

Knowledge Gaps in Pediatric Pain Management Among Multidisciplinary Healthcare Professionals: A Cross- Sectional Survey

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Research Article

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Abstract

Background

To identify knowledge gaps regarding pediatric pain management among multidisciplinary healthcare professionals in a French general hospital and to identify priorities for future educational interventions.

Methods

We conducted a prospective, monocentric, cross-sectional survey among healthcare professionals involved in pediatric care. A structured questionnaire assessed knowledge of EMLA, MEOPA, analgesic pharmacology, and morphine, as well as reported pain-assessment practices. Thirty-one knowledge items were combined into a preliminary Pediatric Pain Management Knowledge Score (PPKMS), calculated as the proportion of correct responses at the aggregate level. Exploratory comparisons according to professional category were performed using Pearson's chi-square or Fisher's exact tests, with odds ratios (ORs).

Results

Seventy-three questionnaires were included: 39 nurses, 17 nursing assistants, and 17 physicians. Across the 31 knowledge items, 1,167 of 2,263 possible responses were correct, corresponding to an overall aggregate PPKMS of 51.6%. Knowledge varied substantially across domains, with the highest scores for EMLA (59.2%) and MEOPA (55.9%), followed by analgesic pharmacology (46.2%), while morphine-related knowledge was the weakest domain (31.8%). Overall PPKMS scores were relatively similar among nurses (51.5%), nursing assistants (49.7%), and physicians (53.5%), but domain-specific knowledge profiles differed substantially.

Conclusions

Multidisciplinary healthcare professionals demonstrated substantial and heterogeneous knowledge gaps in pediatric pain management, with particularly pronounced deficiencies in morphine-related knowledge. These findings support targeted, role-specific multidisciplinary education combined with standardized clinical protocols and systematic pain assessment and reassessment. Larger multicenter studies using validated instruments and individual-level data are warranted to confirm these findings and evaluate whether educational interventions translate into improved clinical practice.

Introduction

Pain relief is increasingly recognized as a fundamental component of the right to health and of high-quality healthcare. Over the past three decades, considerable progress has been achieved in

understanding the neurobiology of pain, the long-term consequences of untreated pain during childhood, and evidence-based approaches to procedural and acute pain management. International organizations, including the International Association for the Study of Pain (IASP), the World Health Organization (WHO), the American Academy of Pediatrics (AAP), and several European scientific societies, have published comprehensive recommendations promoting systematic pain assessment, timely analgesia, multimodal pain management, and family-centered care [1–6].

Nevertheless, pediatric pain remains consistently undertreated across healthcare systems [7]. Numerous studies performed in emergency departments, pediatric wards, intensive care units, and procedural settings have demonstrated that children frequently experience moderate-to-severe pain without receiving adequate analgesia. Inadequate analgesia (oligoanalgesia) remains a persistent problem affecting both high-income and low-income countries despite increasing awareness and the availability of effective analgesic strategies [1, 7–9].

The consequences of inadequate pain management extend well beyond immediate discomfort. Untreated pain during infancy and childhood has been associated with physiological instability, increased stress responses, heightened procedural anxiety, needle phobia, avoidance of healthcare [10–12]. Repeated painful experiences may also contribute to long-term psychological consequences for both children and their families, emphasizing that optimal pain management represents not only a clinical obligation but also an important patient safety issue [13].

The persistence of undertreated pediatric pain despite well-established recommendations illustrates a broader evidence-to-practice gap. Healthcare professionals' knowledge represents one of the most potentially modifiable determinants of evidence-based pediatric pain management. Previous and recent investigations have shown deficiencies regarding pain assessment, opioid prescribing, procedural analgesia, and non-pharmacological interventions [14–16]. Misconceptions concerning opioid safety, uncertainty regarding age-specific indications, inadequate familiarity with topical anesthetics and inhaled analgesia, and inconsistent use of validated pain assessment scales continue to limit adherence to international recommendations. These knowledge gaps may contribute to unnecessary variations in clinical practice and ultimately compromise the quality and safety of pediatric care [16, 17].

In France, relatively few studies have comprehensively evaluated multidisciplinary healthcare professionals' knowledge regarding pediatric pain management in general hospitals. Furthermore, most previous surveys have focused on individual therapeutic modalities or specific professional groups rather than providing a broader assessment of knowledge and reported practices across the continuum of pediatric pain management.

The primary objective of this study was therefore to identify critical knowledge gaps regarding pediatric pain assessment and analgesic management among multidisciplinary healthcare professionals working in a French general hospital. Our secondary objective was to identify priority areas for future educational interventions and quality improvement strategies aimed at improving adherence to evidence-based pediatric pain management recommendations.

Methods

Study design and setting

We conducted a monocentric, cross-sectional survey to assess healthcare professionals' knowledge and reported practices regarding pediatric pain management. The study was conducted among healthcare professionals involved in the care of children.

The survey was conducted over one week period, from June 26 to July 3, 2023, as a baseline assessment before the planned implementation of a dedicated pediatric pain-management training program.

Participants

Healthcare professionals working in the emergency department, pediatric and surgical units, neonatology, maternity, and pharmacy were invited to participate. The target population included nurses, nursing assistants, physicians, and midwives.

Participation was voluntary and anonymous. Questionnaires that were incomplete, not returned, or did not specify the participant's professional category were excluded.

A total of 83 questionnaires were distributed. The questionnaires were on paper and completed by hand.

Questionnaire

The questionnaire was adapted from one previously used in a PhD thesis on paediatric pain. As the investigator hold a french university qualification in paediatric pain, he adapted the questionnaire for this study. The answers to the questions were aligned with French national and international guidelines on the assessment and management of paediatric pain. It should be noted that the questionnaire was not tested on healthcare professionals before the study began.

The questionnaire covered four principal knowledge domains: EMLA, MEOPA, analgesic pharmacology, and morphine use. A separate section assessed reported pain-assessment practices.

The EMLA and the MEOPA sections assessed knowledge of indications, age of use, prescription requirements, minimum application time, duration of analgesic efficacy after removal, and monitoring after application.

The analgesic section assessed knowledge concerning parental presence during painful procedures, pediatric marketing authorization of commonly used analgesics, the pain threshold for morphine use, and the antidote to morphine.

A separate section assessed reported pain-assessment practices at different stages of care, including arrival, discharge, painful procedures, verbal expression of pain by the child, parental report of pain, and behavioral changes.

Pediatric Pain Management Knowledge Score

A preliminary Pediatric Pain Management Knowledge Score (PPKMS) was developed to provide an integrated descriptive measure of knowledge.

The PPKMS included 31 knowledge items distributed across four domains: EMLA (9 items), MEOPA (11 items), analgesic pharmacology (7 items), and morphine (4 items). The six questions assessing reported pain-assessment practices were deliberately excluded from the PPKMS because they assessed reported clinical behavior rather than factual knowledge.

Each correct response was assigned one point.

The aggregate PPKMS was calculated as the total number of correct responses divided by the total number of evaluable responses across all participants, and was expressed as a percentage.

Domain-specific knowledge indices were calculated using the same approach.

Because the original individual-level responses were not available for secondary analysis, the PPKMS was developed post hoc as a descriptive aggregate index and has not undergone psychometric validation.

No arbitrary threshold for "good" or "poor" individual knowledge was therefore applied.

Pain Assessment Practice Index

Pain-assessment questions were analyzed separately. A descriptive Pain Assessment Practice Index was calculated from the six situations addressed in the questionnaire.

This index was intended to characterize reported pain-assessment practices throughout the child's care pathway rather than knowledge. Because individual responses were unavailable, the index was interpreted descriptively at the aggregate level.

Statistical analysis

Categorical variables were summarized using absolute frequencies and percentages.

For each knowledge item, the number and proportion of correct responses were calculated overall and according to professional category. Aggregate domain-specific knowledge indices were calculated for EMLA, MEOPA, analgesic pharmacology, and morphine.

Differences between professional categories for individual binary knowledge items were explored using Pearson's chi-square test when the assumptions of the test were met. Fisher's exact test was used when expected cell counts were small.

For selected comparisons, odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to quantify the association between professional category and a correct response.

Because individual-level responses were unavailable, statistical analyses were restricted to associations that could be reconstructed from the aggregate contingency tables. Individual-level PPKMS comparisons and multivariable regression analyses were not performed.

Given the exploratory nature of this preliminary study and the limited sample size, the analyses were considered hypothesis-generating. No adjustment for multiple comparisons was performed. All tests were two-sided, and $p < 0.05$ was considered statistically significant.

We did not use any statistical software, and the calculations were carried out manually.

Ethical considerations

This study was conducted in accordance with applicable French regulations governing research involving human participants, including the French Jardé Law (Law No. 2012 – 300 of 5 March 2012).

The study was conducted as an anonymous survey of healthcare professionals and did not involve patients or the collection of identifiable patient data. No directly identifying information was collected from participants. Participation was voluntary and anonymous, and confidentiality was maintained throughout the study.

Informed consent

was obtained from the participants orally.

Heads of the relevant departments and unit managers were informed about the study. Participation was voluntary, and completion and submission of the anonymous questionnaire were considered to constitute implied consent to participate.

The investigator formally contacted the relevant ethics committee at the Centre Hospitalier de Chaumont. At the time of the study, the committee was in the process of being established and was therefore unable to provide a formal ethical opinion. Furthermore, we officially contacted the Institutional Ethics Committee (IRB/Ethics Committee) of the Dijon University Hospital. In accordance with its strict internal institutional policy, the Committee cannot issue authorisation or an official statement retrospectively, once a study has already begun or been completed. On 17 August 2026 at 11.14 am, we received an email from the Research Ethics Committee at the Dijon University Hospital confirming this.

Results

Participants

Seventy-three questionnaires were included in the final analysis, comprising 39 nurses, 17 nursing assistants, and 17 physicians. Seven questionnaires completed by midwives were excluded before the primary analysis because their clinical activity was predominantly focused on maternity and neonatal care, resulting in insufficient exposure to the broader pediatric pain-management domains assessed by the questionnaire.

One questionnaire without a specified professional category and two non-returned questionnaires were also excluded.

EMLA knowledge

Knowledge regarding EMLA was heterogeneous. The indication of EMLA for venipuncture was correctly identified by all nurses and physicians and by 16 of 17 nursing assistants. Knowledge was substantially lower for the use of EMLA in other situations, including bone marrow aspiration and vaccination (Table 1).

Table 1
Healthcare professionals' knowledge of EMLA use

Knowledge item	Nurses (n = 39)	Nursing assistants (n = 17)	Physicians (n = 17)
Indications for EMLA use			
Venipuncture	39 (100.0)	16 (94.1)	17 (100.0)
Bone marrow aspiration	23 (59.0)	5 (29.4)	9 (52.9)
Vaccination	33 (84.6)	16 (94.1)	13 (76.5)
Skin biopsy	25 (64.1)	16 (94.1)	7 (41.2)
Minimum age for EMLA use: term newborn	10 (25.6)	5 (29.4)	8 (47.1)
Medical prescription required	32 (82.1)	13 (76.5)	11 (64.7)
Minimum application time before the procedure: 1 h	19 (48.7)	15 (88.2)	11 (64.7)
Duration of analgesic effect after removal: 1 h	6 (15.4)	6 (35.3)	3 (17.6)
Post-application monitoring required	18 (46.2)	9 (52.9)	4 (23.5)
<i>Values are presented as n (%). Percentages are calculated within each professional category. Correct responses are shown in bold.</i>			

Only 10/39 nurses, 5/17 nursing assistants, and 8/17 physicians correctly identified the age at which EMLA could be used in a term newborn. Knowledge of the minimum application time was higher, with correct responses from 19/39 nurses, 15/17 nursing assistants, and 11/17 physicians. Knowledge of the duration of analgesic efficacy after removal was particularly limited, with only 6/39 nurses, 6/17 nursing assistants, and 3/17 physicians answering correctly (Table 1).

MEOPA knowledge

Only 6/39 nurses, 3/17 nursing assistants, and 4/17 physicians correctly identified the minimum age for MEOPA use. Knowledge of the three-minute pre-procedure inhalation period was also limited, with correct responses from 9/39 nurses, 8/17 nursing assistants, and only 3/17 physicians (Table 2). Knowledge of the appropriate flow rate was similarly limited.

Table 2

Healthcare professionals' knowledge of MEOPA use (MEOPA : equimolar oxygen–nitrous oxide mixture)

Knowledge item	Nurses (n = 39)	Nursing assistants (n = 17)	Physicians (n = 17)
Indications for MEOPA use			
Venipuncture	35 (89.7)	15 (88.2)	14 (82.4)
Lumbar puncture	29 (74.4)	13 (76.5)	13 (76.5)
Dental procedures	10 (25.6)	1 (5.9)	7 (41.2)
Burn dressing	36 (92.3)	16 (94.1)	15 (88.2)
Sickle-cell pain crisis	9 (23.1)	1 (5.9)	8 (47.1)
Minimum age for use: 1 month	6 (15.4)	3 (17.6)	4 (23.5)
Medical prescription required	33 (84.6)	17 (100.0)	13 (76.5)
Pre-procedure inhalation time: 3 min	9 (23.1)	8 (47.1)	3 (17.6)
Administration throughout the procedure	33 (84.6)	15 (88.2)	15 (88.2)
Flow rate adapted to respiratory pattern	9 (23.1)	3 (17.6)	4 (23.5)
Post-procedure monitoring required	26 (66.7)	16 (94.1)	10 (58.8)
<i>Values are presented as n (%). Percentages are calculated within each professional category.</i>			

In contrast, knowledge that MEOPA should be continued throughout the painful procedure was substantially better, with correct responses from 33/39 nurses, 15/17 nursing assistants, and 15/17 physicians (Table 2).

Analgesic pharmacology

Knowledge of pediatric marketing authorization was particularly limited for several analgesics. The correct age for tramadol oral solution was identified by 12/39 nurses, 1/17 nursing assistants, and 5/17 physicians. Knowledge of the pediatric authorization of nalbuphine was similarly limited, with 12/39 nurses, 1/17 nursing assistants, and 10/17 physicians answering correctly (Table 3).

Table 3
Healthcare professionals' knowledge of analgesic pharmacology

Knowledge item	Nurses (n = 39)	Nursing assistants (n = 17)	Physicians (n = 17)
Parental presence is appropriate during a painful procedure	25 (64.1)	13 (76.5)	13 (76.5)
Paracetamol: authorized from birth	34 (87.2)	12 (70.6)	11 (64.7)
Oral tramadol: authorized from 3 years	12 (30.8)	1 (5.9)	5 (29.4)
Nalbuphine: authorized from 18 months	12 (30.8)	1 (5.9)	10 (58.8)
Oral morphine: authorized from 6 months	2 (5.1)	2 (11.8)	3 (17.6)
Morphine is the treatment of choice from VAS ≥ 6	10 (25.6)	6 (35.3)	6 (35.3)
Morphine antidote: naloxone	34 (87.2)	8 (47.1)	16 (94.1)
VAS : visual analog scale. Values are presented as n (%). Percentages are calculated within each professional category.			

Knowledge of the pediatric authorization of oral morphine was extremely limited, with only 2/39 nurses, 2/17 nursing assistants, and 3/17 physicians providing the correct answer. Knowledge of the appropriate pain threshold for morphine use was also limited, with correct responses from 10/39 nurses, 6/17 nursing assistants, and 6/17 physicians (Table 3).

Reported pain-assessment practices

Pain-assessment practices were analyzed separately from knowledge. Most respondents reported assessing pain when the child arrived and during painful procedures. However, reassessment at discharge was less frequently reported, particularly among nursing assistants and physicians (Table 4).

Table 4
Reported pain-assessment practices among healthcare professionals

Situation	Nurses (n = 39)	Nursing assistants (n = 17)	Physicians (n = 17)
On arrival	37 (94.9)	13 (76.5)	14 (82.4)
At discharge	24 (61.5)	3 (17.6)	5 (29.4)
When performing a painful procedure	32 (82.1)	16 (94.1)	14 (82.4)
When the child reports pain	30 (76.9)	14 (82.4)	14 (82.4)
When the parent reports that the child is in pain	28 (71.8)	14 (82.4)	10 (58.8)
When abnormal behavior suggests pain	29 (74.4)	16 (94.1)	11 (64.7)
<i>Values are presented as n (%). Percentages represent the proportion of respondents reporting pain assessment in each situation.</i>			

Among nurses, 37/39 reported assessing pain on arrival, compared with 24/39 at discharge. Among nursing assistants, the corresponding figures were 13/17 and 3/17, while among physicians they were 14/17 and 5/17 (Table 4). Pain assessment was also reported when the child stated that they were in pain and when parents reported pain, but was less consistently associated with behavioral changes (Table 4).

Overall, these findings suggest a discrepancy between recognition of acute pain and systematic reassessment throughout the patient's care pathway.

Morphine knowledge

Knowledge of intravenous morphine authorization was correct in 11/39 nurses, 3/17 nursing assistants, and 5/17 physicians (Table 5). Knowledge that morphine should be prioritized for severe pain was correct in 19/39 nurses, 4/17 nursing assistants, and 10/17 physicians.

Table 5
Healthcare professionals' knowledge of morphine use in children

Knowledge item	Nurses (n = 39)	Nursing assistants (n = 17)	Physicians (n = 17)
Intravenous morphine: authorized from birth	11 (28.2)	3 (17.6)	5 (29.4)
Morphine should be prioritized for severe pain	19 (48.7)	4 (23.5)	10 (58.8)
For persistent severe pain, morphine may be repeated every 5 min until adequate analgesia	21 (53.8)	1 (5.9)	11 (64.7)
Oral morphine may be used for severe gingivostomatitis	3 (7.7)	2 (11.8)	3 (17.6)
<i>Values are presented as n (%). Percentages are calculated within each professional category.</i>			

Knowledge of repeated morphine administration every five minutes for persistent severe pain until adequate analgesia was achieved was correct in 21/39 nurses, only 1/17 nursing assistants, and 11/17 physicians.

Knowledge concerning the use of oral morphine in severe gingivostomatitis was particularly poor, with only 3/39 nurses, 2/17 nursing assistants, and 3/17 physicians answering correctly (Table 5).

Overall knowledge of pediatric pain management

Across the 31 knowledge items included in the preliminary Pediatric Pain Management Knowledge Score (PPKMS), 1,167 of 2,263 possible responses were correct, corresponding to an overall aggregate knowledge score of 51.6% (Table 6).

Table 6
Domain-specific Pediatric Pain Management Knowledge Scores (PPKMS)

Knowledge domain	No. of items	Correct responses / possible responses	Aggregate score
EMLA	9	389 / 657	59.2%
MEOPA	11	449 / 803	55.9%
Analgesic pharmacology	7	236 / 511	46.2%
Morphine	4	93 / 292	31.8%
Overall PPKMS	31	1,167 / 2,263	51.6%

Knowledge varied substantially across domains. EMLA-related knowledge was highest overall, with 389 of 657 responses correct (59.2%), followed by MEOPA-related knowledge, with 449 of 803 responses correct (55.9%). Knowledge of analgesic pharmacology was lower, with 236 of 511 responses correct

(46.2%), whereas morphine-related knowledge represented the weakest domain, with only 93 of 292 responses correct (31.8%) (Table 6).

The pattern of knowledge deficits was heterogeneous within each domain. For EMLA, knowledge was particularly limited regarding the duration of analgesic effect after removal, which was correctly identified by only 15.4% of nurses, 35.3% of nursing assistants, and 17.6% of physicians. For MEOPA, knowledge of the minimum age for use and the three-minute pre-procedure inhalation period was limited across professional categories. In analgesic pharmacology, knowledge of the pediatric authorization of oral morphine was particularly poor, with correct responses from only 5.1% of nurses, 11.8% of nursing assistants, and 17.6% of physicians. Morphine-related knowledge was consistently limited across all four assessed items.

These findings indicate that knowledge gaps were not uniform across pediatric pain management. The most pronounced deficit concerned morphine-related knowledge, while EMLA and MEOPA knowledge was relatively better but remained incomplete.

Knowledge according to professional category

Overall aggregate PPKMS scores were relatively similar across professional categories. The overall score was 51.5% among nurses, 49.7% among nursing assistants, and 53.5% among physicians (Supplemental Table 7).

Despite these relatively similar overall scores, domain-specific knowledge profiles differed. Nursing assistants had the highest aggregate EMLA score (66.0%) and a relatively high MEOPA score (57.8%), but lower scores for analgesic pharmacology (36.1%) and particularly morphine-related knowledge (14.7%). Physicians had the highest scores for analgesic pharmacology (53.8%) and morphine-related knowledge (42.6%), whereas nurses showed intermediate performance across most domains (Supplemental Table 7).

Thus, the similarity of overall aggregate knowledge scores masked clinically relevant differences in the distribution of knowledge across domains and professional categories. These findings suggest that educational priorities may need to be tailored according to professional role rather than based solely on an overall knowledge score.

Discussion

Substantial and domain-specific knowledge gaps

The overall PPKMS of 51.6% suggests that, in this sample, knowledge of pediatric pain management was incomplete despite the multidisciplinary workforce being routinely involved in the care of children. This finding is consistent with previous studies reporting persistent deficiencies in pediatric pain knowledge among healthcare professionals, including difficulties related to pain assessment, pharmacological treatment, opioid use, and non-pharmacological approaches [14–18].

The pattern observed in our study is particularly relevant because knowledge deficits were not evenly distributed across the different components of pediatric pain management. EMLA and MEOPA knowledge was relatively better than knowledge of systemic analgesics and morphine, although important gaps remained even within these domains. In particular, several practical aspects of EMLA and MEOPA administration were poorly recognized, including age-specific use, application or inhalation timing, and monitoring requirements. Thus, a relatively higher domain score should not be interpreted as indicating adequate knowledge across all clinically relevant aspects of a treatment.

The most pronounced deficit concerned morphine-related knowledge, with only 31.8% of responses correct.

This observation is consistent with previous research describing persistent misconceptions and knowledge gaps concerning opioid analgesia among healthcare professionals and healthcare students [18–21]. Fear of adverse effects, respiratory depression, and addiction may contribute to conservative opioid use in children. However, our study did not directly assess attitudes or fears regarding opioids, and therefore the mechanisms underlying the observed knowledge deficits cannot be established from our data.

Knowledge does not necessarily translate into practice

Knowledge and reported clinical practice should be considered related but distinct dimensions. In our study, pain assessment was frequently reported at initial presentation and during painful procedures, but appeared less consistently reported at discharge. This pattern suggests incomplete continuity of pain assessment across the child's care pathway.

This finding illustrates the broader evidence-to-practice gap in pediatric pain management. Awareness of the importance of pain assessment does not necessarily result in systematic assessment and reassessment in routine clinical care. Conversely, inconsistent implementation of pain assessment cannot be attributed to insufficient knowledge alone.

Several organizational and contextual factors may contribute to this gap, including workload, time constraints, absence of standardized protocols, variability in professional responsibilities, limited access to validated pain assessment tools, insufficient training, and lack of systematic prompts for reassessment [16, 22, 23]. Previous studies have similarly identified deficiencies in education and training as recurrent barriers to effective pediatric pain management [24–29].

Our findings therefore support a multidimensional interpretation of pediatric pain-management quality. Improving knowledge is necessary, but knowledge acquisition alone is unlikely to guarantee sustained changes in clinical practice. Educational interventions should be combined with organizational measures that facilitate the application of evidence-based recommendations at the point of care.

Interestingly, a recent international multicenter study involving 2,807 healthcare professionals and students also found only moderate knowledge of pediatric pain management and persistent

misconceptions, particularly regarding opioid use [16]. A significant fear regarding the use of opioids in the pediatric population was observed, associated with the belief of a high risk of addiction [30, 31]. This phenomenon has been reported both among students and healthcare professionals and is associated with conservative and insufficient analgesic practices [30, 31]. This broader evidence suggests that the educational gaps identified in our single-center sample may reflect a more general challenge in pediatric pain education rather than an isolated institutional phenomenon.

Strengths and limitations

This study has several strengths. First, it included multiple professional categories involved in pediatric care, allowing assessment of knowledge across a multidisciplinary workforce. Second, the questionnaire explored several clinically relevant components of pediatric pain management rather than focusing exclusively on a single analgesic or professional group. Third, examining knowledge and reported pain-assessment practices as distinct dimensions allowed a more comprehensive description of both factual knowledge and reported clinical practices.

Several limitations should nevertheless be acknowledged. First, the survey was conducted over a short period and may also have been influenced by temporal or seasonal variation in participation or clinical activity. Second, the study was monocentric and involved a relatively small sample, limiting the generalizability of the findings to other institutions and healthcare systems. The response rate and potential non-response bias may also have influenced the results, as professionals with a particular interest in pediatric pain may have been more likely to participate. In addition, the exclusion of seven midwives from the primary analytical population may have reduced the representativeness of the multidisciplinary sample, particularly for maternity and neonatal settings.

Third, the questionnaire was not developed or formally validated as a psychometric instrument. The PPKMS should therefore be regarded as a preliminary aggregate knowledge index rather than a validated individual-level scale. In particular, its reliability, construct validity, and discriminatory properties were not formally assessed.

Fourth, the original individual-level responses were not available for secondary statistical analysis. We were therefore unable to calculate individual PPKMS values, assess their distribution, examine associations between individual knowledge scores and professional characteristics, or perform multivariable analyses to identify independent predictors of knowledge. Statistical analyses were consequently restricted to associations that could be reconstructed from aggregate contingency tables.

Conclusions

This study identified substantial and heterogeneous knowledge gaps in pediatric pain management among multidisciplinary healthcare professionals in a French general hospital. Although overall knowledge scores were relatively similar across professional categories, important differences emerged

across specific knowledge domains. Morphine-related knowledge represented the most pronounced deficit, while EMLA and MEOPA knowledge was relatively better but remained incomplete.

The findings suggest that pediatric pain education should be targeted according to both clinical domain and professional role. However, education alone is unlikely to eliminate the gap between knowledge and practice. Sustainable improvement will probably require the combination of multidisciplinary training, standardized clinical protocols, accessible assessment tools, and systematic integration of pain assessment and reassessment into routine care.

These preliminary findings provide a rationale for larger multicenter studies using validated instruments and individual-level data, as well as prospective interventions evaluating whether improvements in knowledge can translate into measurable improvements in pediatric pain management.

Declarations

Consent for publication :

The author has given his consent for the publication of this study.

Patient and Public Involvement

: None

Patient consent for publication

: Not required

Competing interests :

The author declare no competing interests

PPKMS calculation

aggregate score = total number of correct responses divided by the total number of theoretically possible responses $\times 100$. The PPKMS was calculated at the aggregate level and should not be interpreted as an individually validated psychometric score.

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none

Author Contribution

C.T. made a significant contribution to all the work reported, whether that is in the study design, execution, acquisition of data, analysis, and interpretation, took part in drafting, revising, critically reviewing the article.

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Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information.

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