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Implementation and Evaluation of a Pediatric Pain Education Program for Healthcare Providers in Ghana: A Multidisciplinary Approach

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ABSTRACT

Pediatric pain remains one of the inadequately managed conditions in clinical practice, especially in low-resource settings, due in part to limited training across health professions. Addressing this gap requires a coordinated, multidisciplinary approach to improve pain assessment and management in children. This study aimed to implement and evaluate a multidisciplinary pediatric pain education program to enhance healthcare professionals' (HCPs) knowledge, attitudes, and self-efficacy. A one-group pretest-posttest quasi-experimental design was conducted among HCPs from diverse professional backgrounds at the Kwame Nkrumah University of Science and Technology (KNUST) Hospital. A 45–60-min educational session on pediatric pain assessment and management was delivered to participants. Knowledge and attitudes were assessed using the Pediatric Healthcare Providers' Knowledge and Attitudes Survey Regarding Pain (PHPKASRP), and self-efficacy was assessed using a validated six-item tool. Program acceptability was evaluated using a structured training evaluation form. Quantitative data were analyzed using the Wilcoxon signed-rank test. Open-ended responses were analyzed using content analysis guided by Kirkpatrick's evaluation model. A multidisciplinary group including 10 nurses, 14 pharmacists, and 11 physicians participated in the study. Participants demonstrated statistically significant improvements in knowledge and attitude scores ($z = -5.118$, $p < 0.001$), as well as self-efficacy scores ($z = -4.79$, $p < 0.001$), following the educational program. The standard score for knowledge and attitude improved from 49.54 to 68.63, and self-efficacy scores rose from 59.33 to 86.57. Qualitative feedback revealed high participant satisfaction, perceived relevance of training, and suggestions for improvement. This brief pediatric pain education program significantly improved HCPs' knowledge, attitudes, and self-efficacy in a resource-limited setting. The findings highlight the need for ongoing multidisciplinary pain education and refinement of training content for sustained improvements in pediatric pain care.

1 | Introduction

Pain is defined by the International Association for the Study of Pain (IASP) as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage" [1]. Pain is common to every child and may be experienced from injury, acute illness, or chronic conditions such as sickle cell disease, headaches, or gastrointestinal problems [2]. Acute pain is highly prevalent in children, and approximately 20% of children and adolescents experience chronic pain [3, 4].

Although pain is highly prevalent among children, it remains one of the most underdiagnosed and undertreated conditions [2]. Pain can adversely affect a child's overall well-being by disrupting sleep, limiting participation in daily activities, and negatively influencing mood and behavior [5]. Additionally, inadequate management of pediatric pain can have serious consequences, including increased risks of mortality and morbidity, prolonged hospital stays, delayed healing, and heightened risk of pain hypersensitivity [6].

A major barrier to adequate pediatric pain management is the limited pain-related knowledge among many healthcare professionals (HCPs) [7, 8]. Despite abundant literature on pediatric pain management for HCPs, this knowledge is often not translated into clinical practice [8, 9]. The persistent gap between knowledge and practice has been largely attributed to insufficient education and training across various health disciplines, both at prelicensure and during practice years [7, 8, 10].

Given this, there is a need to promote pediatric pain education across disciplines as part of continuing professional development. Education programs have been shown to improve pain assessment and management competencies among HCPs [11–14]. Effective pain management requires a multidisciplinary approach, where physical therapists, psychologists, medical doctors, nurses, pharmacists, and other healthcare providers work collectively to assess and manage pain [15–17]. Therefore, educational initiatives should target a diverse group of HCPs to enhance pediatric pain care. This study aimed to implement and evaluate a pain education program delivered to a multidisciplinary group of HCPs to improve knowledge, attitudes, and self-efficacy regarding pediatric pain assessment and management.

2 | Methods

2.1 | Study Design

A one-group pretest-posttest quasi-experimental design was employed to implement and evaluate a multidisciplinary pain education program aimed at improving HCPs' knowledge, attitudes, and self-efficacy regarding pain assessment and management. This design was chosen for its feasibility in a resource-limited setting and its suitability for evaluating within-group changes over time. The study employed a multimethod approach, collecting quantitative data through structured questionnaires and qualitative feedback through open-ended responses.

2.2 | Setting

The Kwame Nkrumah University of Science and Technology (KNUST) Hospital in Kumasi, Ghana, was used as the study site. The hospital has a 125-bed capacity and various units including a children's ward with a neonatal unit, adult male and female wards, a public health unit, an infectious disease unit, a maternity, an antenatal care unit, a surgical theater, a medical laboratory, in-patient and out-patient pharmacies, a medical imaging unit, a dental clinic, and an eye clinic. It also offers special outpatient services on designated days for patients with sickle cell disease, asthma, urological problems, diabetes, and hypertension.

The KNUST Hospital was primarily established to cater to the health needs of the university's staff, dependents, and students. However, it has now extended its services to the public and provides health care services to the surrounding communities with a rapidly increasing population.

2.3 | Study Population and Sampling

The target population consisted of HCPs providing direct clinical care, assessment, or support services to pediatric patients at the KNUST Hospital. Participants of the study were selected using the census sampling technique. This technique ensures the inclusion of all participants who fit the inclusion criteria for the study. A total of 35 healthcare providers who provided care to pediatric patients at the KNUST Hospital participated in the study.

2.4 | Inclusion and Exclusion Criteria

Healthcare professionals providing direct clinical care, assessment, or support services to pediatric patients at the time of data collection, including nurses, pharmacists, and physicians, were included. Those on leave or absent due to illness during the study period were excluded.

2.5 | Data Collection

Before data collection, administrative and ethical approvals were obtained. The head of the pediatric ward introduced the researchers to the healthcare staff. Participants were provided with detailed information about the study and gave written informed consent before participation. They were invited to an educational session in the conference room at the Osei Tutu II Medical Complex (OTMC) located on the hospital premises. Pre- and post-intervention surveys were administered to assess pediatric pain knowledge, attitudes, and self-efficacy. Acceptability of the educational program was assessed post-intervention.

Knowledge and attitudes were evaluated using the Pediatric Healthcare Providers' Knowledge and Attitudes Survey Regarding Pain (PHPKASRP), which consists of 41 items in true/false and multiple-choice formats [18]. The instrument was developed in 2014 by revising the Pediatric Nurses' Knowledge and Attitudes Survey Regarding Pain (PNKAS) to reflect the

roles of the various healthcare professionals involved in pediatric pain management [18].

Self-efficacy was measured using a validated six-item tool developed by Chiang et al. [19], with six items rated on a 5-point Likert scale. In this study, the points were labeled as follows: 1 = "Not confident at all," 2 = "Slightly confident," 3 = "Somewhat confident," 4 = "Fairly confident," and 5 = "Extremely confident."

Program acceptability was measured using a modified version of the Iowa ESL (English as a Second Language) Regional Training Evaluation Form, which included both closed-ended and open-ended questions.

2.6 | Educational Program

A pediatrician (CKH) and a pain researcher (AKA) facilitated a single, in-person training session lasting approximately 45–60 min for all participants. The session included a PowerPoint presentation, followed by a brief discussion on the content and a dedicated question-and-answer segment to promote engagement and reflection. The presentation was developed based on the *Assessment* component of the Core Content of the Pediatric Pain PRN Curriculum [20]. Topics covered included the definition of pain, the importance of pain assessment, pain measurement techniques, the use of the OPQRST framework, involvement of parents or caregivers in pain assessment, available assessment tools, recommended frequency of pain assessment, documentation practices, and an overview of both pharmacologic and non-pharmacologic pain management strategies. During the session, participants were given printed copies of the presentation and pictorial representations of pain assessment tools for reference.

2.7 | Theoretical Framework and Study Outcomes

Kirkpatrick's model of evaluation [21, 22] guided the conduct of this study. The model consists of four levels of evaluation: Level 1 (Reaction), Level 2 (Learning), Level 3 (Behavior), and Level 4 (Results) (Kirkpatrick [23]) (Refer to Figure 1). However, this study focused solely on the first three levels. The third level was modified to assess intended behavior change rather than actual implementation of knowledge in practice. The decision to limit the assessment to these two levels was based on the scope of the study, which aimed to evaluate participants' immediate responses to the training and the knowledge and attitude changes resulting from the training. Assessing actual behavior change and long-term results (Level 4) was not feasible within the time frame and resources of this study.

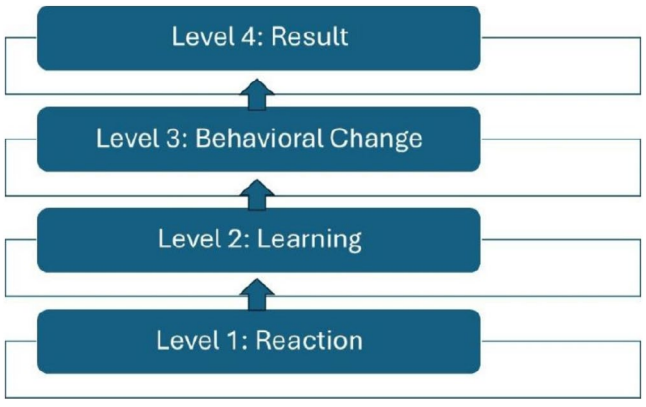

FIGURE 1 | Kirkpatrick model of training evaluation.

For Level 1, immediate feedback was collected from participants through a training evaluation form, focusing on aspects such as the training's relevance, engagement, interaction, content organization, and overall effectiveness of the instructor and learning environment. For Level 2, the assessment of learning was conducted through pre- and post-tests to evaluate changes in participants' knowledge and attitude scores. For Level 3, participants were required to mention ways in which they intended to apply the knowledge gained in clinical practice on the training evaluation form.

2.8 | Data Analysis

Quantitative data were analyzed using IBM SPSS Statistics version 29.0. The data were collated into an Excel file and cleaned to ensure completeness before exporting to SPSS for analysis. Participant demographic characteristics were analyzed and presented using descriptive statistics such as means, standard deviations, frequencies, and percentages. The Wilcoxon signed-rank test was used to evaluate changes in knowledge, attitudes, and self-efficacy before and after the training. The Wilcoxon signed-rank test was appropriate since most items on the PHPKASRP were dichotomous, and the data distribution for the knowledge and attitude scores was not normally distributed, as indicated by a Shapiro–Wilk test. Additionally, the results of a Shapiro–Wilk test indicated that the data distribution for self-efficacy was not normally distributed, both at pre-test ($p = 0.018$) and post-test scores ($p = 0.054$). The mean scores were converted into standard scores using the following formula: the average of the correct score/total score × 100.

With the aid of NVivo software (Version 14.0), open-ended responses on the training evaluation form were content analyzed. The responses were read multiple times for familiarization. The analysis process was primarily deductive using a coding framework developed based on Kirkpatrick's model of evaluation. New codes were also identified and added during the analysis process, leading to the development of new themes. Following the initial coding, the codes were examined for patterns and grouped into meaningful categories. These categories were refined and labeled as sub-themes. Subsequently, the sub-themes were organized into overarching themes, three of which aligned with the first three levels of Kirkpatrick's model. The third level was modified and labeled "Intended Behaviour Change" to reflect participants' stated intentions to apply what they had learned.

2.9 | Quality Assurance: Validity, Reliability, and Trustworthiness

The content validity of the PHPKASRP in the Ghanaian context has been established in a previous study by [18]. In this study,

the internal consistency of the PHPKASRP improved from a Cronbach's alpha of 0.573 at pre-test to 0.734 at post-test.

Chiang et al. [19] established both internal consistency and content validity for the self-efficacy instrument in their study, reporting Cronbach's alpha values of 0.88 and 0.91 at the pre-test and post-test, respectively. The internal consistency in the present study was 0.931 at pre-test and 0.702 at post-test.

Trustworthiness was established by applying the principles of credibility, confirmability, dependability, and transferability [24]. Credibility was ensured by describing participants' feedback and incorporating their own descriptive words in the results to represent their experiences of the training, and by involving two authors in the data analysis. Transferability was ensured by providing a detailed description of the study setting, participants, and educational intervention. Dependability was maintained by clearly documenting how participants were selected, the data collection instruments, and the procedures used for data collection and analysis. Confirmability was ensured by saving the summary report of completed Google Forms on Google Drive, which will be made available upon request for research audit. The original data exported from Google Forms to Excel files is secured in external storage drives and is also available upon request for verification.

2.10 | Ethical Considerations

Before the study's implementation, administrative and ethical approvals were obtained from the hospital management and the Committee for Human Research, Publications and Ethics (CHRPE) of the KNUST School of Medical Sciences. The principles of autonomy, beneficence, non-maleficence, and confidentiality were upheld in this study. Participation in this study was voluntary, and all participants provided written informed consent after they were provided with clear information about the study. As the study involved an educational program, it posed no physical, psychological, or social risk to participants, thereby upholding the principle of non-maleficence. Beneficence was upheld by designing the study to contribute to improved pediatric pain management. Confidentiality was maintained by anonymizing all data; no direct identifiers such as names, contact information, photographs, or ID numbers were collected. All data were securely stored and accessed only by authorized research personnel.

3 | Results

3.1 | Demographic Characteristics of Participants

All 35 participants completed the survey, resulting in a 100% response rate. The mean age of the participants was 30.91 (SD = 7.31), with most of them being female ($n = 21$, 60%). Participants were selected from various units and professional fields, with pharmacists ($n = 14$, 40%) constituting the largest proportion. Most of the participants had an undergraduate degree ($n = 19$, 54.3%) and had worked in the healthcare profession for at most 10 years ($n = 25$, 71.4%). This information is illustrated in Table 1 below.

TABLE 1 | Demographic characteristics of participants.

Variables	Median (SD)	Frequency (%)
Age (years)	30.91 (7.31)	
Gender		
Female		21 (60.0)
Male		14 (40.0)
Professional title		
Pharmacist		14 (40.0)
Physician		11 (31.4)
Nurse		10 (28.6)
Highest educational qualification		
Undergraduate (Diploma, Bachelor's)		19 (54.3)
MBChB		8 (22.9)
Postgraduate (Master's, PhDs, membership & fellowship)		8 (22.8)
Professional working years		
≤ 10 years		25 (71.4)
> 10 years		10 (28.6)
Current unit		
Pharmacy		14 (40.0)
Public Health		7 (20.0)
Pediatrics		4 (11.4)
Obstetrics and Gynecology		4 (11.4)
Emergency		3 (8.6)
Medicine and Surgery		2 (5.8)
Dentistry		1 (2.9)
Working years in the current unit		
Up to 5 years		26 (74.3)
More than 5 years		9 (25.7)

3.2 | Participants' Pediatric Pain Knowledge and Attitudes (PPKA)

Figures 2 and 3 present the percentage of correct responses of all 41 questions on PPKA before and after the training. Overall, there was an increase in the proportion of correct responses for most questions in this category after the training. Particularly, the proportion of correct responses to Question 31 (time to administer analgesics for post-operative pain) increased from 85.7% at pre-test to 100% at post-test. This change was found to be statistically significant based on the results of the Wilcoxon signed-rank test ($z = -2.236$, $p = 0.025$) (Table 2). However, a

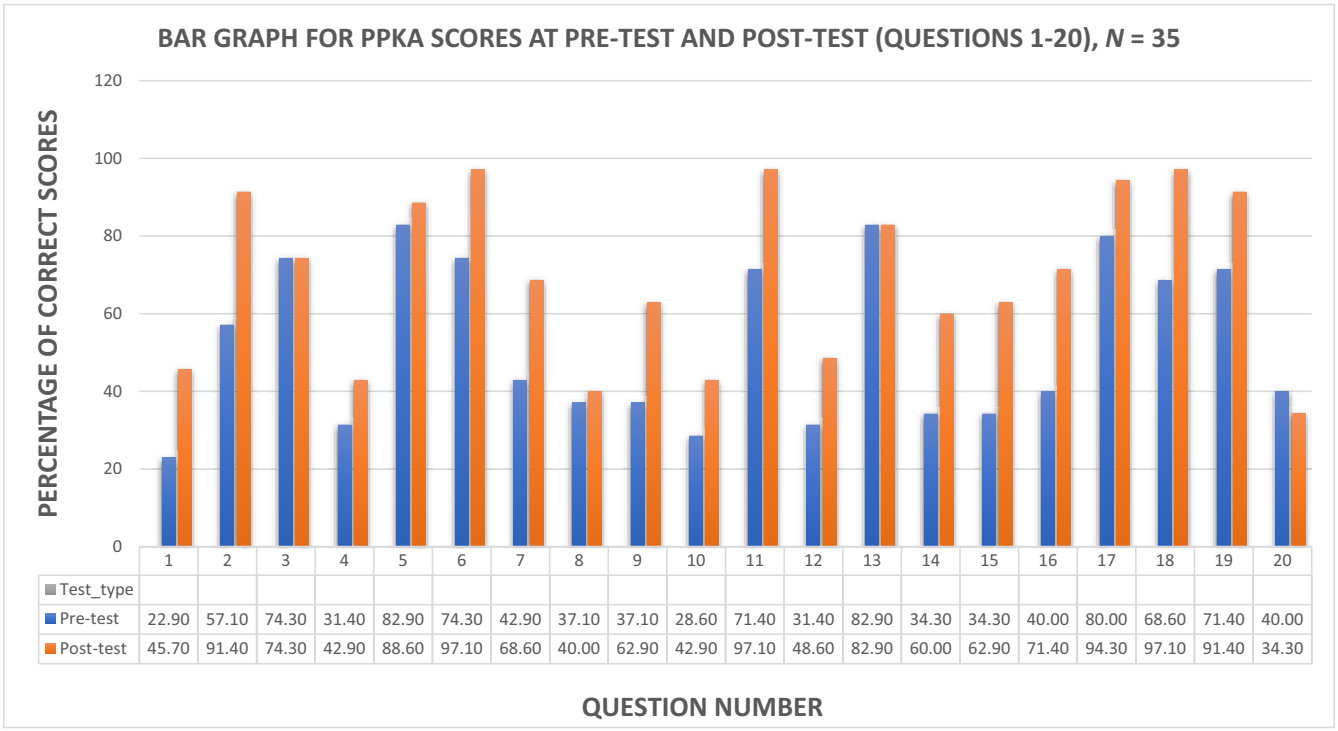

FIGURE 2 | Bar graph for participants' PPKA scores at pre-test and post-test (Questions 1–20). Data source: Author's data collection at KNUST hospital (2022).

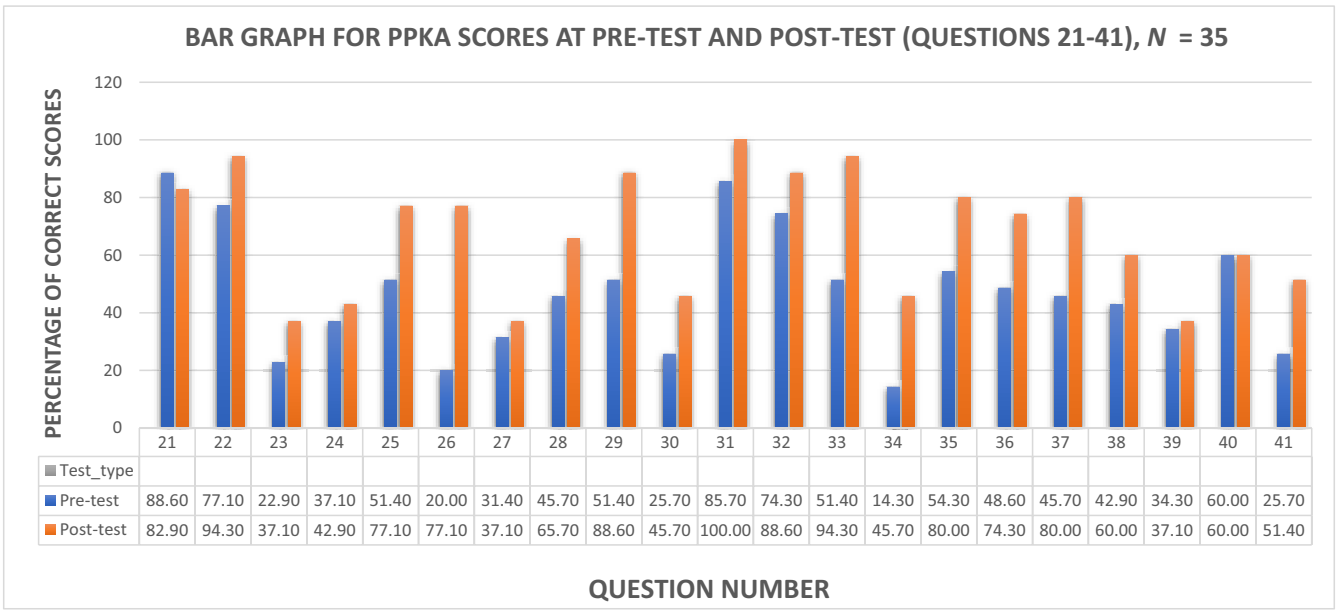

FIGURE 3 | Bar graph for participants' PPKA scores at pre-test and post-test (Questions 21–41). Data source: Author's data collection at KNUST hospital (2022).

decrease in the proportion of correct responses was observed for Question 20 (anxiolytics, sedatives, and barbiturates for pain relief) in the post-test. Additionally, the proportion of correct responses for Questions 3 (Whether distraction from pain indicates absence of severe pain in pediatric patients), 13 (Opioids for pain relief in adolescents with a history of substance abuse), and 40 (numerical rating of pain severity) remained the same at both the pre-test and post-test. The total standard score increased from 49.54 at the pre-test to 68.63 at the post-test. The Wilcoxon signed-rank test indicated that this difference was statistically significant ($z = -5.118$, $p < 0.001$) (Table 2). See Table S1 for item-level details, including question text, corresponding correct response frequencies, and percentages.

Profession-specific analyses were conducted to explore how the intervention influenced knowledge and attitudes across nurses, pharmacists, and physicians. These results are presented in Tables S2–S7.

TABLE 2 | Effect of the training on participants' pediatric pain knowledge and attitudes ($n = 35$).

Questions (Answer)	Pre-test, M(SD)	Post-test, M(SD)	*Z*	*p*
1. Observable changes in vital signs must be relied upon to verify a child's/adolescent's statement that he/she has severe pain.	0.23 (0.426)	0.46 (0.505)	−2.530	0.011*
2. Because their nervous system is underdeveloped, children under 2 years of age have decreased pain sensitivity and limited memory of painful experiences.	0.57 (0.502)	0.91 (0.284)	−3.464	< 0.001*
3. Pediatric patients (infants, children, adolescents) who can be distracted from pain usually do not have severe pain.	0.74 (0.443)	0.74 (0.443)	0.000	> 0.999
4. The usual duration of analgesia of morphine IV is 4–5 h.	0.31 (0.471)	0.42 (0.502)	−1.155	0.248
5. Comparable stimuli in different people produce the same intensity of pain.	0.83 (0.382)	0.89 (0.323)	−1.000	0.317
6. Children who will require repeated painful procedures (e.g., daily blood draws), should receive maximum treatment for the pain and anxiety of the first procedure to minimize the development of anticipatory anxiety before subsequent procedures.	0.74 (0.443)	0.97 (0.169)	−2.828	0.005*
7. Respiratory depression rarely occurs in children/adolescents who have been receiving stable doses of opioids over a period of months.	0.43 (0.502)	0.69 (0.471)	−2.496	0.013*
8. Infants/children/adolescents may sleep in spite of severe pain.	0.37 (0.490)	0.40 (0.497)	−3.780	0.705
9. Ibuprofen and other nonsteroidal anti-inflammatory agents are NOT effective analgesics for pain from bone metastases.	0.37 (0.490)	0.63 (0.490)	−2.324	0.020*
10. Evidence-based non-drug interventions are very effective for mild–moderate pain control but are rarely helpful for more severe pain.	0.29 (0.458)	0.43 (0.502)	−1.890	0.059
11. Combining analgesics (e.g., using acetaminophen, topical anesthetics) and non-drug therapies (e.g., sucrose, non-nutritive sucking) that work by different mechanisms may result in better pain control with fewer side effects than using a single analgesic agent.	0.71 (0.458)	0.97 (0.169)	−3.000	0.003*
12. Benzodiazepines do not reliably potentiate the analgesia of opioids unless the pain is related to muscle spasms.	0.31 (0.471)	0.49 (0.507)	−1.604	0.109
13. Parents should not be present during painful procedures.	0.83 (0.382)	0.83 (0.382)	0.000	> 0.999
14. Adolescents with a history of substance abuse should not be given opioids for pain because they are at high risk for repeated addiction.	0.34 (0.482)	0.60 (0.497)	−3.000	0.003*
15. Beyond a certain dosage of morphine, increases in dosage will NOT provide increased pain relief.	0.34 (0.482)	0.63 (0.490)	−2.887	0.004*
16. Young infants less than 6 months of age cannot tolerate opioids for pain relief.	0.40 (0.497)	0.71 (0.458)	−3.317	< 0.001*
17. Spiritual beliefs may lead a child/adolescent to think that pain and suffering are necessary.	0.80 (0.406)	0.94 (0.236)	−1.890	0.059
18. The child/adolescent with pain should be encouraged to endure as much pain as possible before resorting to an opioid for pain relief.	0.69 (0.471)	0.97 (0.169)	−3.162	< 0.002*
19. Most children as young as 4 years of age can reliably report pain intensity using a developmentally appropriate self-report tool.	0.71 (0.458)	0.91 (0.284)	−2.333	0.020*

(Continues)

TABLE 2 | (Continued)

Questions (Answer)	Pre-test, M(SD)	Post-test, M(SD)	*Z*	*p*
20. Anxiolytics, sedatives, and barbiturates are appropriate medications for the relief of pain during painful procedures.	0.40 (0.497)	0.34 (0.482)	−0.632	0.527
21. After the initial dose of opioid analgesic is given, subsequent doses should be adjusted based on the individual patient's response.	0.89 (0.323)	0.83 (0.382)	−0.816	0.414
22. The child/adolescent should be advised to use non-drug techniques alone rather than concurrently with pain medications.	0.77 (0.426)	0.94 (0.236)	−2.121	0.034*
23. Giving children/adolescents sterile water by injection (placebo) is often a useful test to determine if the pain is real.	0.23 (0.426)	0.37 (0.490)	−1.667	0.096
24. Sedation always precedes opioid related respiratory depression.	0.37 (0.490)	0.43 (0.502)	−0.707	0.480
25. Opioid/narcotic addiction is defined as a chronic neurobiological disease, characterized by impaired control over drug use, compulsive use, continued use despite harm, and craving. It may occur with or without the physiological changes of tolerance to analgesia and physical dependence (withdrawal). Given this information, all children/adolescents whose pain have been treated with opioids for longer than a month are addicted to opioids.	0.51 (0.507)	0.77 (0.426)	−2.714	0.007*
26. The recommended route of administration of opioid analgesics to children with prolonged cancer-related pain is:	0.20 (0.406)	0.77 (0.426)	−4.472	< 0.001*
27. The usual time to peak effects for traditional analgesics acetaminophen, non-steroidal anti-inflammatory drugs, and opioids given orally is:	0.31 (0.471)	0.37 (0.490)	−0.707	0.480
28. The recommended route administration of opioid analgesics to children with brief, severe pain of sudden onset, e.g., trauma or postoperative pain, is:	0.46 (0.505)	0.66 (0.482)	−1.807	0.071
29. Which of the following analgesic medications is considered the drug of choice for the treatment of prolonged moderate to severe pain for children with cancer?	0.51 (0.507)	0.89 (0.323)	−3.357	< 0.001*
30. Which of the following IV morphine doses is approximately equivalent to 15 mg of oral morphine?	0.26 (0.443)	0.46 (0.505)	−1.807	0.071
31. Analgesics for post-operative pain should initially be given:	0.86 (0.355)	1.00 (0.000)	−2.236	0.025*
32. Analgesia for chronic cancer pain should be given:	0.74 (0.443)	0.89 (0.323)	−1.890	0.059
33. The most likely reason a child/adolescent with pain would request increased doses of pain medication is:	0.51 (0.507)	0.94 (0.236)	−3.638	< 0.001*
34. Which of the following drugs are potentially useful for treatment of children's cancer pain	0.14 (0.355)	0.46 (0.505)	−2.840	0.005*
35. The most accurate judge of the intensity of the child's/adolescent's pain is the:	0.54 (0.505)	0.80 (0.406)	−2.714	0.007*
36. Which of the following describes the best approach for cultural considerations in caring for a child/adolescent in pain?	0.49 (0.507)	0.74 (0.443)	−3.000	0.003*
37. Children generally over report their pain.	0.46 (0.505)	0.80 (0.406)	−3.207	< 0.001
38. On the patient's record you must mark his pain on the scale below. Choose the number that represents your assessment of Andrew's pain.	0.43 (0.502)	0.60 (0.497)	−1.897	0.058

(Continues)

TABLE 2 | (Continued)

Questions (Answer)	Pre-test, M(SD)	Post-test, M(SD)	*Z*	*p*
39. Your assessment, above, is made 2 h after he received morphine 2 mg IV. After he received the morphine, his pain ratings every half-hour ranged from 6 to 8 and he had no clinically significant respiratory depression, sedation, or other untoward side effects. He has identified 2 as an acceptable level of pain relief. His physician's order for analgesia is "morphine IV 1–3 mg q1h PRN pain relief." Check the action you will take at this time.	0.34 (0.482)	0.37 (0.490)	−0.258	0.796
40. Select the number that represents your assessment of Robert's pain:	0.60 (0.497)	0.60 (0.497)	0.000	> 0.999
41. Your assessment, above, is made 2 h after he received morphine 2 mg IV. After he received the morphine, his pain ratings every half-hour ranged from 6 to 8 and he had no clinically significant respiratory depression, sedation, or other untoward side effects. He has identified 2 as an acceptable level of pain relief. His order for analgesia is "morphine IV 1–3 mg q1h PRN pain relief." Check the action you will take at this time:	0.26 (0.443)	0.51 (0.507)	−2.324	0.020*
Total score	20.31 (4.450)	28.14 (5.050)	−5.118	< 0.001
Standard score	49.54	68.63		

*Statistically significant at p value < 0.005.

Nurses performed well at the pre-test and post-test on Questions 6 (understanding that children who require repeated painful procedures should receive maximum treatment) and 13 (recognizing that parents should not be excluded during painful procedures), with 100% answering correctly at both time points. Their performance also improved significantly on Question 26 (identifying the recommended route for administering opioids for prolonged cancer pain), increasing from 30.0% to 90.0% (z = −2.449, p = 0.014); Question 29 (identifying morphine as the drug of choice for moderate to severe pain), rising from 50.0% to 100.0% (z = −2.236, p = 0.025); and Question 17 (acknowledging the influence of spiritual beliefs on pain perception), which improved from 50.0% to 90.0% (z = −2.000, p = 0.046). However, nurses performed poorly on several pharmacology-related questions both before and after the training. For instance, correct responses on Question 4 (identifying the usual duration of IV morphine) and Question 30 (calculating the IV morphine dose equivalent to 15 mg oral morphine) increased slightly from 10% to 20% and 40% to 50%, respectively. Performance declined on Question 20 (recognizing that anxiolytics, sedatives, and barbiturates are ineffective analgesics), where correct responses dropped from 30% to 20% post-training. Additionally, correct response rates for Question 24 (understanding that sedation precedes respiratory depression) and Question 27 (identifying the time to peak effect of oral analgesics) remained unchanged at 40% at both time points (Refer to Tables S2 and S3).

Pharmacists performed well on Question 31 (analgesics for postoperative pain should be given on a fixed schedule) and Question 35 (the child is the most accurate judge of their pain), with post-test scores of 100.0% (n = 14) and 92.9% (n = 13), respectively. Additionally, they demonstrated statistically significant improvements on Question 2 (children under 2 do not have decreased pain sensitivity), improving from 50.0% (n = 7) to 100.0% (n = 14) (z = −2.646, p = 0.008); Question 11 (combining analgesics with non-drug therapies), which increased from 57.1% (n = 8) to 92.9% (n = 13) (z = −2.236, p = 0.025); and Question 26 (recommended route of opioid administration for prolonged cancer pain), which rose from 7.1% (n = 1) to 64.3% (n = 9) (z = −2.828, p = 0.005).

However, their performance remained low on some questions, with a consistent proportion of correct scores at pre-test and post-test. For instance, only 21.4% (n = 3) correctly identified the IV morphine dose equivalent to 15 mg of oral morphine (Question 30) at both time points. Less than half were able to represent the child's pain level on the numerical scale in Question 38, with 42.9% (n = 6) correct at both time points. Furthermore, performance declined after training on Question 39 (clinical decision after suboptimal pain relief), decreasing from 42.9% (n = 6) to 21.4% (n = 3); Question 8 (recognizing that children may sleep despite pain), which dropped from 50.0% (n = 7) to 35.7% (n = 5); and Question 27 (time to peak effect of oral analgesics), which declined from 21.4% (n = 3) to 7.1% (n = 1). Furthermore, they did not perform well on Question 20 (recognizing that anxiolytics, sedatives, and barbiturates are ineffective analgesics) at pre-test and post-test (Refer to Tables S4 and S5).

Physicians performed well on Question 19 (most children as young as 4 years can reliably report pain intensity) and Question 21 (opioid doses should be adjusted based on individual response), with 100.0% (n = 11) correct at both time points. They demonstrated significant improvements on several items closely related to their prescribing and clinical decision-making roles. These included Question 2 (pain sensitivity in children under 2), which increased from 54.5% (n = 6) to 90.9% (n = 10) (z = −2.000, p = 0.046); Question 7 (opioid tolerance and respiratory depression), from 54.5% (n = 6) to 90.9% (n = 10) (z = −2.000, p = 0.046); and Question 26 (recommended opioid route for prolonged cancer pain),

which improved from 27.3% ($n=3$) to 81.8% ($n=9$) ($z=-2.449$, $p=0.014$). They also showed significant gains on Question 30 (IV morphine equivalence), increasing from 18.2% ($n=2$) to 72.7% ($n=8$) ($z=-2.121$, $p=0.034$), and Question 34 (selection of appropriate analgesics for cancer pain), rising from 9.1% ($n=1$) to 72.7% ($n=8$) ($z=-2.646$, $p=0.008$).

Despite these improvements, post-test performance remained moderate on Question 8 (recognizing that children may sleep despite pain), with only 54.5% ($n=6$) answering correctly, though this was a significant increase from baseline ($z=-2.000$, $p=0.046$). Decision-making questions such as Question 39 and Question 41, involving appropriate clinical action after suboptimal pain relief, reached 72.7% ($n=8$) and 63.6% ($n=7$) accuracy post-training, respectively (Refer to Tables S5 and S6).

3.3 | Participants' Self-Efficacy in Pediatric Pain Assessment and Management

Tables 3 and 4 present participants' overall responses to the items on the Self-efficacy tool and the changes before and after the training. The findings indicate a general increase in self-efficacy of participants after the training session. A statistically significant increase ($z=-4.396$, $p<0.001$) was observed in participants' confidence regarding interprofessional collaboration. The proportion of participants who rated themselves as extremely confident in response to the question on working together with the medical team to relieve children's pain increased from 20.0% ($n=7$) at pre-test to 68.6% ($n=20$) at post-test. Moreover, the total standard score for self-efficacy at the pre-test was 59.33, which increased to 86.57, indicating a significant improvement in participants' self-efficacy after the training ($z=-4.79$, $p<0.001$).

3.4 | Participants' Evaluation of the Pediatric Pain Assessment Training Program

Table 5 presents the results of the participants' evaluation of the training program. These responses were taken after the training program.

The majority of the participants ($n=28$, 80%) strongly agreed that the topics covered were relevant. The same results were obtained with regard to organization and coherence. Additionally, about 74 ($n=26$, 74.3%) strongly agreed that the experience was useful in their work. Furthermore, 60% ($n=21$) of the participants strongly agreed that the trainers demonstrated expertise in the training topics. Similarly, most of the participants ($n=23$, 65.7%) strongly agreed that the training objectives were achieved. Over half of the participants ($n=19$, 54.3%) also strongly agreed that the allotted training time was sufficient. The details of this evaluation are presented in Table 5 below.

3.5 | Response to Open-Ended Questions on Training Evaluation

An analysis of the open-ended responses from the training evaluation identified four main themes and three sub-themes. The main themes include: Reaction, Learning, Intended Behavior

TABLE 3 | Participants' self-efficacy in pediatric pain assessment and management.

	Pre-test					Post-test				
	1	2	3	4	5	1	2	3	4	5
Confidence areas	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)	f (%)
1. How confident are you: that you could assess children's pain across developmental stages	4 (11.4)	19 (54.3)	6 (17.1)	4 (11.4)	2 (5.7)	—	2 (5.7)	6 (17.1)	17 (48.6)	10 (28.6)
2. How confident are you: that you could choose appropriate pain assessment methods	5 (14.3)	9 (25.7)	13 (37.1)	5 (14.3)	3 (8.6)	1 (2.9)	—	3 (8.6)	18 (51.4)	13 (37.1)
3. How confident are you: that you could use the pediatric pain assessment tool for your patients?	4 (11.4)	8 (22.9)	17 (48.6)	2 (5.7)	4 (11.4)	—	—	2 (5.7)	17 (48.6)	16 (45.7)
4. How confident are you: of your ability to give the correct pain controller to patients?	—	13 (37.1)	14 (40.0)	3 (8.6)	5 (14.3)	1 (2.9)	2 (5.7)	—	16 (45.7)	16 (45.7)
5. How confident are you: of your ability to provide nonpharmacological pain management to children?	—	6 (17.1)	19 (54.3)	5 (14.3)	5 (14.3)	—	—	2 (5.7)	15 (42.9)	18 (51.4)
6. How confident are you: of your ability to cooperate with the medical team to relieve children's pain?	—	2 (5.7)	21 (60.0)	5 (14.3)	7 (20.0)	—	—	1 (2.9)	10 (28.6)	24 (68.6)

TABLE 4 | Effect of training on self-efficacy in pediatric pain assessment and management.

Questions	Pre-test, M(SD)	Post-test, M(SD)	*z*	*p*
1. How confident are you: that you could assess children's pain across developmental stages	2.46 (1.039)	4.00 (0.840)	−4.752	<0.001*
2. How confident are you: that you could choose appropriate pain assessment methods	2.77 (1.140)	4.20 (0.833)	−4.316	<0.001
3. How confident are you: that you could use the pediatric pain assessment tool for your patients?	2.83 (1.098)	4.40 (0.604)	−4.862	<0.001
4. How confident are you: of your ability to give the correct pain controller to patients?	3.00 (1.029)	4.26 (0.950)	−4.056	<0.001
5. How confident are you: of your ability to provide nonpharmacological pain management to children?	3.26 (0.919)	4.46 (0.611)	−4.556	<0.001
6. How confident are you: of your ability to cooperate with the medical team to relieve children's pain?	3.49 (0.887)	4.66 (0.539)	−4.396	<0.001
Total score	17.80 (5.29)	25.97 (2.833)	−4.794	<0.001
Standard score	59.33	86.57		

*Statistically significant at p value < 0.005.

TABLE 5 | Participants' evaluation of the pediatric pain educational/training program ($n = 35$).

Variables	SD (1)	D (2)	N (3)	A (4)	SA (5)
Evaluation questions	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**	***n* (%)**
1. The objectives of the training were clearly defined	—	—	3 (8.6)	16 (45.7)	16 (45.7)
2. Participation and interaction were encouraged	—	—	—	21 (60.0)	14 (40.0)
3. The topics covered were relevant to me			1 (2.9)	6 (17.1)	28 (80.0)
4. The content was organized and easy to follow	—	—	—	7 (20.0)	28 (80.0)
5. The materials distributed were helpful	—	—	1 (2.9)	14 (40.0)	20 (57.1)
6. This training experience will be useful in my work	—	—	—	9 (25.7)	26 (74.3)
7. There trainer(s) was/were knowledgeable about the training topics	—	—	—	14 (40.0)	21 (60.0)
8. The trainer was well prepared	—	—	—	13 (37.1)	22 (62.9)
9. The training objectives were met	—	—	—	12 (34.3)	23 (65.7)
10. The time allotted for the training was sufficient	—	1 (2.9)	—	15 (42.9)	19 (54.3)
11. The meeting room and facilities were adequate and comfortable	—	1 (2.9)	—	20 (57.1)	14 (40.0)

Change, and Future Training Needs. Below is a detailed description of these themes, along with their corresponding sub-themes:

3.6 | Reaction

This theme captures participants' immediate responses to the training, reflecting their perceptions of its relevance, satisfaction, and suggestions for improvement.

3.6.1 | Relevance of Training

Some ($n = 3$, 8.6%) participants noted that the knowledge acquired from the program was relevant to clinical practice and could improve patient care.

3.6.2 | Satisfaction

Feedback from participants indicates a high level of satisfaction with the program. Two participants ($n = 2$, 5.7%) expressed overall satisfaction with all aspects of the program, with one describing it as "perfect." The majority of participants ($n = 9$, 25.7%) provided positive feedback regarding the facilitators, praising their presentation style, engagement, and clarity in explaining concepts. They characterized the facilitators as "knowledgeable," "good," "vocal," "audible," "lively," and "charismatic." Participants also noted that the sessions were interactive, and they appreciated how the facilitators made concepts easy to understand.

Additionally, five participants (14.3%) valued the use of practical examples and illustrations with pain assessment tools.

Others ($n = 6$, 17.1%) mentioned that the distribution of teaching and learning materials during the training session enhanced their understanding of the content. One nurse (2.9%) expressed satisfaction with the use of the QUEST approach to assess pain.

3.6.3 | Suggestions for Improvement

While some participants ($n = 3$, 8.6%) felt that everything about the program was on point, others suggested that certain areas could be improved. Most ($n = 4$, 11.4%) of them mentioned that the meeting place was too small. Others participants suggested that: images should be added to the teaching materials ($n = 2$, 5.3%), the content of the presentation should reflect more of what is in the evaluation tool ($n = 2$, 5.3%), teaching/learning materials should be shared after training for future reference ($n = 2$, 5.3%), and participants should be given earlier notice about the workshop ($n = 2$, 5.3%). Two (5.3%) participants, who were pharmacists, suggested that the training content should elaborate on pharmacological pain management, and one nurse mentioned pain assessment. Participants had mixed opinions on time allocation, as some felt it was more than enough ($n = 1$, 2.9%), while others felt the time allocated for completing the surveys was too short ($n = 2$, 5.3%). Finally, one participant (2.9%) suggested that there should be more interaction and participation.

3.7 | Learning

Feedback from participants ($n = 4$, 11.4%) indicated that the training was informative and beneficial in enhancing their knowledge of pediatric pain management.

3.8 | Intended Behavior Change

Participants shared various strategies for applying the knowledge gained from the training to improve pediatric pain assessment and management. The majority of participants ($n = 6$, 17.14%) expressed their commitment to enhancing pain assessment by using appropriate pain assessment methods, increasing the use of pain assessment tools, and assessing pain more frequently. One participant was committed to taking patients' verbalizations of pain more seriously ($n = 1$, 2.9%).

Additionally, participants emphasized their intention to adopt multidimensional pain management strategies. Some indicated that they would administer analgesics during painful procedures ($n = 1$, 2.9%) and improve the analgesic regimens for pediatric patients ($n = 2$, 5.3%). Two physicians (5.3%) mentioned increasing their use of non-drug techniques to manage pain more effectively.

Furthermore, some participants ($n = 2$, 5.3%) expressed a commitment to individualized pain management, ensuring that interventions are tailored to each child's specific needs. One (2.9%) participant noted that they would be more assertive, while another (2.9%) planned to share the knowledge they acquired with other healthcare professionals.

3.9 | Future Training Needs

Participants expressed interest in a variety of topics for future training programs, with the most frequently mentioned area being pharmacological pain management in children ($n = 5$, 14.3%). Specific subjects under this category included: medication dose calculation (suggested by pharmacists), reconstitution of medications (suggested by pharmacists), medication administration (suggested by a physician), drug monitoring parameters, classical regimen and drugs used in the management of pain in children (suggested by a pharmacist), and discussion on more medication-related issues in pediatric pain management (suggested by a pharmacist).

Additionally, participants suggested topics related to pain assessment and non-pharmacological management ($n = 5$, 14.3%). These topics included: the use of Face, Legs, Activity, Cry and Consolability (FLACC) scale (suggested by a nurse), self-control tools for pain management (suggested by a nurse), breakthrough pain management (suggested by a nurse), art and coloring for pain management.

Two (5.3%) participants expressed interest in the management of cancer pain (suggested by pharmacists), while one participant (2.9%) mentioned the management of children experiencing withdrawal symptoms (suggested by a pharmacist). Other topics of interest included management of seizures (suggested by a physician) ($n = 1$, 2.9%), the use of antibiotics in children (suggested by pharmacists) ($n = 1$, 2.9%), and pediatric emergencies (suggested by a physician) ($n = 1$, 2.9%).

4 | Discussion

This study aimed to implement an education program to improve HCPs' knowledge and self-efficacy in pediatric pain assessment and management, and also to promote a multidisciplinary approach to pain care. Given the complex nature of pediatric pain, which demands collaboration across disciplines, educational interventions should target a wide range of HCPs [8, 16, 25, 26]. The findings of this study demonstrate that a multidisciplinary pain education program can enhance HCPs' knowledge, attitudes, and self-efficacy in pediatric pain assessment and management, highlighting the importance of targeted educational interventions in improving HCPs' competencies in pain care and patient outcomes [11–13, 27, 28].

The improvement in pediatric pain knowledge and attitudes observed in this study is consistent with findings of previous studies in which pain education was delivered to a multidisciplinary audience. For instance, Lalloo et al. [28] reported improvement in knowledge following the delivery of pediatric pain core competency curricula to an interprofessional group of HCPs using the Project ECHO model. Likewise, another study evaluating a five-week interprofessional education program in pediatric pain care demonstrated significant improvements in pain-related knowledge and attitude among healthcare trainees from multiple professions [27]. The current study's findings can be linked to the enhanced awareness resulting from the educational intervention and the participants' readiness to accept the information offered to them during the educational intervention. Although

this study did not assess whether knowledge gains translated into clinical practice, there is a potential for the observed knowledge and attitude improvement to reflect in the standards of pain assessment and management across various healthcare disciplines, as well as clients' satisfaction with care.

Although overall improvements in knowledge and attitudes were observed, not all items showed positive change. The proportion of correct responses for Question 20 decreased at the post-test. However, profession-specific analyses indicated that physicians performed relatively well on this item with an increase in correct scores at post-test, though this change was not statistically significant. This item was about the appropriateness of using anxiolytics, sedatives, and barbiturates for pain relief during painful procedures. The decline in correct responses may indicate lingering misconceptions about the role of these medications, possibly due to confusion between their use for sedation versus analgesia. This highlights the need for clearer emphasis during training on the distinction between sedation and effective pain relief. Additionally, the proportion of overall correct responses for Questions 3, 13, and 40 remained unchanged from pre- to post-test, and changes observed in profession-specific analyses were also not statistically significant. These items assessed beliefs about observable pain behaviors (e.g., whether distraction indicates less pain), the presence of parents during painful procedures, and the interpretation of pain using a numeric rating scale in a case scenario. While these items did not show statistically significant changes across or within professions, the response patterns still provide useful insight. For example, nurses demonstrated consistently high performance on Question 13, reflecting a strong understanding of family involvement in pain care, whereas pharmacists and physicians showed more moderate scores. On Question 3, which addressed the misconception that distraction rules out severe pain, nurses maintained 80% accuracy, pharmacists showed a slight decline, and physicians showed modest improvement. Question 40, involving a numeric rating of pain based on a case scenario, had the lowest and most variable performance across groups. These findings suggest that HCPs may benefit from more interactive or case-based teaching strategies to strengthen their understanding of behavioral cues in pain assessment and improve the effective use of pain assessment tools.

Profession-specific analyses revealed distinct patterns of performance that aligned with the typical clinical responsibilities of each professional group. Physicians, whose roles often center around diagnosis and prescribing, demonstrated significant improvement in knowledge of pharmacological management, including opioid dosing, equivalence, and appropriate drug selection for cancer pain. However, gaps remained in behavioral assessment, particularly in recognizing that children may sleep despite experiencing pain. This suggests the need for enhanced training in nonverbal and developmental cues of pediatric pain expression. Pharmacists performed well on items involving drug safety and the integration of pharmacological and non-drug strategies. Their improvement on items such as combining analgesics with non-drug therapies and selecting the appropriate route for opioid administration highlights their contribution to medication optimization in pain management. Nonetheless, persistent low scores on scenario-based dosing and use of pain assessment tools suggest that pharmacists may benefit from greater involvement in multidisciplinary case-based training to guide pharmacologic decisions. Nurses, who play a key role in frontline pain monitoring and patient advocacy, demonstrated strong baseline and post-training knowledge in non-pharmacological strategies and family-centred care. Significant improvements were observed in their understanding of appropriate opioid use and spiritual influences on pain perception. However, consistent underperformance on items related to morphine pharmacokinetics and analgesic monitoring suggests the need to strengthen nursing pharmacology education within pain curricula. These variations support the value of tailored multidisciplinary education that both leverages and strengthens the unique contributions of each profession in pediatric pain care.

Self-efficacy refers to the belief in one's capability to accomplish a specific task [29]. It reflects an individual's confidence in their ability to exert control over their own motivation, behavior, and social environment [30]. Findings from the present study showed a significant improvement in participants' self-efficacy following the education program. A similar outcome was observed in the study by Lalloo et al. [28], in which healthcare providers reported increased confidence in managing pediatric pain after participating in a pediatric pain core competency program. Additionally, Chiang et al. [19] reported a comparable improvement in self-efficacy among nurses, where self-efficacy scores increased from 73.37% to 87.07% following a pain education intervention. While that study focused solely on nurses, the consistent improvement across different professional groups reinforces the value of pain education in enhancing self-efficacy for pediatric pain management. Furthermore, a noteworthy finding regarding self-efficacy was the improvement in participants' confidence to collaborate with other HCPs in pain management. Although the present study was primarily didactic, this finding suggests that even brief educational interventions, particularly those delivered to a multidisciplinary audience, can promote interprofessional readiness and collaboration.

Evaluating a program helps determine its success in achieving objectives, identifying areas for development, and ensuring that it meets the needs of the target audience. In this study, qualitative feedback was analyzed and organized according to the first three levels of the Kirkpatrick model: Reaction, Learning, and Behavior Change, to provide a structured interpretation of participants' experiences. Participants provided satisfactory feedback across all three levels. At the Reaction level, participants described the training as relevant to their clinical practice and patient care responsibilities. Their responses also reflected satisfaction with the organization and coordination of the training as well as the trainer's expertise and behavior. These positive reactions suggest that the training was conducted within a supportive and engaging learning environment, which appeared to contribute to the program's overall acceptability. At the Learning level, responses indicated that participants perceived an improvement in their knowledge and understanding of pediatric pain assessment and management. At the Behavior Change level, participants reported intentions to apply specific strategies and behaviors gained from the training in their clinical settings. This commitment to translating learning into practice is encouraging and reflects the perceived practical value of the program. The fact that participants were already identifying concrete actions they intended to adopt suggests early indicators of behavior

change, although long-term follow-up would be needed to assess sustained impact.

Despite the positive responses, they suggested ways to improve the program. The majority of the concerns were related to the meeting environment, while others focused on improving the training content by adding visuals, aligning teaching materials with assessment tools, and elaborating on pharmacological pain management.

Participants also identified specific learning needs that aligned with the clinical responsibilities of their respective professions. Pharmacists expressed interest in more detailed pharmacological content, including medication dosing, drug reconstitution, and monitoring parameters, which highlights their role in optimizing pharmacological management of pediatric pain. Nurses, on the other hand, mentioned non-drug pain management strategies such as art and the use of the FLACC scale for pain assessment, reflecting their frontline role in assessing pain and providing holistic care. Physicians requested additional training on clinical scenarios involving seizures and pediatric emergencies, as well as more focus on medication administration. These responses highlight the importance of tailoring multidisciplinary training programs not only to shared competencies but also to the specific scopes of practice and learning priorities of each profession, to promote collaborative and effective pediatric pain management. The findings of this study provide a foundation for future educational interventions on pediatric pain management.

5 | Limitations

Despite the promising outcomes, this study has some limitations. First, the training was limited to nurses, physicians, and pharmacists, excluding other members of the multidisciplinary team such as psychologists, physiotherapists, and social workers. Additionally, the study was conducted in a single hospital in Ghana, which may limit the generalizability of the findings to other healthcare settings or regions with different resources, patient populations, or institutional practices. Furthermore, the participants were not randomized, and there was no control group. The study also relied on self-reported measures, which may be subject to social desirability bias. Lastly, the short follow-up period did not allow for the evaluation of knowledge retention or the long-term effects of the training. Future research should include broader multidisciplinary participation, use objective clinical indicators, assess longer-term impact, and explore strategies for institutionalizing pain education programs in varied healthcare settings.

6 | Conclusion

This study suggests that a structured multidisciplinary pain education program can improve HCPs' competence and confidence in pediatric pain assessment and management. Ongoing training and curriculum enhancements are recommended to address persistent knowledge gaps and ensure continued improvement in pain care practices. Expanding such programs to other institutions and including a wide range of professionals could promote sustainable improvements in pediatric pain care. Additionally, future interventions should incorporate more collaborative and case-based learning activities to strengthen interprofessional collaboration.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that supports the findings of this study are available in the supporting information of this article.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information. **Table S1:** Participants' Pediatric Pain Knowledge and Attitude Scores at Pre-test and Post-test ($n = 35$). **Table S2:** Nurses' Pediatric Pain Knowledge and Attitude Scores at Pre-test and Post-test ($n = 10$). **Table S3:** Effect of the Training on Nurses' Pediatric Pain Knowledge and Attitudes ($n = 10$). **Table S4:** Pharmacists' Pediatric Pain Knowledge and Attitude Scores at Pre-test and Post-test ($n = 14$). **Table S5:** Effect of the Training on Pharmacists' Pediatric Pain Knowledge and Attitudes ($n = 14$). **Table S6:** Physicians' Pediatric Pain Knowledge and Attitude Scores at Pre-test and Post-test ($n = 11$). **Table S7:** Effect of the Training on Physicians' Pediatric Pain Knowledge and Attitudes ($n = 11$).