim of this review paper is to describe the available tools which are

able to adequately assess pain intensity in adolescents, in particular those validated in Italian.

Methods: We conducted a systematic review using four databases: CINAHL, PsycINFO, PubMed and Cochrane, and selected all the articles published between January 1970 and November 2017. We selected all the papers reporting the validation process of pain assessment tools specifically tailored for adolescent patients (age range 10–18 years) and based on psychometric and linguistic parameters, and focused especially on the tools available in Italian and able to measure acute and chronic pain.

Results: The results of our investigation have revealed the existence of 40 eligible tools, 17 of which are monodimensional and the remaining 23 multidimensional, more specifically tailored to assess both acute and chronic pain. Some of the instruments (26) were self-reports while others were classified as behavioral (13) and/or mixed. Only one tool turned out to be suitable for fragile adolescents, while six adopted a person-oriented approach that better emphasized the cognitive and behavioral process typical of the adolescent population. None of them has ever been validated in Italian.

Conclusion: Valid and reliable psychometric tools specifically organized to provide a cultural and linguistic evaluation of the patient are indeed the most recommended instruments to assess the intensity of the pain experienced by the patient, as they may provide useful

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information to implement a health policy aimed at identifying the best assistance programs.

Keywords: Adolescent; Assessment; Italian; Pain measurements; Pain Scale; Tool

INTRODUCTION

The World Health Organization (2014) identifies adolescence as the period in human growth and development that occurs after childhood and before adulthood, from ages 10 to 19. It represents one of the critical transitions in the life span and is characterized by a tremendous pace in growth and by important biological changes. Although the biological determinants of adolescence are fairly universal, the duration and defining characteristics of this period may vary across time, cultures, and socioeconomic situations [1].

During each growing phase in a child's life, pain is experienced in different ways, according to the child's age and his evolutionary, psychological and biological development [2]. The child's communicative capacity, comprehension skills and past painful experiences may affect the way of perceiving pain throughout his whole life. Many children and adolescents with repeated acute episodes of nociceptive pain develop chronic pain that increases the risk of pain, as well as physical and psychiatric disorders in adulthood [3].

Patients aged 0–18 make up about 22% of admissions to emergency departments in the USA; among the symptoms for seeking hospital care, reporting of pain [4] seems to be quite common, and the prevalence of self-reporting increases proportionally with age. A painful event may vary from the typical everyday pain experienced by a child (i.e., bumps and bruises) [5] to more serious causes that require medical care or admission to hospital [6]. Pain is a subjective and multidimensional experience [7], which needs to be carefully assessed when it occurs in adolescents, as patients falling within this particular age group tend to minimize or even to deny pain to their parents and friends [8]. The cognitive and psychological

development of adolescents gives pain a multi-dimensional perspective not limited to the sensory experience; sometimes the cause of pain itself may influence the way people individually respond to it [9]. Pain in some adolescents upsets their daily life, in that the intense fear of pain and disability emerge as particularly important, also influencing the lives of their parents that report significant distress and changes in their roles [10].

In addition, health professionals may be influenced by false and outdated beliefs which lead them to misinterpret the way pediatric patients feel pain, influencing therefore their capacity to properly assess its real intensity [11]. Misinterpreting results and underestimating pain may lead to an inadequate management of both acute and chronic pain [12]. As highlighted in a recent Italian survey, we observed that Italian nurses lack an adequate preparation to properly assess pain, which may account for the general low prescriptive appropriateness [13].

Therefore, the health personnel dealing with patients belonging to this specific age group must be aware of their particular bio-psychological characteristics and should find the most suitable assessment tools normally difficult to apply in clinical practice [14]. Of note, a lack of pain education in nursing and medical schools is the major cause for underestimating chronic pain in adolescents, especially from a diagnostic point of view [15], as chronic pain is normally attributed and identified only with older patients. It is estimated that about 25% of pediatric patients suffer from chronic pain [16] and these findings confirm that, differently than expected, it is a common complaint in childhood and adolescence, the most affected age group represented by adolescents between 12 and 15 years of age [17].

Chronic and acute pain assessment tools to measure the intensity of pain in adolescent patients are countless and may be classified as self-reports, behavioral observations or physiologic measures.

Assessments that use multiple measures (behavioral and physiologic) and assess different aspects of the pain experience (i.e., intensity, location, pattern, context, and meaning) may

result in more accurate appraisals of pediatric pain experiences [8].

Self-reporting methods are considered the gold standard for the assessment of pain, both in adolescents and younger patients [11], and may use verbal and non-verbal tools; however, only children who have attained a certain degree of cognitive ability are able to provide information this way. The capacity to self-report increases proportionally to the age of the patient and may be further enriched by life experiences typical of patients classified as adolescents [18]. Preverbal patients or those with serious cognitive impairments cannot communicate their pain in words [19]. In the absence of self-reporting, behavioral and physiologic parameters have to be used to infer pain. Behavioral indicators of pain include facial expressions, weeping, gross motor movements, changes in behavioral state and patterns [20].

In some instances, behavioral and self-report tools may be associated to physiological scales that may measure the pediatric patient's response to stressful events by using parameters such as heart rate, blood pressure and sweating of the hands [8]. The available literature reports the existence of multidimensional scales, which simultaneously use self-report, behavioral and physiological variables to assess frail pediatric patients [21].

Given the high number of pain assessment tools reported in literature that can be specifically applied to adolescent patients, the aim of this study was to summarize and describe their most remarkable psychometric and linguistic features. This may help health practitioners who need to be advised on how to apply such tools in clinical practice. Particular attention was paid to all the tools validated in Italian, which are therefore fit to be used in national clinical settings.

METHODS

Research Strategies

This systematic review was conducted according to PRISMA guidelines, using four databases: CINAHL Plus with full text, PsycINFO, PubMed

and Cochrane. Information was retrieved by using the following key words: pain measurement, adolescent, pain scale. A search string that could efficiently retrieve studies on (adolescent) AND (pain OR analgesia) AND (scale OR assessment) was developed and all the articles published from January 1970 to November 2017 were selected. Secondly, the results were further filtered by including patients between 10 and 18 years of age. A more accurate selection was possible thanks to the snowballing sampling strategy, which implied the careful reading of all the eligible articles, checking if the included articles cited any other relevant article that respect our inclusion criteria. We retrieved those articles and continued this process until the absence of other relevant articles. The snowballing strategy allowed us to include the pain assessment tools which had been missed by the electronic database research strategy. The same articles selected by two or more online database were included among the results only once.

Inclusion and Exclusion Criteria

We selected all the articles reporting the validation process of pain assessment tools specifically tailored for adolescent patients (age range 10–18 years) and based on psychometric and linguistic parameters. We mainly focused on the tools available in Italian and able to measure acute and chronic pain. Our revision excluded all those articles written in languages different from English and Italian, as well as those centered mostly on evaluating the best tools to be applied when deciding on a pharmacological/non-pharmacological or surgical treatment.

Analysis of the Psychometric Characteristics

Pain assessment is a multidimensional observational assessment of a patient's experience of pain, including its characteristics and the impact it may have on daily life activities [22].

We needed valid and reliable tools to make a rigid and accurate evaluation of a parameter that could be strongly influenced by the

subjective way of perceiving pain. By reliability we referred to the stability of the tool, meaning it was able to provide equivalent results after repeated administrations and regardless of the interviewer. The soundness of the tool could be demonstrated in various ways, i.e., by confirming its validity and reliability [23].

A certain tool may be considered reliable and valid if applied on a specific population, while it may be totally inadequate for another set of patients affected by different clinical conditions [7].

Data Retrieval

All the articles retrieved by the different data banks were selected according to their title and abstract and, if pertinent to our study, the full text was analyzed. During the whole selection phase, the articles were evaluated according to the inclusion/exclusion criteria previously described.

Encoding the Psychometric Characteristics

Validity (content, criterion and construct) and reliability (stability, internal consistency and equivalence) are essential to test the psychometric characteristics of pain assessment tools and are useful to subsidize the selection of trustworthy instruments that may ensure the quality of the results of studies [23]. The selected articles were then classified according to the model adopted by Law et al. [24] and already presented in a secondary study [8]. A Likert scale was used to confer different quality levels to each evaluated tool that was classified as being “excellent, satisfactory or mediocre”. A tool was considered “excellent” when it could be applied in more than two well-performed studies, “satisfactory” if used in not more than two well-performed studies and “mediocre” if applied in unsatisfactory studies or not applied at all. A researcher who wishes to use a pain assessment tool in a study or in a clinical setting usually tends to adopt the instrument that mostly satisfies the required psychometric characteristics, although he/she also refers to those studies in

which that same tool has been frequently adopted.

This article is based on previously conducted studies and does not contain any studies with human participants or animals performed by any of the authors.

RESULTS

The preliminary research retrieved 1583 articles from public data banks such as PubMed, CINAHL, PsycINFO and Cochrane. Selection criteria are reported in Fig. 1. We identified 61 eligible papers which were in compliance with our inclusion/exclusion criteria. With the snowballing strategy we identified 26 more suitable articles; at the end of the review process, we were able to identify 40 tools normally used to assess pain in adolescent patients.

By analyzing the age range to which each tool could be applied, only six instruments (Table 1): Adolescent Pediatric Pain Tool (APPT) [25], Bath Adolescent Pain questionnaire (BAPQ) [22], Pain-related Problem List (PPL) [26], Pediatric Pain Questionnaire (PPQ) [27], Pain Stages of Change Questionnaire—Adolescent Version (PSOCQ-A) [28], and Pain Stages of Change Questionnaire—Parent Version

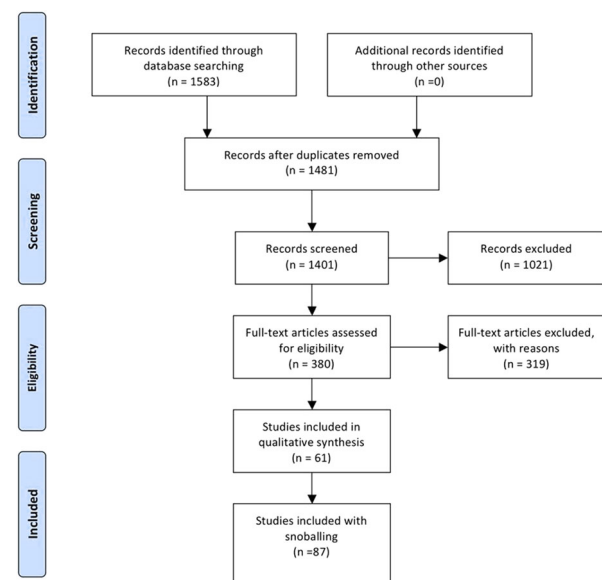


Fig. 1 PRISMA chart

Table 1 Adolescent pain tools and their psychometric characteristics

Tool	Age	Type of Pain	Type of measure	Dimension	Validity	Reliability	Authors
APPT Adolescent Pediatric Pain Tool	10–17	Acute	Self-report	Multidimensional	Original article not retrieved		Savedra et al. [25]
BAPQ Bath Adolescent Pain Questionnaire	10–15	Chronic	Self-report	Multidimensional	The average intercorrelation values were $r = 0.48$ and 0.39 , making the average shared variance between subscales 23 and 15%. (convergent validity).	Cronbach's $\alpha =$ ranging from 0.79 to 0.89. $R = 0.60$	Eccleston et al. [22]
PSOCQ- A Pain Stages of Change Questionnaire (adolescent version)	13–17	Chronic	Self-report	Multidimensional	Original article not retrieved		Guite et al. [28]
PSOCQ- P Pain Stages of Change Questionnaire (parent version)			Behavioral				
PPL Pain-related Problem List	13–18	Chronic	Self-report	Multidimensional	The total scale and the four domains all showed convergent and divergent validity in both samples. This was also shown by t tests comparing adolescents with low pain intensity to adolescents with high pain intensity. Adolescents with high pain intensity scored higher on the total scale ($t(28) = -2.15, P < 0.05$).	Total $\alpha = 0.82$; concentration $\alpha = 0.86$; mobility a $\alpha = 0.77$; adaptability $\alpha = 0.71$; and mood $\alpha = 0.78$	Weel et al. [56]

Table 1 continued

Tool	Age	Type of Pain	Type of measure	Dimension	Validity	Reliability	Authors
PPQ	13–18	Chronic	Self-report	Multidimensional	Original article not retrieved		Varni et al. [27]

This table is meant to describe only the essential psychometric characteristics of the available pain assessment tools. In order to have a more detailed description of the reported information, the reader should refer to the original works, considering that we purposely omitted to mention the statistical tests used and their interpretation. Therefore, data reported herein are not to be considered exhaustive

(PSOCQ-P) [28] turned out to be suitable for assessing pain in adolescents between 10 and 18 years of age. The characteristics and strength/weakness points of the tools specifically intended for adolescents are summarized in Table 2. We also managed to identify 29 tools (Table 3) which could be applied not only to adolescents but to a wider population set (0 years to adult age). Further five tools (Table 4): Children’s Hospital of Eastern Ontario Pain Scale (CHEOPS) [29], Poker Chip Tool (HPCT) [30], Comprehensive Pain Evaluation Questionnaire Modified (CPEQ-M) [31], Face Legs, Activities, Cry, Consolability (FLACC) [32], and Observational Scale of Behavioral Distress (OSBD) [33] were instead specific for a pre-adolescent population (< 10 years), but could also be used in older patients or in mentally impaired adolescents unable to verbally assess their pain.

Analyzing the dimension of the pain scales, our literature review identified 23 multidimensional scales useful to assess pain intensity in youth. The Bath Adolescent Pain Questionnaire (BAPQ) [22], for instance, evaluates social, physical and family functioning. The Child Self-Efficacy Scale (SEQ-C) [34] evaluates the adolescent’s capacity to set up friendly ties, to self-assess his school progress, to perform simple housework tasks, to take care of himself and to autonomously do his homework. The McGill Pain Questionnaire (MPQ) [35] is a tool specifically tailored to evaluate the patient’s way to manage his emotions affections. The Pain Experience Questionnaire—child version (PEQ-C) [36] monitors emotional discomfort and social support. The Pain Stages of Change Questionnaire (adolescent version; PSOCQ-A) [28] measures the youth actions and expectations, while his emotions and affections are evaluated by using the Pediatric Pain Assessment Tool (PPAT) [37]. Finally, the Pediatric Pain Questionnaire (PPQ) [27] takes into account several factors, from social support to the capacity to carry out problem-solving strategies, from the search of physical and mental distraction to externalization/internalization. Our research also found 17 monodimensional assessment tools which are mostly

focused on measuring the intensity of the experienced pain.

Analyzing the type of pain, we found 11 scales for the assessment of chronic pain applicable to patients ranging from 4 to 20 years of age, although only 5 turned out to be adolescent-specific. Acute pain is normally assessed with 17 scales. Five instruments are recognized as being suitable for assessing chronic and recurrent pain, and lastly seven assessment scales did not clearly specify to what kind of pain they could be favorably applied. Classifying the pain scales about the type of measurement we retrieved 13 behavioral assessment tools and 26 self-report tools. The only mixed tool that could be successfully applied to fragile children was the Questionnaire on Pain caused by Spasticity (QPS) [38]. Table 5 reports the psychometric properties rated using the criteria described by Law et al. [24].

Our review highlighted the lack of pain assessment tools validated in Italian and suitable for adolescent patients.

DISCUSSION

The aim of this review was to summarize and describe psychometric and linguistic features of tool assessment for pain in adolescent patients. Adolescence is the period in human growth and development that occurs before and is different from adulthood [1], a significant psychosocial benchmark characterized by rapid growth and a unique way of experiencing pain, very likely dependent on the patients biological/psychological development, their comprehension and communicative skills and on any painful experience they may have experienced during their childhood [2]. The first step to take in order to avoid any possible underestimation of the importance of properly treating pediatric pain [39] is to use necessary and reliable tools in different clinical settings. Our review has obtained several pain assessment tools applicable to the adolescent population. Although pain assessment prefers to adopt a person-oriented approach, which better highlights the cognitive development and the behavioral attitude typical of this age group [40], our review has

recognized only 6 tools that can be used on patients of an age ranging from 10 to 18 years (Table 1). Another 29 instruments, specifically reported in Table 3, can be more widely applied to a wider population of patients aged 0–18 years. Keep in mind that each assessment process has to take into account the characteristics and personal features of each evaluated subject so as to deliver a more accurate and personalized evaluation [41]. Assessment tools specifically intended for children between 0 and 7 years of age (Table 4), who in most instances are unable or only partially capable to verbally express the intensity of their pain, may also be applied to cognitively impaired pediatric patients, such as children affected by Down Syndrome, who find it very difficult to express the precise localization and intensity of their suffering [42]. These more vulnerable subjects may benefit from using body diagrams to easily identify the exact location of their pain [43]. It is important not to compromise the observers' judgment and to avoid doing this we need to make a global assessment of the patient from a clinical point of view. It is necessary to identify the presence of pre-existing clinical conditions, comorbidity and disability, as well as consider the age, education status, communicative skills, cognitive process, ethnic/biologic/cultural aspects and any previous pain experiences [44]. This review has highlighted how multidimensional tools have outnumbered monodimensional ones, which means that particular attention has been paid to the overall assessment of the adolescent suffering from pain and the impact this has on the quality of life of the young patient. Health no longer means merely "absence of illness" but extends to a wider concept of psycho-social welfare. This new way of evaluating the patient's symptomatology requires the use of more and more accurate tools capable of assessing the intensity of pain by analyzing additional pain-related information. Such tools are shaped on multidimensional instruments specifically applicable to the adolescent population [45]. This paper has considered 23 multidimensional pain assessment scales used to measure pain in adolescent patients; all the tools suitable for patients belonging to this age group proved to be

Table 2 Specific characteristics of the available adolescent tools

Tool	Age	Tool characteristics	Strengths	Weakness
APPT Adolescent Pediatric Pain Tool	10–17	<ol style="list-style-type: none"> 1. The number of pain sites as a measure of pain location from marks on a body outline 2. A pain intensity score measured by a 10-cm line known as the Word Graphic Rating Scale (WGRS) and anchored by words: no pain, little, medium, large, worst possible pain 3. The number of pain quality descriptors, which yields percent scores for the sensory, affective, evaluative subscales 4. The number of temporal descriptors, which yields a percent temporal subscale 5. The percent of total pain quality and temporal descriptors as a total subscale 	<p>It measures the different dimensions of pain, including the location, intensity, quality, and temporal pattern components of the sensory dimension as well as the affective and evaluative dimensions. Potentially, it may be able to discriminate between nociceptive and neuropathic pain, and may guide the use of multimodal interventions in adolescents with a variety of pain conditions.</p>	<p>A major limitation in many of the studies is the small sample size in each study, and therefore one must be cautious with interpretation of the findings. The interpretability of this questionnaire could be a problem for the clinicians. Furthermore, the studies were predominantly reflective of acute pain states, rather than the more complex, recurrent, chronic or persistent pain states.</p>
BAPQ Bath Adolescent Pain Questionnaire	10–15	<ol style="list-style-type: none"> 1. Social life and relationships with people (9 items) 2. Activities and difficulties (9 items). 3. Feelings and other experiences (6 items) 4. General worries or feelings (7 items) 5. Specific worries or concerns about pain (7 items) 6. Family life (12 items) 7. Comparison between the adolescent and other people of the same age (11 items) 8. Personal consideration about pain and life (free text) 	<p>The BAPQ may offer a comprehensive way to assess the widespread deleterious impact of adolescent chronic pain in both a research and clinical setting. The questionnaire analyzes many aspects of adolescent life such as family, relation with friends, school, fear, and difficulty in daily activities. There is also a parent version that could be used to analyze the family relationships.</p>	<p>The questionnaire is very long (62 items).</p>

Table 2 continued

Tool	Age	Tool characteristics	Strengths	Weakness
PPL Pain-related Problem List	13–18	<ol style="list-style-type: none"> 1. Concentration 2. Mobility 3. Adaptability 4. Mood 	The PPL is a brief self-report, 18-item instrument developed to assess the impact of chronic pain in conditions commonly seen in clinical practice, in particular those that do not necessarily have an organic cause, such as headaches, abdominal pain, and back pain.	Not detected
PPQ Pediatric Pain Questionnaire	13–18	<ol style="list-style-type: none"> 1. Information 2. Problem solving 3. Social support 4. Positivist attitude 5. Behavioral distraction 6. Cognitive distraction 7. Externalization 8. Internalization <p>There are also three complex scales (approach, distraction, lack of emotion).</p>	<p>The PPQ assesses intensity, location, and the sensory, affective, and evaluative qualities of the pain experience. Present and worst pain in the past week is each measured on a 100-mm horizontal VAS.</p> <p>For location, adolescents are instructed to color in the locations of the body where they are experiencing pain, using colours of their choice to indicate pain intensity.</p> <p>The PPQ is a well-established instrument that has been tested in various populations such as adolescents with rheumatic diseases and fibromyalgia.</p>	Not detected

Table 2 continued

Tool	Age	Tool characteristics	Strengths	Weakness
PSOCQ-A Pain Stages of Change Questionnaire (adolescent version)	13–17	Tool based on the Adult Pain Stages of Change Questionnaire. This tool consists of 3 subscales (30 items): 1. Pre-contemplation: little perceived personal responsibility for managing pain 2. Contemplation: awareness of personal responsibility for pain management, considering behavioral change 3. Action/maintenance: active involvement in learning or continued use of self- management strategies	The adolescent is asked his agreement/ disagreement level for each item and to circle the answer that better reflects his condition and pain experience of a specific illness.	Needs further investigations if it has to be used in a clinical setting
PSOCQ-P Pain Stages of Change Questionnaire (parent version)	Parents 13–17	Tool based on the Adult Pain Stages of Change Questionnaire. This tool consists of 4 subscales (30 items): 1. Pre-contemplation 2. Contemplation 3. Action 4. Maintenance.	Parents are asked to provide their agreement/disagreement level for each item on behalf of the child. They will circle the answer that better reflects their child's condition and pain experience of a specific illness.	Needs further investigations if it has to be used in a clinical setting

multidimensional, meaning that pain is not limited to a sensory experience, but implies several other aspects [9].

Monodimensional scales, on the contrary, are certainly more suitable to highlight one of the most important aspects of discomfort, that is the severity of pain, defined as the fifth vital sign. The degree of severity has to be constantly monitored [46], but cannot be the only parameter used to confirm the patient's distress [16]. Although all vital parameters may be affected by the presence of pain [47], it has been observed that significant variations do not necessarily occur only during painful procedures. Vital signs are easily accessible but represent only one of the aspects that nurses and healthcare operators should take into account when making a global pain assessment. Only five scales were suitable to measure the severity of pain in adolescent patients: BAPQ, PPQ, PPL, PSOCQ-A, and PSOCQ-P. Chronic pain is a health issue which normally characterizes the adult and geriatric population, where 50% of the subjects > 65 years of age show multiple chronic morbidity [48]; however, no age group is to be considered immune to this kind of suffering and the adolescent population seems to be one of the selected targets [16]. A study from a few years back [6] demonstrated that pediatric patients suffering from chronic pain reached a percentage of 25%. As in adults, chronic pain in younger patients is also a multidimensional condition affecting several aspects of the child's life: social relations, education, ability to perform physical activities, and limitations which may lead to social isolation [49]. In particular, pain assessment in this specific category of patients needs to use tools capable of investigating all the parameters typical of patients belonging to this age group. The adolescent years are characterized by the maturation of emotional and cognitive abilities that provide the developing individual with capacities needed for independent functioning during adulthood, and this process affects all the patterns of logic and social significance [8].

As a matter of fact, some of the available tools enable making a comprehensive evaluation. Pain assessment includes a series of sequential steps that measure the degree of

discomfort experienced by the patient; however, in assessing chronic pain, this process should also evaluate to what extent pain impacts the life of the young patient, not only from a biological point of view but also in the social and psychological spheres [16]. Pain assessment has to take into account all the changes that seriously impact the patient's quality of life and evaluate the outcome of the administered treatments. In some instances, the reassessment process is included in the tool, as in the case of Chronic Pain Grading (CPG), Pain indicator for communicatively impaired children (PICIC), Pediatric Pain Profile (PPP), Questionnaire on Pain caused by Spasticity (QPS), which consider the systematic re-evaluation of the pain after a given time interval. The accuracy of a pain assessment tool is also given by its validation, which takes into account the linguistic and cultural characteristics of a specific territory and population. Most of the tools presently in use are published in English. Our investigation was able to identify only 10 instruments validated in Italian, Children's Hospital of Eastern Ontario Pain Scale (CHEOPS), Face Legs Activities Cry Consolability (FLACC), Face Pain Scale (FPS), Face Pain Scale Revised (FPS-R), McGill Pain Questionnaire (MPQ), Non-communicating Children's Pain Checklist Postoperative version (NCCPC-PV), Non-communicating Children's Pain Checklist Revised (NCCPC-R), Numeric Rate Scale (NRS), OUCHER, and Pain Catastrophizing Scale for Children (PCS-C), which were not applicable to the adolescent population. Pain assessment tools validated in Italian may exist, although our research did not provide us with any of them. Validation of these available instruments may presently be ongoing or in press. According to the Italian National Institute for Statistics, there are about 416,7000 adolescents in Italy, totaling 14.58% of the entire population [50]; however, the epidemiology of chronic pain in this population still remains unclear. Existing literature reports that 25% of children and adolescents suffer from chronic pain [6]. The lack of pain assessment tools suitable for adolescents may have serious implications from a clinical, ethic and juridical perspective. Pain is a public health concern

Table 3 Pediatric pain tools also applicable to the adolescents and to the adult

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
A.A. OPFS African-American Oucher Scale	03–12	Acute	Self-report	Monodimensional	Content validity W statistic = 0.67, $P < 0.0001$, construct validity r Pearson = from 0.88 to 0.97	Unclear ^a	Beyer et al. [57]
CAS Color Analog Scale ^b	05 +	Acute, recurring, chronic	Self-report	Monodimensional	Unclear	$R = 0.97$ R^2 values were 0.921 and 0.922 for the CAS and VAS groups, respectively. Comparison of the average R^2 values from the various models indicated that the psychophysical relationship between children's responses and intensity was best described by a power function for both the CAS and VAS scales.	McGrath et al. [29]

Table 3 continued

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
COMFORT Scale	0–18	Acute	Behavioral	Multidimensional	Congruent validity of the 'behavior' was implied by high correlations between this latent variable and VAS (0.96, 0.89, and 0.90, respectively).	Median Kappa = 0.70. Internal consistency reliability = 0.92	Ambuel et al. [58]
CPASS	08–18	Not specified	Self-report	Monodimensional	Total score on the PCS-C; $r = 0.627$ ($P < 0.001$) and anxiety sensitivity (total score $r = 0.599$, ($P = 0.001$), suggesting good preliminary construct validity	Internal consistency (20-item: $\alpha = 0.903$)	Page et al. [59]
CPG	11 +	Chronic	Self-report	Multidimensional	Original article not retrieved		Von Korff et al. [60]
FACE	03 +	Acute	Self-report	Monodimensional	$r = 0.93$ ($P < 0.001$)	Excellent interscale agreement	Wong and Baker [61]
FCT	07 +	Not specified	Self-report	Monodimensional	$r = 0.95$	$\alpha = 0.97$	Ergin et al. [62]
FPS-R	03 +	Acute	Self-report	Monodimensional	$r = 0.93$ ($P < 0.001$)	Excellent interscale agreement	Hicks et al. [63]
INRS	06–18	Not specified	Behavioral	Monodimensional	Pearson's $r > 0.60$ (indicating convergent validity)	Unclear	Solodiuk and Curley [64]

Table 3 continued

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
MPQ	12 +	Acute	Self-report	Multidimensional	Unclear		Melzack [35]
MPS	03 +	Acute	Self-report	Monodimensional	Spearman's rank correlation coefficient was 0.802 ($P < 0.0001$; convergent validity)	Unclear	Lyon et al. [65]
NCCPC-PV	03–19	Acute	Behavioral	Monodimensional	Convergent validity: before surgery was 0.71 and after surgery was 0.72. Sensitivity = 0.88. Specificity = 0.81	Caregivers' internal consistency $\alpha = 0.91$; Researchers' internal consistency was satisfactory ($\alpha = 0.71$). Intraclass correlations for total scores were 0.82 before surgery and 0.78 after surgery.	Breau et al. [66]
NCCPC-R	Non-Communicating Children's Pain Checklist-Revised					Original article not retrieved	

Table 3 continued

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
NRS	07 +	Acute, chronic	Self-report	Monodimensional	Convergent validity ($r > 0.3$ to 0.5) ^c Discriminant validity $r = 0.63$ ($P < 0.001$)	The authors chose to evaluate the NRS in clinical practice, recognizing that there may be more variability in how the NRS was administered and that there would be a longer time interval between administrations of the two pain scales. Thus, it is possible that lower correlation coefficients are obtained.	McCaffery and Beebe [67]
OUCHER	03 +	Acute	Self-report	Monodimensional	Content validity $W = 0.726$, convergent validity $T = 0.695-0.978$	Test $r = 0.96$, $P = 0.01$, retest $r = 0.99$, $P = 0.01$	Beyer et al. [68]
PBCL	03 +	Acute	Self-report	Monodimensional	Correlations between the PBCL scale scores and the Pain Rating Index of the MPQ and the WHYMPI Pain Severity Scale range were from 0.12 to 0.35	Correlations between the $\alpha = 0.85$ stability coefficient = 0.80	Kerns et al. [69]

Table 3 continued

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
PCS-C	08–16	Chronic	Self-report	Multidimensional	The value of pain catastrophizing in predicting validity of disability beyond age, gender and pain intensity was significant (FChange1; 36 = 4:22, $P = 0:05$).	$\alpha = 0.81$ up to 0.89	Crombez et al. [70]
PEQ-C	09–15	Chronic	Self-report	Multidimensional	The concordance between child and parent report was tested. There was good agreement for pain severity. Child- and parent-rated interference correlated moderately (0.37).	Internally consistent as indicated by the respective a values: 0.88 (pain severity), 0.86 (interference), 0.78 (parental distress)	Hermann et al. [71]
PEQ-P							
PICIC	02 +	Not specified	Behavioral	Multidimensional	$r = 0.678$ ($P = 0.01$).	Unclear	Stallard et al. [72]

Table 3 continued

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
PPAT	05–16	Acute	Self-report	Multidimensional	Construct validity = the lowered pain scores at each of the four hourly intervals confirm construct validity of tool. Convergent validity = from 0.88 to 0.98. Discriminant validity = the low relationship between the fear measure and the pain measures supports the discriminant validity of both tools, the intensity scale and the word descriptors.	Unclear	Abu-Saad [37]
PPP	03–11	Acute	Behavioral	Multidimensional	Sensitivity (1.00) and specificity (0.91) were optimized at a cut-off of 14/60. PPP has face, concurrent, and construct validity with PPP scores increasing in line with the observer's global rating of the child's pain and decreasing when analgesics were administered for pain.	Internal consistency α from 0.75 to 0.89. Interrater reliability from 0.74 to 0.89 (intraclass correlation)	Hunt et al. [54]

Table 3 continued

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
PQC	03–16	Not specified	Self-report	Multidimensional	Unclear		Rossato and Magaldi [73]
QPS	02–16	Not specified	Mixed	Multidimensional	Unavailable (qualitative study)		Geister et al. [38]
SEQ-C	08–18	Chronic	Self-report	Monodimensional	Construct validity was also obtained as 23 of the 27 hypothesized correlations were confirmed.	$\alpha = 0.89$ for the 7 child items and 0.90 for the 7 parent items	Bursch et al. [34]
TOPS	04–20	Acute, chronic	Behavioral	Multidimensional	Unavailable (qualitative study)		Parker et al. [45]
VAS	05 +	Acute, recurring, chronic	Self-report	Monodimensional	Original article not retrieved		Scott and Huskisson [74]
VRS	04 +	Acute, chronic	Self-report	Monodimensional	Original article not retrieved		Jensen et al. [75]

Table 3 continued

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
WGRS	6 +	Acute	Self-report	Monodimensional	Unclear	$R = 0.91$	Tesler et al. [76]

Tools validated for different age groups including the adolescent population

This table is meant to describe only the essential psychometric characteristics of the available pain assessment tools. In order to have a more detailed description of the reported information, the reader should refer to the original works, considering that we purposely omitted to mention the statistical tests used and their interpretation. Therefore, data reported herein are not to be considered exhaustive

^a Please refer exclusively to the original article or contact the authors directly

^b The psychometric properties of the CAS are equivalent to those of a 165-mm horizontal VAS

^c Correlated with VAS

^d Authors suggest that PEQ-C and PEQ-P address important psychosocial facets of chronic pediatric pain. Our data suggest strong correspondence between PEQ-C/PEQ-P and the adult MPI, hence facilitating comparisons between child and adult pain patients

^e It measures the presence of pain, not its intensity

Table 4 Psychometric characteristics of the pain assessment tools applicable to the adolescent with cognitive deficits

Tool	Age	Type of pain	Type of measure	Dimension	Validity	Reliability	Authors
FLACC	0–07	Acute	Behavioral	Monodimensional	$r = 0.849^a$ ($P < 0.01$)	$\alpha = 0.882$	Merkel et al. [32]
OSBD	01–04	Acute	Behavioral	Multidimensional	Original article not retrieved	Original article not retrieved	Jay et al. [33]
CHEOPS	01–07	Acute	Behavioral	Monodimensional	Original article not retrieved	Original article not retrieved	McGrath et al. [77]
HPCT	03–06	Acute	Self-report	Monodimensional	Original article not retrieved	Original article not retrieved	Hester [78]
CPEQ-M	03–07	Chronic	Self-report	Multidimensional	$r = 0.955$; ($P < 0.001$); $\alpha = 0.777$;	Kendall's tau- $b = 0.825$, ($P < 0.001$); $\alpha = 0.777$;	Nelli [31]
Questionnaire (modified)						Kruskal–Wallis = 27.4 ($P < 0.001$); $F = 16.1$	

This table is meant to describe only the essential psychometric characteristics of the available pain assessment tools. In order to have a more detailed description of the reported information, the reader should refer to the original works, considering that we purposely omitted to mention the statistical tests used and their interpretation. Therefore, data reported herein are not to be considered exhaustive

^a 10 In correlation with COMFORT Scale

Table 5 Psychometric properties rated using the criteria described by Law et al. [24]

Tool	Psychometric properties	Tool	Psychometric properties	Tool	Psychometric properties
A.A. OFPS	African-American Oucher Scale Validity: satisfactory Reliability: satisfactory	HPCT	Poker Chip Tool Validity: excellent Reliability: excellent	PICIC	Pain indicator for communicatively impaired children Validity: mediocre Reliability: mediocre
APPT	Adolescent Pediatric Pain Tool Validity: excellent Reliability: excellent	INRS	Individualized Numeric Rating Scale Validity: Satisfactory Reliability: Satisfactory	PPAT	Pediatric Pain Assessment Tool Validity: mediocre Reliability: mediocre
BAPQ	Bath Adolescent Pain Questionnaire Validity: satisfactory Reliability: satisfactory	MPQ	McGill Pain Questionnaire Validity: excellent Reliability: excellent	PPL	Pain-related Problem List Validity: satisfactory Reliability: satisfactory
CAS	Color Analog Scale Validity: excellent	MPS	Manchester Pain Scale Validity: satisfactory. Reliability: satisfactory	PPP	Pediatric Pain Profile Validity: satisfactory. Reliability: satisfactory
CHEOPS	Children's Hospital of Eastern Ontario Pain Scale Validity: excellent. Reliability: excellent	NCCPC - PV	Non-communicating Children's Pain Checklist Postoperative version Validity: satisfactory Reliability: satisfactory	PPQ	Pediatric Pain Questionnaire Validity: excellent. Reliability: excellent

Table 5 continued

Tool	Psychometric properties	Tool	Psychometric properties	Tool	Psychometric properties
COMFORT	COMFORT Scale Validity: satisfactory. Reliability: satisfactory	NCCPC-R	Non-Communicating Children's Pain Checklist-Revised Validity: satisfactory. Reliability: satisfactory	PQC	Pain Quality Cards Validity: mediocre. Reliability: mediocre
CPASS	Child Pain Anxiety Symptoms Scale Validity: satisfactory. Reliability: satisfactory	NRS	Numeric Rate Scale Validity: excellent. Reliability: excellent	PSOCQ-A	Pain Stages of Change Questionnaire (adolescent version) Validity: mediocre. Reliability: mediocre
CPEQ-M	Comprehensive Pain Evaluation Questionnaire (modif.) Validity: mediocre. Reliability: mediocre	OUCHER	The Oucher Validity: excellent. Reliability: excellent	PSOCQ-P	Pain Stages of Change Questionnaire (parent version) Validity: mediocre. Reliability: mediocre
CPG	Chronic Pain Grading Validity: mediocre. Reliability: mediocre	OSBD	Observational Scale of Behavioral Distress Validity: satisfactory. Reliability: satisfactory	SEQ-C	Child Self-Efficacy Scale Validity: satisfactory. Reliability: satisfactory
FCT	Full Cup Test Validity: mediocre. Reliability: mediocre	PBCL	Pain Behavior Check List Validity: mediocre. Reliability: mediocre	TOPS	Tailored Observational Pain Screen Validity: mediocre. Reliability: mediocre

Table 5 continued

Tool	Psychometric properties	Tool	Psychometric properties	Tool	Psychometric properties
FLACC	Face, Legs, Activity, Cry, Consolability Validity: excellent Reliability: excellent	PCS-C	Pain Catastrophizing Scale for Children Validity: excellent Reliability: excellent	VAS	Visual Analog Scale Validity: excellent
FACE	Wong-Baker FACES Pain Rating Scale Validity: excellent Reliability: excellent	PEQ-C	Pain Experience Questionnaire—3 child version Validity: satisfactory Reliability: satisfactory	VRS	Verbal Rating Scale Validity: satisfactory Reliability: satisfactory
FPS-R	Faces Pain Scale—Revised Validity: excellent Reliability: excellent	PEQ-P	Pain Experience Questionnaire—parent version Validity: satisfactory Reliability: satisfactory	WGRS	Word Graphic Rating Scale Validity: mediocre Reliability: mediocre

which is often under-reported, underestimated and untreated in a population set that will soon reach adulthood. It is important to remember that perception of pain is influenced by the level of education of the patient, but the determinants of health also include the social, economic and physical environments, as well as the person's individual characteristics, beliefs and behaviors. All these factors inevitably influence the acceptance and outcome of medical treatment. Linguistic validation is an essential step to make a tool reliable and applicable in the cultural setting where it is used [29]. As of January 1, 2015, in Italy 1,130,946 foreign children between 0 and 18 years were regularly registered, and of these 427,014 were adolescents, all from 191 different nations, the 10 most representative being Romania, Albania, Morocco, Ukraine, the People's Republic of China, Philippines, Moldova, India, Bangladesh and Peru. A total of 67.4% of the adolescent population in Italy is represented by these ethnic groups [50]. Although born in Italy, they are inevitably influenced by the cultural background and linguistic traditions of their parents' native country. Therefore, pain assessment tools also have to take into account and include these important cultural aspects [51]. Linguistic validation represents a step towards a reliable applicability of the tool to patients of a given nationality; however, the different ethnic characteristics may also help to reach a more accurate assessment of pain. Our review has retrieved two "faces" of pain scales (African-American Oucher Scale and Oucher) for self-assessing the severity of pain (smiling face, unhappy face) experienced by children of different ethnic groups: Afro-American, Caucasian, Hispanic, Asiatic, and First Nations peoples (Native Americans). Obtaining an accurate self-assessment of pain is vital to gauging baseline discomfort and response to therapy; children have to be able to identify themselves in the image they see and this is why pictures representing the various ethnic groups should be used. The use of male figures alone is discouraged even if stylized, as they may prevent girls from identifying themselves with the shown picture [52]. Picture pain scales that use drawings of both sexes (boys/girls) were found only

in the versions specifically validated for Asiatic and the First Nations peoples.

Most of the tools which emerged from our survey (no. 26) are of the self-report type, meaning that attention is specifically focused on the importance of recognizing the subjective experience of pain [11]. The importance of subjectivity is stressed in some tools more than in others, as in the case of Individualized Numerical Rating Scale (INRS) [53], a unique and personalized pain assessment instrument tailored for a single patient. The Pediatric Pain Profile (PPP), on the contrary, is a rating scale for assessing pain in children with the help of their parents, who can understand how their child is feeling (well or unwell), thus reducing the risk of underestimating the intensity of their pain [54]. When we have to evaluate patients verbally unable to communicate, there is the need to use behavioral pain assessment tools. We found 13 tools of this kind, which measure the intensity of pain by observing the patient's posture. As these are monodimensional tools, they are limited to measuring only the sensory aspect of pain, rather than assessing the distressful experience in its whole complexity [9], which may generate potential measurement biases if the person using the tool has not received specific training for understanding and interpreting results [12]. The Questionnaire on Pain caused by Spasticity (QPS) turned out to be the only mixed-pain assessment tool. Its peculiarity is to make three different evaluations (self-report, health care operator and parents/caregivers) in two different moments and after a 1-week interval. Although fragility is a very complex situation to evaluate, the research in this field is still very limited and underrated, probably because of the many facets that should be considered when evaluating a patient with severe cognitive and physical impairments, which may lead the operator to underestimate the true intensity of the pain [38]. Our review paper has also highlighted that pain assessment tools which are now applied to adolescent patients had originally been made to assess the intensity of pain in the adult population suffering from chronic or degenerative pathologies. It is true that chronic pain negatively affects the adolescent population and impacts

on daily life activities of the youth [36]. Social relations and absence from school are undoubtedly the most affected areas in an adolescent's life [28]. Also, when assessing the intensity of pain in this young population set, the relationship with the parents and the child's degree of involvement have to be taken into account [36]. In particular, the Pain Experience Questionnaire—parent version (PEQ-P) analyzes the parents' stressful thinking about their child's pain, which inevitably impacts the child life and compromises family dynamics and social behaviors, thus emphasizing once again the concept of pain being a complex biological, psychological and social experience [55].

As for the psychometric characteristics reported in Table 1, 3, and 4, it is important to underline that the use of the model suggested by Law [53] (Table 5) for assessing the available instruments may not be completely applicable in a given clinical setting. Several are the variables which establish both the validity and reliability of a tool, which should therefore be evaluated according to the psychometric characteristics of the tool as well as to the setting in which it is used [7].

Limitations

This review presents some limitations. In the search process, papers written in languages other than English or Italian were excluded, so it is possible that relevant findings were missed. In addition, we could not retrieve the full texts of potentially pertinent papers, so these studies were not included.

CONCLUSION

This review indicates the following key points:

1. The cognitive and psychological development of adolescents requires multidimensional and specific pain assessment scales.
2. The six pain assessment tools applicable to the adolescent population are multidimensional and self-reporting; five of them have good psychometric characteristics.
3. No tool for the evaluation of adolescent pain is translated into Italian.
4. The lack of tools specific for the adolescent population validated in Italian poses serious limitations on the way we approach this problem because it's of utmost importance to use the right pain assessment tools to avoid the underestimation of this condition.
5. The use of validated scales in Italian but not specific to adolescents could be in many cases limited and inadequate.
6. It is very important to implement the validation of adolescent's pain tools also in the Italian language.

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