# Clinical Utility of the Adolescent Pediatric Pain Tool Compared to the Visual Analog Scale in Hospitalized Children: A Prospective Observational Study

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## Abstract

***Background:*** *Pain is a complex and subjective experience, particularly in pediatric populations, where communication limitations often hinder accurate assessment.*

***Methods:*** *To address this challenge, we conducted an observational, descriptive, and prospective study aimed at evaluating the clinical utility of an adapted version of the Adolescent Pediatric Pain Tool in comparison with the Visual Analog Scale, while also exploring pediatric pain from a multidimensional perspective.*

***Results:*** *The study involved 27 children aged 8 to 14 years, with both scales administered prior to analgesic treatment. Findings revealed a strong and statistically significant correlation between the Visual Analog Scale and the Adolescent Pediatric Pain Tool's ordinal scale (rho = 0.81; p < 0.001), confirming consistency in pain intensity measurement. Importantly, the Adolescent Pediatric Pain Tool provided additional insights by capturing temporal, sensory, and emotional descriptors of pain, with notable differences observed based on gender and social context particularly among vulnerable children, who tended to express pain in more intense and negative terms.*

***Conclusions:*** *These results underscore the value of multidimensional tools in achieving a more comprehensive, personalized, and context-sensitive assessment of pediatric pain, and support their systematic integration into hospital clinical practice to enhance the quality of therapeutic approaches.*

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# Introduction

Pain is one of the main causes of consultation and hospitalization in the pediatric population, with a prevalence ranging from 59 % to 94 % in hospitalized children. Of these, 27-40 % experience moderate to severe pain (Stinson et al., 2008; Friedrichsdorf et al., 2015). The International Association for the Study of Pain (IASP) defines pain as an unpleasant sensory and emotional ex-perience associated with or similar to that associated with actual or potential tissue damage, emphasizing its inherently subjective and multidimensional nature (IASP 2020). In pediatrics, this complexity is accentuated by the potential limitations of the child's ability to adequately understand, verbalize, and express the painful experience (Cohen et al., 2019).

In the clinical setting, unidimensional tools, such as the Visual Analogue Scale (VAS), are frequently used because of their ease of use and speed of application (Von Baeyer, 2006). However, these scales focus exclusively on measuring pain intensity, without consid-ering other relevant components such as location, sensory qualities, or the emotional component, which may lead to an incomplete assessment of the discomfort perceived by the child (Jaaniste al., 2019); (Wilkie et al., 2010).

Given these limitations, multidimensional assessment tools have emerged, such as the Adolescent Pediatric Pain Tool (APPT), which is specifically designed to assess pain intensity, location, and quality in children and adolescents. This tool facilitates a more detailed understanding of pain from the patient's perspective, overcoming the re-strictions of unidimensional methods (Jacob et al., 2014); (Madi et al., 2019). Recent studies have shown that multidi-mensional assessments allow the identification of emotional and contextual aspects of pain, improving the tailoring of therapeutic approaches to the individual needs of the pediatric patient (Eccleston et al., 2012); (Birnie et al., 2018). Furthermore, this type of assessment has been recommended as a reference standard by international organizations and scientific societies special-izing in pediatric pain (World Health Organization 2012); (American Academy of Pediatrics 2021).

In this context, the present study aimed to evaluate the clinical usefulness of the APPT tool in comparison with the VAS scale in the assessment of pain in hospitalized children and to describe the characteristics of pain from a multidimensional perspective. The aim of this study was to provide evidence of the added value of this type of tool for a richer, more accurate, and more pediatric patient-centered assessment.

To evaluate the clinical utility of the Adolescent Pediatric Pain Tool (APPT) in comparison with the visual analog scale (VAS) for the assessment of pain in hospitalized children and to describe the characteristics of pain from a multidimensional per-spective.

# Materials and methods

## 1 Study design and scope

We conducted a cross-sectional, observational study with a descriptive and prospective design, aimed at comparing two pain assessment instruments (VAS and APPT) and characterizing pediatric pain from a multidimensional perspective. The study was conducted between October 2024 and December 2025 in the Pediatrics Unit of Hospital Universitario XXXX-XXXX, a tertiary-level referral center serving a catchment population of approximately XXXX inhabitants. Each eligible child underwent a single pain assessment session in which both instruments were simultaneously administered, thereby enabling a within-subject comparison of their psychometric outputs. The study was conducted and reported in accordance with the recommendations of the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational research.

## 2 Population and sample

The target population comprised children aged 8–14 years admitted to the Pediatrics Unit with acute or chronic pain during the data collection period. The lower age limit of 8 years was established based on the validated developmental threshold for reliable self-report of pain using the APPT instrument (Jacob et al., 2014). The inclusion criteria were: (1) age between 8 and 14 years; (2) hospitalization with a primary or secondary diagnosis involving pain; (3) ability to communicate verbally and to understand the instruments employed; and (4) provision of written informed consent by parents or legal guardians, together with the assent of the child. Patients with diagnosed psychiatric, neurological, or cognitive disorders that could interfere with the comprehension and application of pain assessment tools were excluded, as were children who received analgesic medication within 30 minutes prior to assessment.

Sampling was non-probabilistic by consecutive convenience, including all eligible patients admitted during the data collection period whose assessment

coincided with the availability of nursing staff trained in the application of the instruments. Given the exploratory and descriptive nature of this study and the absence of comparable prior data on the simultaneous use of the VAS and APPT in this population, a formal a priori power calculation was not feasible. The final sample comprised 27 assessments. A post-hoc sensitivity analysis confirmed that this sample size is sufficient to detect Spearman's correlation coefficients of rho $\geq 0.50$ with a power of 80% ($\alpha = 0.05$, two-tailed), which is consistent with the effect sizes reported in the literature for analogous psychometric validation studies (Jacob et al., 2014; Madi & Badr, 2019). The findings should therefore be interpreted as preliminary, and a larger confirmatory study is warranted.

## 3 Instruments and variables

Two tools were used for pain assessment:

Visual Analogue Scale (VAS): A one dimensional instrument for measuring pain intensity on a

**Table 1: Qualitative Pain Categories and Descriptors Identified by the APPT**

| Temporals | Descriptives | Perception / Emotion |
|---|---|---|
| always | stabbing | annoying |
| comes and goes | sharp | bad |
| once in a while | pin like | horrible |
| constant | like a pin | miserable |
| continuous | like a sharp knife | terrible |
| forever | biting | uncomfortable |
| comes on all of a sudden | cutting | painful |
| off and on | cramping | hurting |
| steady | crushing | like a hurt |
| sometines | like a pinch | awful |
| sneaks up | pinching | deadly |
| never goes away | pressure | dying |
| uncontrollable | beating | killing |
| | hitting | crying, |
| | pounding | frightening |
| | punching | screaming |
| | throbbing | terrifying |
| | aching | dizzy |
| | hurting | sickening |
| | like an ache | suffocating |
| | like a hurt | crying from pain |
| | sore | screaming from pain |
| | itching | terrified from pain |
| | like a scratch | horrible |
| | like a sting | breaking me |
| | scratching | tearing apart |
| | stinging | |
| | stiff | |
| | swollen | |
| | tight | |
| | burning | |
| | blistering | |
| | hot | |

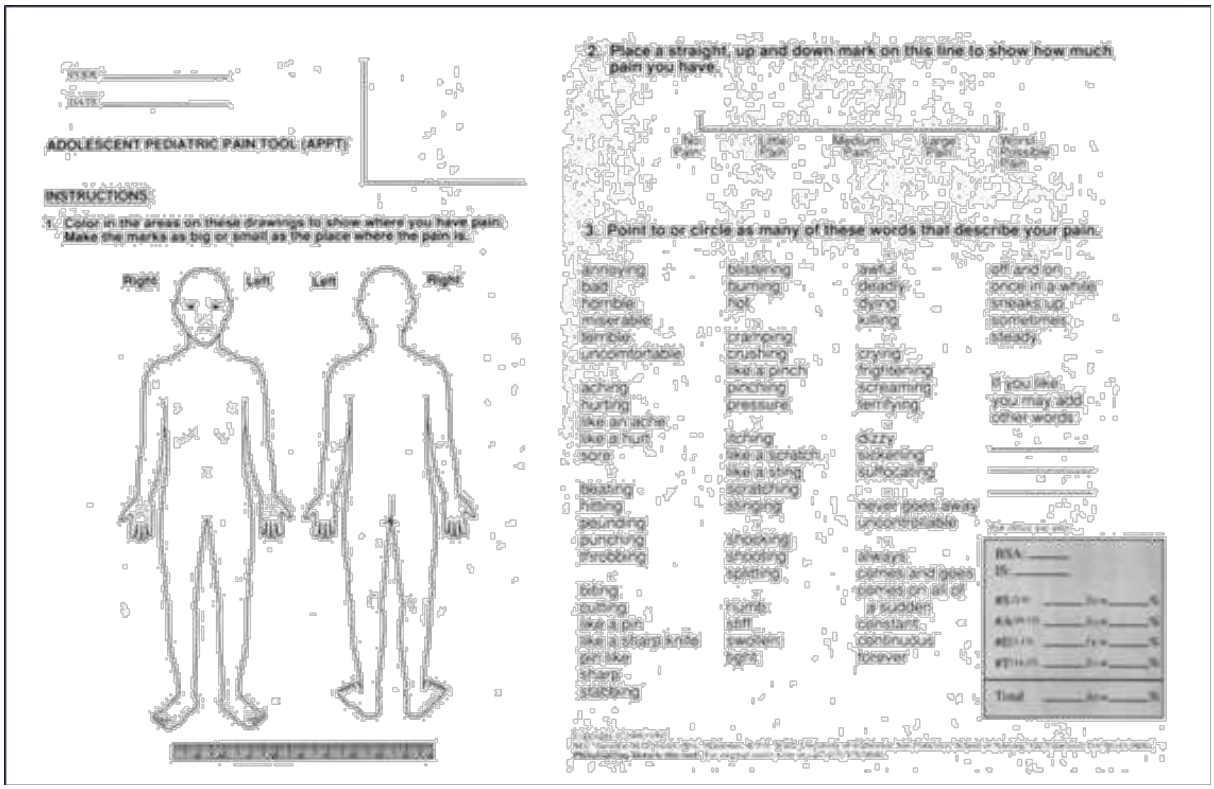
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continuous scale from 0 to 10, where 0 indicates "no pain" and 10 indicates "worst possible pain".

Adolescent Pediatric Pain Tool (APPT): This multidimensional instrument has been validated in Spanish and designed to assess the location, intensity, and qualities of pain in pediatric populations. It is especially useful in clinical and research contexts. It consists of three components: Body drawing to indicate painful areas; Qualitative or-dinal scale of intensity based on five verbal descriptors (1 = no pain; 5 = unbearable pain); List of 67 qualitative descriptors of pain, which were subsequently grouped into ana-lytical categories for interpretation: sensory/descriptive, emotional/affective and tem-poral dimensions analyzed (Table 1).

In addition, sociodemographic and contextual variables were collected: age, sex, reason for admission, presence of social stressors, family situation (separated parents), and the assessor's perception of possible external factors that could influence the ex-pression of pain. analyzed.

**Figure 1: Adolescent Pediatric Pain Tool (APPT)**




Madi D, Badr LK. (2019)

## 4 Procedure

Pain assessments were conducted by a team of four nursing professionals who received standardized training (two-hour session) in the administration and scoring of both the VAS and the APPT prior to the start of the study. To minimize interobserver variability, a calibration exercise was performed before data collection began, in which all assessors independently rated a set of standardized vignettes; discrepancies were resolved by consensus. Assessments were carried out at the bedside during the morning shift (08:00–14:00 h), prior to the administration of prescribed analgesics and in the absence of parents or guardians to reduce social desirability bias. Each session lasted approximately 15–20 minutes. The VAS was administered first, followed by the APPT, in order to prevent the qualitative descriptors of the APPT from influencing the child's numerical self-report. The child's responses were recorded verbatim on a standardized data collection form and subsequently entered into an anonymized database designed for the study, with double-entry verification to minimize transcription errors.

## 5 Data analysis

A descriptive analysis of all study variables was performed. Continuous quantitative variables were tested for normality using the Shapiro–Wilk test (appropriate for $n < 50$) and expressed as mean ±

standard deviation (SD) when normally distributed, or as median and interquartile range [IQR] when non-normality was confirmed. Categorical variables were summarized using absolute frequencies and percentages.

To quantify the degree of concordance between pain intensity as measured by the numerical VAS (continuous scale, 0–10) and the ordinal intensity scale of the APPT (ordinal scale, 1–5), Spearman's rank correlation coefficient (rho) was calculated, given the ordinal nature of one of the variables and the non-normal distribution of VAS scores. The strength of the association was interpreted following conventional benchmarks: rho 0.10–0.39 (weak), 0.40–0.59 (moderate), 0.60–0.79 (strong), and ≥0.80 (very strong). The coefficient of determination ($R^2$) was additionally calculated to estimate the proportion of shared variance between the two scales. For intergroup comparisons of pain intensity (VAS) according to categorical variables (sex, presence of social problems, parental separation, and perceived external influence), the Mann–Whitney U test was applied, as the assumptions for parametric tests were not met. Effect sizes for group comparisons were estimated using the rank-biserial correlation coefficient (r). The pain descriptors captured by the APPT were classified into three analytical dimensions (sensory/descriptive, emotional/affective, and temporal) and their distribution was explored using descriptive statistics and cross-tabulation by sociodemographic and clinical variables. All statistical analyses were performed using IBM SPSS Statistics software (version 30.0; IBM Corp., Armonk, NY, USA). The threshold for statistical significance was set at $p < 0.05$ (two-tailed) for all inferential tests.

## 6 Ethical considerations

The study was approved by the Ethics Committee of the Hospital Universitario XXX-XXX. Informed consent was obtained from the parents or legal guardians of all participants, ensuring confidentiality and ethical treatment of data in accordance with the General Data Protection Regulation (EU 2016/679) and Law 14/2007 on Biomedical Research.

# Results

A total of twenty-seven assessments of hospitalized children who experienced pain during the data collection period were analyzed, and their characteristics are presented in Table 2.

The sample had a mean age of 11.11 ± 1.63 (range 8-13), and was predominantly female (74.07%). The etiology of pain was very heterogeneous, and patients were classified into two groups. The 62.96% of patients presented with pain in the upper limbs (MMSS), head and neck, and the rest in the trunk and lower limbs (MMII).

Pain assessment using the Visual Analogue Scale (numerical VAS, range 0-10) re-vealed a mean score of 5.52 ± 3.08, indicating moderate to acute pain in the majority (n=18, 66.67%) of participants. The qualitative VAS assessment of the APPT scale (range 0-5) yielded a mean score of 3.04 ± 1.37, values that also correspond, according to their distribution, to a medium or higher pain perception in 66.67% of the patients and con-firm internal consistency with the measurements obtained through the numerical scale. In addition, 25.93% of the children were identified as having social problems, coinciding exactly with the proportion of cases in which the nurse considered that pain was in-fluenced by factors external to their clinical situation. Only 7.41% of the respondents had parents during their separation.

Correlation analysis between numerical VAS scores (0-10) and the APPT qualitative VAS scale revealed a strong and statistically significant positive association (rho = 0.81, ρ = 3.56e-07; $p < 0.001$), with a coefficient of determination R2 = 0.6191, indicating sub-stantial agreement between the two pain assessment instruments. After verifying the non-normality of the distribution of VAS scores by the normality test (Shapiro-Wilk), non-parametric tests were implemented for intergroup contrasts analyzed (Figure 2).

Comparison by sex showed that boys reported slightly higher pain intensities (mean=6.14, SD=2.54) compared to girls (mean=5.30, SD=3.28), although with less vari-ability in their scores. However, it did not show statistically significant differences in pain intensity ($t = -0.62$; $p > 0.05$), despite the observed trend toward higher values in boys. Similarly, comparisons based on contextual factors identified no significant dif-ferences in VAS scores between patients with and without social problems (5.00 ± 3.42 vs. 5.70 ± 3.03; $t = 0.51$; $p > 0.05$), nor between those with and without perceived external influence ($t = 0.51$; $p > 0.05$). Children with separating parents (n=2) had a higher mean pain intensity (7.00 ± 0.00 vs. 5.40 ± 3.18), although this difference also did not reach statistical significance ($t = -0.70$; $p > 0.05$), possibly due to the limited power of the analysis due to the small sample size of this subgroup. These findings suggest that although psychosocial factors may qualitatively modulate the pain experience, their quantitative impact on perceived pain intensity is too small to show statistical signifi-cance in the sample analyzed (Table 3, Figure 3).

**Table 2. Sociodemographic and clinical characteristics of the sample**

| Variable | Category | n (%) | Mean ± SD | Median [RIQ] |
|---|---|---|---|---|
| Age (years) | | | 11.11 ± 1.63 | 12 [10-12] |
| Sex | | | | |
| | Female | 20 (74.07) | | |
| | Male | 7 (25.93) | | |
| Admission diagnosis | | | | |
| | MMSS pain, head, and neck | 17 (62.96) | | |
| | Trunk and MMII pain | 10 (37.04) | | |
| VAS (0-10) | | | 5.52 ± 3.08 | 7 [4-8] |
| | Mild pain (0-4) | 9 (33.33) | | |
| | Moderate pain (5-7) | 10 (37.04) | | |
| | Acute pain (8-10) | 8 (29.63) | | |
| VAS APPT (0-5) | | | 3.04 ± 1.37 | 3 [2-4] |
| | Unclassified (0) | 1 (3.70) | | |
| | Painless (1) | 3 (11.11) | | |
| | A little pain (2) | 5 (18.52) | | |
| | Medium pain (3) | 7 (25.93) | | |
| | A lot of pain (4) | 7 (25.93) | | |
| | Unbearable pain (5) | 4 (14.81) | | |
| Social factors | | | | |
| Social problems | | | | |
| | No | 20 (74.07) | | |
| | Yes | 7 (25.93) | | |
| Parents in the process of separation | | | | |
| | No | 25 (92.59) | | |
| | Yes | 2 (7.41) | | |
| Pain influenced by external factors | | | | |
| | No | 20 (74.07) | | |
| | Yes | 7 (25.93) | | |

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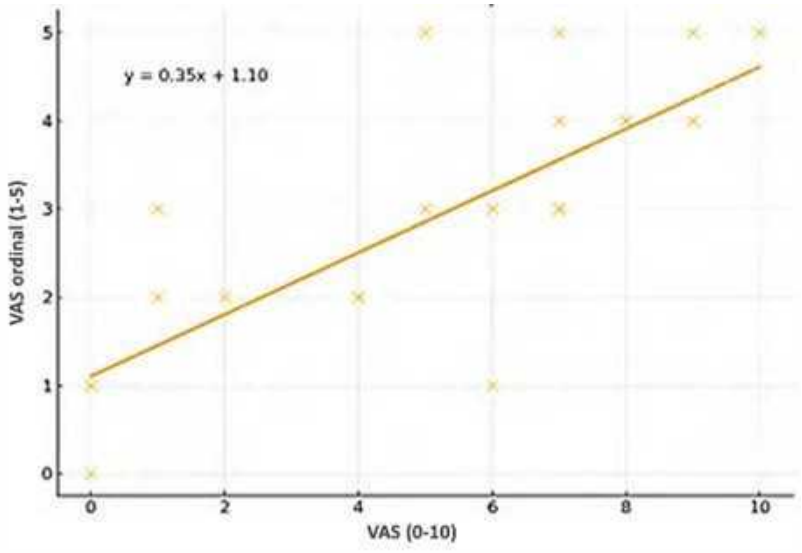
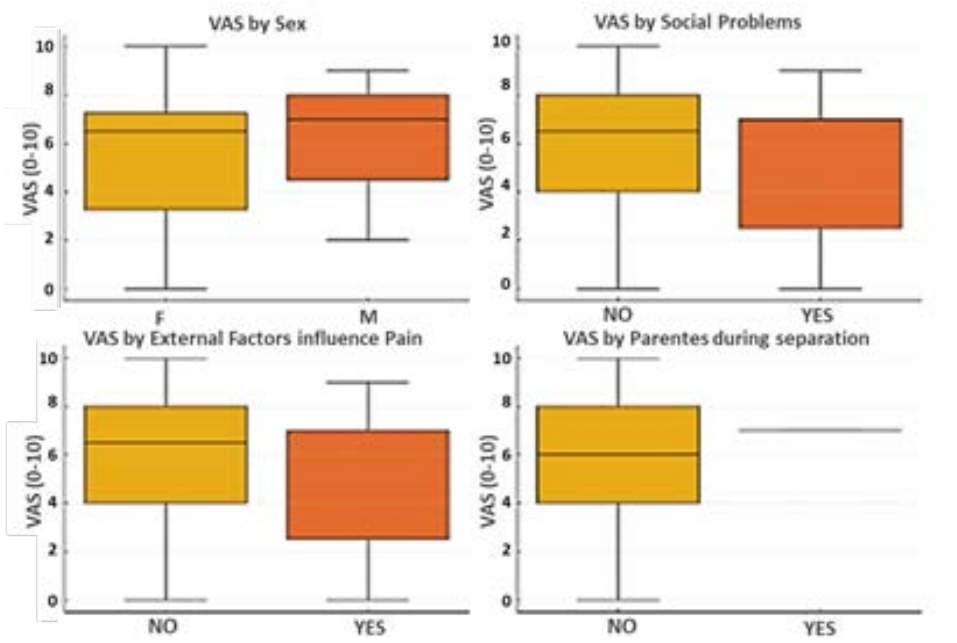



**Figure 2: Correlation of VAS scales and the ordinal scale of the APPT**

**Table 3. Contrast of Means: Nom parametric tests (Mann-Whitney U-test) to compare pain intensity (VAS) between groups.**

| | VAS (0-10) | | |
|---|---|---|---|
| | Mean ± SD | Median [RIQ] | Z, signification |
| Sex | | | |
| Female (n=20) | 5.30 ± 3.28 | 6.5 [3-8] | 0.62 (p > 0.05) |
| Male (n=7) | 6.14 ± 2.54 | 7 [4-8] | |
| Social problems | | | |
| No (n=20) | 5.70 ± 3.03 | 6.5 [4-8] | 0.51, p > 0.05 |
| Yes (n=7) | 5.00 ± 3.42 | 7 [2.5-7] | |
| Parents during separation | | | |
| No (n=25) | 5.40 ± 3.18 | 6 [4-8] | 0.70; p > 0.05) |
| Yes (n=2) | 7.00 ± 0.00 | 7 [7-7] | |
| External factors influence pain | | | |
| No (n=20) | 5.70 ± 3.03 | 6.5 [4-8] | 0.51, p > 0.05; |
| Yes (n=7) | 5.00 ± 3.42 | 7 [2.5-7] | |

**Figure 3: Comparison of VAS according to contextual variables**




The qualitative analysis of the responses obtained using the APPT tool allowed for a deeper exploration of the children's experience of pain through three key dimensions: temporal, descriptive, and emotional perception. In the temporal dimension, the most frequent terms were "permanent" (24.05%), "pain never goes away" (16.46%) and "con-tinuous pain" (16.46%). This recurrence is evidence of the children's perception of per-sistent pain that is difficult to control. When disaggregated by sex, girls more frequently used descriptors such as "permanent", "continuous pain" and "sometimes", suggesting a more sustained and repetitive experience of pain.

In terms of descriptive dimension, the most representative terms were "pressure" (16.54%), "stabbing" (11.28%) and "like a pin" (9.77%). Girls excelled significantly in the use of "stabbing" and "pressure", while boys showed greater presence of descriptors such as "like a beating" and "a bite". These findings suggest gender differences in how children conceptualize pain.

The emotional dimension revealed a significant affective charge. The most frequent terms were "crying in pain" (12.17%), "painful" (10.43%) and "upset" (10.43%). There were marked differences by gender: girls identified more with intensely emotional terms such as "crying in pain" (15.66%) and "dreadful" (9.64%), while boys used descriptors such as "splitting me" (12.5%) and "screaming in pain" (9.38%) to a greater extent.

Analysis by pain intensity showed that, in cases of severe pain (8-10), descriptors such as "permanent", "pain never goes away" and "uncontrollable pain" predominated in the temporal dimension; "pressure", "stabbing" and "a pin" in the descriptive dimension; and "bad", "splitting" and "unmanageable" in the emotional perception. In contrast, cases with mild pain (VAS 0-4) showed less dramatic and more manageable descriptors, such as "controllable pain" and "numb".

Furthermore, the comparative analysis between children with and without social problems revealed that the former used more intense and negative descriptors, such as "uncontrollable pain", "pressure", "stabbing", "horrible" and "screaming in pain". Alt-hough the differences did not reach statistical significance, these results suggest that the psychosocial context influences the experience of pain.

This qualitative analysis reinforces the usefulness of multidimensional pain as-sessment and demonstrates how different dimensions, namely, sensory, temporal, and emotional, contribute to a richer and more accurate understanding of the pediatric pain experience, beyond what can be captured by a unidimensional scale such as the VAS.

## Discussion

*Pain assessment in pediatric populations remains a challenge for health profes-sionals, especially when using unidimensional tools such as the Visual Analogue Scale (VAS). Although widely used for its simplicity, the VAS focuses exclusively on pain intensity, ignoring fundamental components such as temporality, sensory characteris-tics, and emotional impact, which are key aspects in the experience of pediatric pain (Jaaniste et al., 2019; Madi et alt.., 2019). The present study corroborates this limitation while showing that the use of a multidimensional tool, such as the adapted APPT, provides access to a richer and more nuanced understanding of childhood pain.*

*The high correlation observed between the numerical VAS score and the ordinal APPT scale (rho = 0.81; $p < 0.001$) confirms the consistency between the two measures in assessing pain intensity. However, this concordance does not invalidate the differential contributions of the APPT because its additional components reveal qualitative dimen-sions that the VAS cannot capture. Thus, the APPT broadens the clinical horizon by integrating sensory, temporal, and emotional elements, which are essential in pediatric pain perception (Jacob et al., 2014; Wilkie et al., 2010).*

*Qualitative analysis revealed particularly significant descriptors, such as "perma-nent", "stabbing" and "crying in pain", reflecting persistent pain with high emotional charge. This multidimensional profile of the pain experience is consistent with previous studies highlighting the complexity of childhood pain, which is influenced by sensory, affective, and contextual factors (Jacob et al., 2014; Eccleston et al., 2012). The presence of these descriptors, especially among patients with high VAS scores, highlights the usefulness of APPT in identifying cases requiring interventions beyond pharmacological treatment.*

*There were also notable differences according to gender. Girls tended to use more frequently emotionally and sensorially charged terms such as "crying in pain", "stabbing" and "pressure", while boys opted for more visual and impactful descriptors such as "I'm splitting" or "a beating". These findings agree with what has been described in the literature, where greater emotional expressivity and sensitivity to pain among girls have been documented, possibly associated with neurobiological and sociocultural differences (Bartley et alt., 2013; Tsze et al., 2018).*

*Regarding the psychosocial context, although no statistically significant differences were found in pain intensity according to the presence of social or family problems, a more frequent use of intense and negative descriptors was identified among children with adverse social factors. Terms such as "uncontrollable pain", "horrible" or "screaming in pain" were more prevalent in these cases, suggesting a qualitatively more complex pain experience. This observation is consistent with Eccleston et al. (2012) findings, who emphasized the modulating role of the emotional environment in children's pain per-ception. Thus, the APPT not only provides information about physical pain and serves as a screening tool for emotional or social vulnerability (Eccleston et al., 2012).*

*These findings reinforce the need to adopt assessment tools that integrate multiple dimensions of pain, especially in hospital settings where the painful experience may be amplified by environmental, emotional, and social factors. Systematic implementation of instruments, such as the APPT, can allow for a more comprehensive assessment of pediatric patients, improve the appropriateness of treatment, and facilitate comple-mentary interventions when necessary.*

*The results of this study support the clinical utility of the adapted APPT as an ad-junct to traditional unidimensional scales. The ability to capture the sensory, emotional, and contextual aspects of pain makes it a valuable tool for pediatric practice, contributing to a more humanized and patient-centered approach.*

### *Strengths and Limitations*

*This study presents several strengths, notably its use of a validated multidimensional tool (APPT) that enables a richer and more nuanced understanding of pediatric pain, integrating sensory, emotional, and temporal dimensions. The prospective design and direct application in a clinical setting enhance its relevance and translational potential. Additionally, the inclusion of contextual variables such as gender and social stressors adds depth to the analysis. However, limitations must be acknowledged. The small sample size (n=27) restricts the generalizability of findings and limits statistical power, particularly in subgroup analyses. The non-probabilistic sampling method may introduce selection bias, and the reliance on self-reporting tools in children could be influenced by developmental and communicative variability. Furthermore, the study was conducted in a single hospital unit, which may limit external validity. Despite these constraints, the findings offer valuable insights and support the integration of multidimensional pain assessment in pediatric care.*

### *Implications for Practice*

*The implications for healthcare managers and nursing leadership in the assessment of paediatric pain are considerable. The high prevalence of moderate to severe pain among hospitalised children highlights the need for more accurate, patient-centred evaluation strategies. The implementation of multidimensional tools such as the Adolescent Pediatric Pain Tool (APPT) enables a more comprehensive understanding of pain, thereby enhancing clinical decision-making, individualised treatment, and overall care quality. For healthcare managers, this necessitates investment in staff training, the revision of clinical protocols, and the allocation of resources to support more effective and humanised paediatric pain management.*

*Lastly, the simulation highlights the potential impact of increasing surgical profitability. A 10–15% improvement in performance would allow a greater number of patients to be treated and would significantly reduce structural delay. These findings underscore the importance of health information systems as essential tools for decision-making, improving efficiency, and informing strategic planning based on real data.*

## *Conclusions*

*The assessment of pain in hospitalized children using a multidimensional tool such as the adapted APPT allows a more complete and accurate characterization of the pain experience, integrating sensory, emotional, and contextual components that are not captured by unidimensional scales such as the VAS. The high intensity correlation between the two scales reinforces the validity of the multidimensional approach without compromising its clinical reliability. Furthermore, the identification of differ-ential patterns according to gender and psychosocial context highlights the value of personalized assessments. These findings support the systematic incorporation of multidimensional tools into pediatric clinical practice to improve assessment and comprehensive pain management approaches.*

# DECLARATIONS


## Funding

This research received no external funding.


## Conflicts of Interest

The authors declare no conflicts of interest related to this study.

## Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

## Author Contributions (CRediT Taxonomy)

**ARS:** Conceptualization, Methodology, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft Preparation, Writing – Review and Editing, and Supervision.

**JMPJ:** Conceptualization, Methodology, Formal Analysis, Investigation, Resources, Data Curation, Writing – Original Draft Preparation, Writing – Review and Editing, and Supervision.

**MOC:** Investigation, Resources, Writing – Original Draft Preparation, and Writing – Review and Editing.

**JDF:** Investigation, Resources, Writing – Original Draft Preparation, and Writing – Review and Editing.

**MGM:** Investigation, Resources, Writing – Original Draft Preparation, and Writing – Review and Editing.

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- **JMPJ**- José Miguel Pérez Jiménez.

- **MOC**- Mónica Ortega Cáceres.
- **JDF**- Jesús Domínguez Fernández.
- **MGM**- María Gómez Mora.

*All authors contributed to the preparation of the manuscript according to the roles described using the CRediT (Contributor Roles Taxonomy), critically reviewed the manuscript, approved the final version for publication, and accept responsibility for all aspects of the work, in accordance with the criteria established by the International Committee of Medical Journal Editors (ICMJE).*

## Artificial Intelligence Statement

The authors declare that no generative artificial intelligence tools were used in the conception, design, data analysis, interpretation of results, writing, or revision of this manuscript.

## Previous Publication Statement

The authors declare that this manuscript is original and unpublished and is not currently under consideration by any other journal. The work has not been previously published in whole or in part.

## Ethical Considerations

The study was approved by the Ethics Committee of Hospital Universitario Virgen Macarena (Approval No. 1198-N-23). Written informed consent was obtained from the parents or legal guardians of all participants prior to their inclusion in the study. All procedures were conducted in accordance with the ethical principles of the Declaration of Helsinki, Regulation (EU) 2016/679 on data protection, and Spanish Law 14/2007 on Biomedical Research.

## Transparency Statement

The authors affirm that this manuscript is an honest, accurate, and transparent account of the study being reported. No important aspects of the study have been omitted, and any discrepancies from the study as originally planned have been explained. The authors take responsibility for the integrity, accuracy, and completeness of the data and analyses presented.

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