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Factors influencing pain management practices among nurses in university hospitals in Western Japan: A cross-sectional study using hierarchical multiple regression analysis

Short running title: Nurses' pain management practices

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Author Contributions

Xi, M. Y. : conceptualization, methodology, data curation, investigation, formal analysis, and writing of the original draft; Kajiwara, Y. : data curation, investigation, writing, review, and editing;

Morimoto, M. : conceptualization, investigation, formal analysis, supervision, funding acquisition, project administration, writing, review, and editing.

Ethics Statement

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The authors declare no conflicts of interest.

Data Availability Statement

The data used in this study were collected from three hospitals. Data supporting the study's findings are available upon request from the corresponding author. The data are not publicly available due to ethical restrictions.

Factors influencing pain management practices among nurses in university hospitals in Western Japan: A cross-sectional study using hierarchical multiple regression analysis

Abstract

Effective pain management remains a global nursing challenge, requiring awareness of influencing factors. This cross-sectional study examined such factors among nurses in Western Japan's university hospitals from September to November 2023. A self-reported questionnaire was used to investigate nurses' sociodemographic characteristics, collaboration with physicians in the ward, pain management knowledge, empathy, and pain management practices. Among 695 nurses (69.4% valid response rate), 51.4% had under five years' work experience, indicating a relatively junior nursing workforce. The mean practice score was 47.5 (SD=7.1). Hierarchical regression showed knowledge and empathy increased practice scores by 6.2%. Nurses' empathy, particularly their perspective-taking, explained pain management practice ($\beta = 0.242$, $p < .001$). Information-sharing with pain specialists, effective collaboration with physicians in the ward, work experience, and clinical pain education were also associated with pain management practices (all p-values $< .05$). This study suggests that enhancing nurses' empathy and fostering a collaborative ward environment may be essential strategies to improve the pain management quality.

Keywords: pain management practice | empathy | collaboration | nurse

Summary

- Despite pain management being a global nursing challenge, research on the factors influencing nurses' pain management practices, remains limited in Japan.
- Nurses' empathy, particularly their perspective-taking, was identified as a factor that explained pain management practice.
- Nurses must be more empathetic to patients' situations and perspectives and try to understand their pain.

1 | Introduction

Pain remains a global problem, affecting approximately 93% of the population (GSK Consumer Healthcare, 2020). It is defined as "an unpleasant sensory and emotional experience associated

1 with, or resembling that associated with, actual or potential tissue damage” (International
2 Association for the Study of Pain [IASP], 2020). Inadequate pain management can extend hospital
3 stays and lead to adverse consequences accompanied by post-discharge pain (Lin et al., 2021).
4 Studies using the Knowledge and Attitudes Survey Regarding Pain (KASRP) (Ferrell, 2014) have
5 shown that nurses’ knowledge of pain management falls below the 80% standard threshold for
6 correct responses, which may hinder effective pain management practices (Ortiz et al., 2022;
7 Rababa et al., 2021).

8 Nursing pain management practice encompasses admission assessment, nursing
9 reassessment, care planning, pharmacological and non-pharmacological interventions, evaluation
10 of analgesic effects and side effects, communication with physicians, and pain-related patient
11 education (Eaton et al., 2017; Fine et al., 2010; Glowacki, 2015; Song et al., 2015). Therefore,
12 focusing solely on the pain management knowledge of nurses is insufficient to promote quality
13 pain management practice. Cancer-related pain management has been evaluated using the Cancer
14 Pain Practice Index (Fine et al., 2010) and its modified version (Song et al., 2015), primarily
15 through medical record assessments. However, Herr et al. (2004, 2010) noted that nurses do not
16 always document evidence-based pain management. Beyond cancer-related pain, efforts have
17 been made to assess acute and chronic pain management practices using medical records. Song et
18 al. (2015) further highlighted the limitations of relying solely on nursing records, stating that the
19 factors guiding assessment and quality care in nursing pain management practice are insufficiently
20 understood.

21 Extensive research has examined palliative care for patients with cancer in Japan. Although
22 pain-related items are commonly assessed as components of palliative care (Nakazawa et al.,
23 2010; Sato et al., 2014), research on nursing practices specifically related to pain management
24 remains limited. Yamada et al. (2023) showed that although pain management in Japanese
25 hospitals meets guidelines to a certain extent, there remain issues with inadequate systematic pain
26 assessment and incomplete adherence to guideline-recommended symptom management, leading
27 to insufficient assessment or treatment. Moreover, Miyazawa et al. (2018) showed that short-term
28 cancer pain management training did not significantly improve the knowledge and attitude of
29 nurses. Takahashi et al. (2023) developed a measure of nursing practice for cancer pain
30 management, incorporating pain assessment, pharmacological and non-pharmacological treatment,

1 education and teamwork, and chart documentation. They reported that effective practice was
2 associated with participation in in-hospital education programs, experience in caring for patients
3 with cancer, and experience in using medical anesthetics. However, these reports were limited to
4 patients with cancer-related pain. In Japan, in actual clinical practice, nurses are simultaneously
5 involved with patients with various types of pain, including not only cancer pain but also
6 postoperative acute pain and chronic pain. However, the factors related to nurses' pain
7 management practice have not been sufficiently studied.

8 The Knowledge, Attitude, and Practice model is the most basic behavior modification model,
9 which explains that practice depends on knowledge and attitudes (Launiala, 2009). This model can
10 be used to support nurses' pain management practices. Studies applying the KASRP have reported
11 that pain management knowledge is influenced by nurses' personal background and clinical
12 experience, including education level, clinical pain education, work experience, and nurses' fear of
13 opioid side effects (Gretarsdottir et al., 2017; Kiekkas et al., 2015; Ou et al., 2021; Slatyer et al.,
14 2022). These factors are also believed to influence pain management practices. However, much of
15 the supporting research is qualitative, and quantitative research on factors associated with pain
16 management practices among nurses remains insufficient. Intervention studies (Germossa et al.,
17 2018; Gustafsson et al., 2013; Innab et al., 2022) have demonstrated that clinical education
18 interventions can marginally improve nurses' pain management knowledge. However, improving
19 knowledge alone does not necessarily translate into enhanced pain management practices. A
20 review of barriers to pain management practices in ICUs identified several challenges: inadequate
21 pain assessment, insufficient knowledge of the dosage and mechanism of action of analgesics,
22 limited knowledge of non-pharmacological coping strategies, and difficulty perceiving non-
23 verbalized pain (Alotni et al., 2023). Thus, in addition to objective assessment, effective pain
24 management practices require a sense of the patient's pain.

25 Empathy is considered a cognitive ability and an essential attitude for healthcare
26 professionals (Hojat et al., 2016). Empathy toward pain involves an individual's perception,
27 judgment, and emotional response to another person's pain or injury (Giummarra et al., 2015).
28 Studies have shown that empathy is correlated with nurses' pain management knowledge (Sucu
29 Dag et al., 2023; Wu et al., 2023). Higher empathy levels enhance nurses' ability to perceive and
30 interpret patients' pain, which, in turn, may improve pain management practices.

Furthermore, nursing pain management practices involve communication with physicians, with nurse–physician collaboration playing a crucial role in facilitating respectful interactions and joint clinical decision-making (Baggs et al., 1992). Effective collaboration is considered essential, as it leads to higher-quality patient care (Lancaster et al., 2015; Tang et al., 2013). However, perceptions of nurse–physician collaboration vary, and nurses’ contributions to patient care are sometimes overlooked (Tang et al., 2013). Therefore, collaboration in nursing pain management within ward environments should be recognized as an important factor in optimizing patient outcomes.

Nursing pain management practices have been gaining prominence in recent years, with the American Nurses Association (2018) emphasizing the ethical responsibility of nurses toward pain relief and the updated definition of pain (IASP, 2020). While many studies have focused on nurses’ knowledge of pain, reporting associations between education, experience, and knowledge, few have examined whether knowledge and empathy are related to nurses’ pain management practices or their related factors. No studies considering a collaborative environment between physicians and nurses have been conducted, warranting further research to identify factors that improve the quality of nurses’ pain management practices. Identifying the factors associated with pain management practice can provide insights into which factors should be targeted to improve nurses’ pain management practices. This understanding may offer implications for educational interventions for nurses and improvements in the organizational environment. Our study aimed to clarify the current state of nurses’ pain management practices and identify factors associated with pain management practices among nurses in university hospitals in Western Japan. Hierarchical multiple regression analysis was performed to determine whether knowledge and empathy influence pain management practices, after adjusting for nurses’ background factors, experience, pain management education, and the effects of collaboration on practice. Identifying factors related to nursing practice in pain management is expected to contribute to improving the quality of pain management practices.

2 | Methods

2.1 | Study Setting and Participants

This multicenter, cross-sectional study was conducted from September to November 2023. The

reporting complied with the checklist for reporting of survey studies (CROSS) guidelines (Sharma et al., 2021). Nurses caring for patients with pain at two university hospitals and one university-affiliated hospital in a prefecture in Western Japan were selected. These three hospitals are large-scale institutions (600–1100 beds), designated as cancer and emergency hospitals, and provide a comprehensive range of medical specialties. Using G*Power 3.1, a priori power analysis was conducted for linear multiple regression (fixed model, R^2 deviation from zero) with 11 predictors. Assuming a medium effect size ($f^2 = 0.15$), $\alpha = 0.05$, and power = 0.80, the required total sample size was estimated to be 123. A total of 1,589 nurses were included in this study.

The inclusion criteria were (1) nurses employed at the three hospitals during the survey period, (2) nurses who agreed to participate, and (3) nurses working reduced hours. The exclusion criteria were (1) nursing managers without direct patient contact; (2) midwives; (3) nurses working in neonatal ICUs, examination departments, outpatient departments (except for the chemotherapy division), operating rooms, or physical examination centers; and (4) nurses on leave or business trips during the survey period.

2.2 | Data Collection and Ethical Considerations

This study was approved by the <blinded for review>. We sent study assistance requests and study outlines to the nursing directors of the three hospitals in advance. A detailed verbal explanation of the questionnaire was also provided. After obtaining their permission, questionnaires were sent to each nursing director according to the number of eligible nurses, and the directors were responsible for distributing them to the appropriate departments. Participants were provided with written explanations regarding the study purpose, an assurance that their data would be used exclusively for this research to ensure privacy, a confirmation of voluntary participation, and an assurance that non-participation would not result in any disadvantages. All the questionnaires were anonymous. The questionnaire was retained for two weeks. Participating nurses placed their completed questionnaires in sealed envelopes, which were then deposited in collection bags within their respective departments. The researcher later retrieved the collection bags containing the completed questionnaires.

2.3 | Measures

The data collection measures comprised five questionnaires: a self-designed sociodemographic characteristics questionnaire and questionnaires on pain management practices, collaboration with

physicians in the ward, pain management knowledge, and empathy.

2.3.1 | Sociodemographic Characteristics

Sociodemographic characteristics included age, sex, education level, work experience (number of years), department, position, experience in pain management, clinical education, exchange of information with a pain specialist team, and opioid use in the previous month.

2.3.2 | Pain Management Practice

Pain management practice was measured using the short version of the Nursing Practice Scale of Cancer Pain Management, developed by Takahashi et al. (2023). This questionnaire assesses the extent of pain management practices performed by nurses, who spend considerable time with patients, based on cancer pain pharmacotherapy guidelines. It comprises six elements: “listening for pain,” “pain assessment,” “nursing care for pain,” “record of pain,” “education and guidance on pain for patients and their families,” and “effects and side effects of narcotics.” Prior to the survey, an expert panel discussion was conducted to confirm the appropriateness of the questionnaire. The panel consisted of five members: one certified nurse specialist in cancer nursing, two nursing educators and two nursing administrators with experience in acute and chronic pain care. Its item content is applicable not only to cancer pain but also to general nursing practice for patients with pain, making it suitable for assessing nurses’ pain management practices in this study.

The original version, which contains 50 items, has been validated and is reliable (Cronbach’s $\alpha = .97$). The short version contains 12 items and has been evaluated by its developers as having good internal consistency (Cronbach’s $\alpha = .88$), with a high correlation coefficient with the original version ($r = 0.96, p < 0.001$). The factor structure was re-evaluated through a confirmatory factor analysis (Appendix Figure A1). The internal consistency between items was good (Cronbach’s $\alpha = 0.88$). A five-point Likert scale was used, ranging from “not practiced” (1) to “always practiced” (5), with total scores ranging from 12 to 60. Higher scores indicate more comprehensive nursing practices in pain management.

2.3.3 | Collaboration with Physicians in the Ward (Ward Environment)

The Japanese version of the Collaboration and Satisfaction about Care Decisions (CSACD; Ozawa et al., 2012) scale was used. Originally developed by Baggs (1994), the CSACD scale measures collaboration within a ward. It comprises seven items measuring collaboration and two items

measuring satisfaction with collaboration. In this study, the seven collaboration items were used to assess the degree of collaboration within a ward. The Japanese version of the CSACD has the same factor structure as the original, confirming its high internal consistency. The response options range from “strongly disagree” and “no collaboration” (1) to “strongly agree” and “complete collaboration” (7). Total scores range from 7 to 49, with higher scores indicating a greater degree of nurse–physician collaboration in the ward.

2.3.4 | Pain Management Knowledge

The Japanese version of the KASRP (J-KASRP) was used to assess participants’ pain management knowledge. The original KASRP questionnaire was created in 1987 and last revised in 2014 (Ferrell, 2014). The test–retest reliability and internal consistency coefficient of the KASRP are 0.80 and > 0.70, respectively. This questionnaire has been widely translated and utilized to evaluate pain management knowledge among nurses worldwide.

With approval from the original authors, the KASRP was translated to Japanese, adapting it to Japanese pharmacotherapy and medical practices. One item was removed, and several modifications were made to ensure relevance. It comprises 40 items, including 22 true/false questions, 14 multiple-choice questions, and two case studies (each study has two sub-questions). The J-KASRP scores were calculated by assigning a score of 1 to each correct answer and then converting the total correct answers to a 100-point scale using the following formula: $(100/40) \times$ number of correct answers. A score of 80% or higher indicates adequate knowledge. Higher scores indicate higher levels of pain management knowledge.

2.3.5 | Empathy

The Japanese version of the Jefferson Scale of Empathy (JSE, Health Professional [HP]-version; Kataoka, 2012) was used. The JSE HP-Version was developed by Hojat et al. (2001). The scale has been validated internationally, used in 88 countries, and translated into 59 languages. The JSE HP-Version comprises 20 items across three domains: “perspective-taking” (10 items), “compassionate care” (8 items), and “walking in patients’ shoes” (2 items). We used a seven-point Likert-type scale ranging from “Strongly disagree” (1) to “Strongly agree” (7). Items 1, 3, 6, 7, 8, 11, 12, 14, 18, and 19 are reverse-scored items. Scores range from 20 to 140. Higher scores indicate higher empathy. The scale has good reliability (Cronbach’s alpha: 0.80). Permission to use the JSE HP-Version was granted by Thomas Jefferson University.

2.4 | Statistical Analysis

To minimize human error in data entry for paper-based surveys, double data entry and random checking approaches were used. Data were analyzed using IBM SPSS version 29.0. Descriptive statistics were used to summarize participants' sociodemographic characteristics and questionnaire scores. The Pearson's correlation coefficient was calculated to assess the absence of multicollinearity among independent variables. A simple correlation matrix was presented to confirm that the correlations between variables were below 0.7 (Hair et al., 2022). Nurses' pain management practice may be influenced by their personal background, clinical environment after work, knowledge, and empathy. A hierarchical multiple regression analysis was conducted to assess the effects of pain management knowledge, collaboration with physicians in the ward, and empathy on pain management practices. The variables for the regression models were entered after a correlation analysis confirmed that no correlations exceeded 0.7. In multiple regression analysis, it is common to include only those variables that exhibit a statistically significant relationship with the outcome. However, in this study, variables considered theoretically relevant to pain management practice were included in the model regardless of their statistical significance. This is because, in bivariate analysis, suppressor effects may occur, sometimes resulting in variables not even exhibiting a weak association with the outcome (Hair et al., 2022).

In Model 1, nurses' non-modifiable characteristics (education level and work experience [number of years]) were entered as the independent variables. In Model 2, variables easily related to nurses' clinical experience and environment—including clinical pain education, exchange of information with a pain specialist team, opioid use during the previous month, and collaboration with physicians in the ward—were added as independent variables. Finally, in Model 3, knowledge and attitude variables, such as pain management knowledge and empathy, were included as independent variables. We then checked the variance inflation factor (VIF). Statistical significance was set at $p < 0.05$.

3 | Results

3.1 | Participants' Characteristics

A total of 1001 participants agreed to participate (response rate: 63.0%), of whom 695 completed all study questionnaires without missing data (valid response rate: 69.4%). Participants' average

age was 30.3 ± 8.5 years (Table 1).

3.2 | Participants' Pain Management Practices and Instrument Scores

Figure 1 illustrates participants' pain management practices. A total of 67.1% of nurses always used pain assessment scales (item 1), while 45.2% reported that they always monitor for the potential emergence of nausea and vomiting as side effects during the initiation or dosage increase of medical narcotics (item 5). Furthermore, 41.9% reported that they always document the effects of medical narcotics during initiation or dosage increases (item 11). However, only 16.5% always assessed pain from multiple perspectives, including physical and psychological aspects (item 3).

Table 2 presents the scores on each questionnaire. The mean pain management practice score was 47.5 ± 7.1 ; the majority of participants (52.8%) had a pain management practice score ≥ 48 , indicating a high evaluation of their own nursing practices. The mean score for collaboration with physicians on the ward was 34.4 ± 6.2 . The mean J-KASRP total score was 60.0 ± 8.4 . Among 695 participants, 9 had a J-KASRP score of 80% or higher. The mean JSE total score was 100.7 ± 12.0 .

3.3 | Correlations Among Nurses' Characteristics, Collaboration with Physicians in the Ward, Pain Management Knowledge, Empathy, and Pain Management Practices

Table 3 shows the results of Pearson's correlation analysis; no correlation coefficients exceeded 0.7. A positive correlation was observed between opioid use in the previous month and the exchange of information with a team of pain specialists ($r = 0.318$, $p < 0.001$). Additionally, higher scores in perspective-taking were associated with better pain management practice ($r = 0.304$, $p < 0.001$).

3.4 | Factors Associated with Nurses' Pain Management Practices

The results of the hierarchical multiple regression analysis identifying factors associated with pain management practices are presented in Table 4. In Model 1, only work experience (number of years) contributed significantly to the regression model ($\beta = 0.186$, $p < .001$). In Model 2, after adding nurses' clinical experience and environmental factors, the model explained an additional 10.6% of the variance in pain management practice, and this change in R^2 was significant (adjusted $R^2 = .131$, $F = 21.117$, $p < .001$). In Model 2, additional factors explaining pain management practices included receiving clinical pain education ($\beta = 0.089$, $p = .016$), sharing information with a pain specialist team ($\beta = 0.200$, $p < .001$), and ensuring a collaborative environment with physicians in the ward ($\beta = 0.207$, $p < .001$). In Model 3, the addition of pain

management knowledge and empathy further explained 6.2% of the variance in pain management practice. However, pain management knowledge did not predict pain management practice. Instead, two domains of empathy were significant factors: perspective-taking ($\beta = 0.242$, $p < .001$) and walking in the patient's shoes ($\beta = 0.072$, $p < .044$). Among all examined variables, the perspective-taking domain of empathy had the strongest influence on pain management practice. The VIF of all variables in all models was less than 1.31.

4 | Discussion

We investigated factors influencing nurses' pain management practices across three university hospitals in Western Japan. Our findings highlight the critical role of empathy, particularly in the "perspective-taking" domain. Contrary to expectations, pain management knowledge did not have a significant direct impact on practice.

Nurses involved in pain management frequently used numerical rating scales and visual analog scales for pain assessment, which is consistent with previous Japanese studies on nurses caring for cancer patients (Takahashi et al., 2023). Many nurses were aware of and monitored adverse reactions to narcotic pain medication. This may be related to the emphasis placed on pain management guidelines in Japan (Mawatari et al., 2022). Given that narcotic medication can cause adverse effects such as nausea and vomiting, which can influence analgesic effectiveness and patient satisfaction (Maceira et al., 2012; Porreca & Ossipov, 2009), the high implementation rate of adverse reaction monitoring is notable. However, our findings highlight that a comprehensive pain assessment, including psychological aspects, remains lacking. Previous research has confirmed that aspects such as patients' psychological factors profoundly influence patients' pain perception (Linton, 2000; Sobol-Kwapinska et al., 2016; Vlaeyen & Crombez, 2020). Although nurses are aware of the need for a multidimensional pain assessment, our findings suggest that they may struggle to fully integrate these aspects into their clinical practice, leading to lower self-evaluations in this area.

Furthermore, overall empathy scores in our study were 10 points lower than those reported by Otsuka et al. (2024) for Japanese nurses. Empathy is also known to vary with age and position in that study. Since most participants were nurses working at university hospitals, and over 50% had fewer than five years of experience, these factors likely influenced their scores. Only 40% had

received pain education in clinical practice, highlighting the current lack of pain education in clinical practice. Rababa et al. (2021) highlighted that continuous education and professional training in pain assessment and management are crucial drivers of nurses' pain management competencies. In this study, as the majority of nurses had limited experience, increasing opportunities for continuous education may be particularly important for promoting effective pain management.

Our study showed that nurses' work experience had a significant positive effect on pain management practices across all three models. This finding is consistent with Benner's (1984) theory that more experienced nurses provide better care. Similarly, Kidanemariam et al. (2020) reported that nurses' experience influenced their use of non-pharmacological therapies for postoperative pain management, while Asman et al. (2019) and Rababa et al. (2021) identified work experience as a contributing factor in pain management for intubated patients. These findings suggest that clinical experience influences nurses' pain management decisions. However, Youngcharoen and Aree-Ue (2023) found that longer nursing experience was associated with poorer postoperative pain management for older patients. These differences based on years of experience suggest the need for further investigation into whether they arise from variations in pain types or whether patient age acts as a confounding factor in nurses' pain management.

The pain management practices of the nurses in this study were influenced by information-sharing with the pain specialist team and close collaboration with physicians in the ward. A qualitative study indicated that effective interdisciplinary collaboration enhances treatment outcomes for chronic pain patients (Nøst et al., 2024). Similarly, in older patients, active physician–nurse collaboration from the nurse perspective predicts better postoperative pain management (Youngcharoen & Aree-Ue, 2023). A systematic review found that effective nurse–physician collaboration serves as a critical facilitator in pain management (Rababa et al., 2021). Therefore, enhancing pain management culture within the ward, establishing a shared medical consensus among team members, and strengthening interdisciplinary collaboration could improve the quality of pain management practices.

The J-KASRP results showed that only nine participants achieved a score of 80% or higher—the threshold for sufficient pain management knowledge—with an average score of $60.0 \pm 8.4\%$. This is lower than those reported in previous studies (Gretarsdottir et al., 2017; Maestro-Gonzalez

et al., 2021), but higher than the $51.9 \pm 9.4\%$ score reported by Wu et al. (2023). This indicates that there is still a knowledge gap among nurses. Unexpectedly, we found that knowledge was not the dominant factor in determining nurses' pain management practices. One possible explanation is that the J-KASRP emphasizes theoretical knowledge over practical application, and most items focus on pharmacology, which may limit its predictive validity in real hospital settings. Meanwhile, although nurses with pain management knowledge do not necessarily demonstrate superior nursing practice, they may rely less on explicit knowledge or evidence-based decision-making. This finding also suggests that Japanese nurses' practice behavior may be shaped by a passive adherence to medical instructions, as indicated in Sato et al. (2014). Moreover, the majority of nurses did not meet the 80% threshold for adequate pain management knowledge, which may have further influenced the results.

Empathy played a crucial role in pain management practices in this study. The nationwide study found that nurses generally had higher empathy than physicians (Otsuka et al., 2024), likely owing to their more direct and frequent interactions with the patients. Compared to physicians, nurses may require a higher level of empathy to accurately perceive patients' pain experiences and adjust nursing interventions accordingly. Empathy is also reflected in patient communication, which can alleviate psychological distress and make patients more receptive to treatment (Babaii et al., 2021). A review also highlighted empathy's essential role in pain management (He et al., 2025). Through affective and cognitive processes, nurses can perceive and assess patients' pain status more accurately. Our study found that the "perspective-taking" domain of empathy, in particular, plays an important role in influencing nurses' pain management practices. Perspective taking, as a core component of empathy, enables medical staff to better understand the needs and feelings of patients and promotes patient-oriented clinical practice (Hojat et al., 2016). As a cognitively driven intervention, it encourages individuals to adopt another person's perspective and consider how their suffering might affect their lives, thereby increasing empathy. Research has shown that perspective-taking can help healthcare professionals understand patients' health experiences, ultimately leading to improved treatment strategies (Blatt et al., 2010; Drwecki et al., 2011; Wandner et al., 2015).

4.1 | Strengths and Limitations of the Study

First, our study employed hierarchical multiple regression analysis to examine factors associated

1 with pain management practices while controlling for nurses' personal and environmental factors,
2 which highlighted the importance of empathy in nursing pain management. Second, this study
3 included a representative sample from three large university hospitals. However, there are some
4 limitations to our study. Its cross-sectional design precludes the temporal element from the
5 analysis of relationships between pain knowledge, empathy, collaboration and pain management
6 practice. The results were also based on nurses' self-reports, and, as such, may introduce social
7 desirability bias. Voluntary participation may also cause potential selection bias. Moreover, this
8 study was conducted in only three university hospitals in Western Japan, which limits its
9 generalizability, specifically regarding pain and empathy interpretation.

11 **5 | Conclusions**

12 This study examined factors associated with nurses' pain management practices, focusing on their
13 knowledge, empathy, and collaboration with physicians in ward settings. Empathy, particularly
14 perspective-taking, was observed to be more strongly associated with pain management practices.

16 **6 | Relevance for Clinical Practice**

17 Improving the quality of nurses' pain management practices is crucial for effectively alleviating
18 patients' pain and preventing adverse outcomes associated with inadequate pain management. Our
19 findings highlight the need for fostering empathy in nurses to improve pain management practices,
20 with implications for nursing education and patient outcomes.

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1 **Figure legends**

2 **Figure 1.** Responses to the Nursing Practice Scale of Pain Management (N=695).

3

4 **Appendix material**

5 **Figure A1.** One-factor model of the Nursing Practice Scale of Pain Management with
6 standardized re-estimated.

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Table 1 | Participants' sociodemographic characteristics (N = 695).

Characteristics		<i>n</i>	%
Age (years, M±SD)		30.3±8.5	
Sex	Female	640	92.1
	Male	55	7.9
Education level	Diploma	364	52.4
	Bachelor's	318	45.8
	Master's and above	13	1.9
Work experience (number of years)	≤5	357	51.4
	6–10	155	22.3
	11–15	76	10.9
	≥16	107	15.4
Department	Surgical	198	28.5
	Orthopedic	80	11.5
	Medical	184	26.5
	Pediatric	42	6.0
	ICU	109	15.7
	ED	50	7.2
	Others [†]	32	4.6
Position	Assistant Head or Chief Nurse	63	9.1
	Nurse	632	90.9
Clinical pain education	Received	291	41.9
	Not received	404	58.1
Exchange of information with a pain specialist team	Always	75	10.8
	Sometimes	295	42.4
	Almost never	192	27.6
	Never	133	19.1
Opioid use (previous month)	Had	388	55.8
	Never	307	44.2

Note: M, mean; SD, standard deviation; ICU, Intensive Care Unit; ED, Emergency Department. "Others [†]" refers to nurses working in other departments such as palliative care, rehabilitation, and chemotherapy.

1

1. The intensity of the pain reported by the patient is checked using pain scales such as the NRS, Face Scale and VAS, etc.
2. Assess how pain interferes with daily life activities.
3. Pain is assessed from multiple perspectives, including physical pain, mental, social, and spiritual aspects.
4. During the initiation of pain treatment or when pain conditions change, assessments are made to ensure that the right analgesics are used for the type of pain (somatic, visceral, or neuropathic pain).
5. When starting or increasing the dosage of medical narcotics, the patient is observed with awareness of the possible adverse reactions of nausea and vomiting.
6. To reduce the patient's perceived pain intensity, efforts are made to create an environment where the patient feels comfort and relaxed (e.g., providing emotional support, distraction techniques, and engaging in conversation).
7. If patient has misconceptions about medical narcotics (e.g., addiction, gradual loss of effect, adverse reactions) when starting medical narcotics, correct knowledge is explained to them.
8. When initiating medical narcotics, patient is informed about the side effects of medical narcotics (e.g., constipation, nausea, drowsiness).
9. When the patient stays out or is discharged from the hospital, he or she is instructed on how to manage pain-related issues.
10. The type of the patient's reported pain are recorded (e.g., throbbing, heavy, numbness).
11. When medical narcotics are started or increased, their indications are recorded.
12. During the initiation or intensification of pain treatment, the patient's pain status and treatment (including both pharmacological and non-pharmacological) are confirmed with the physicians.

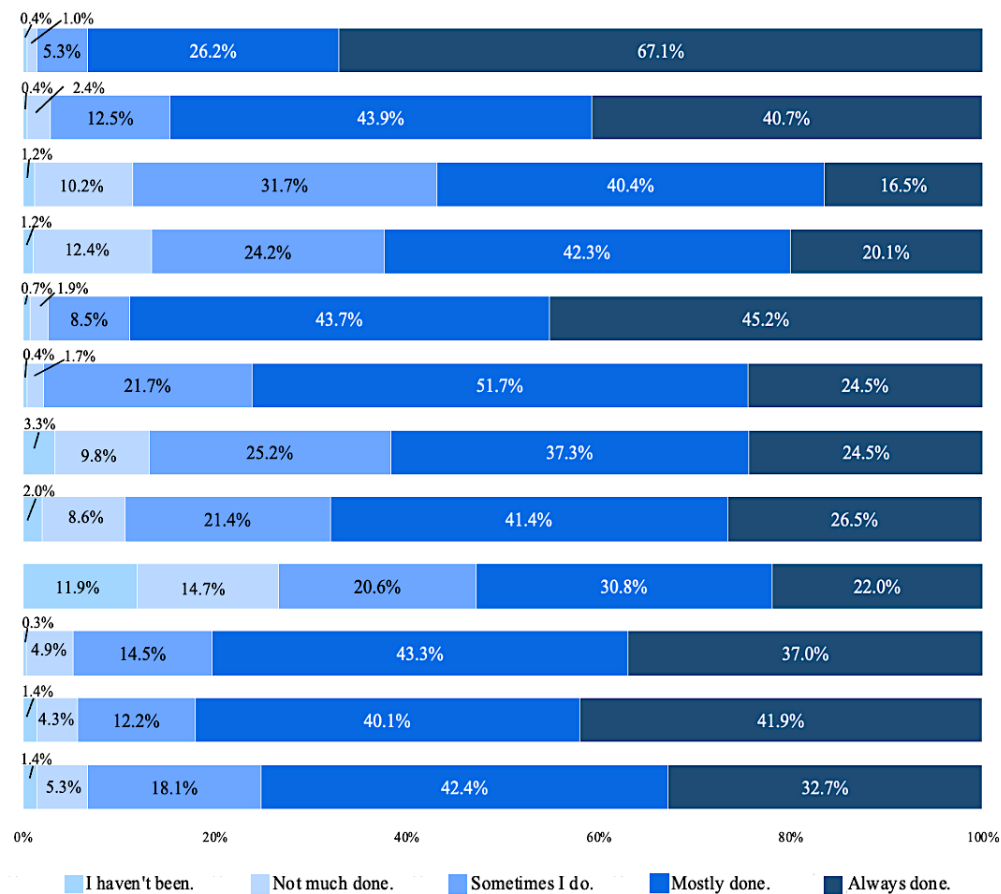


Figure 1 | Responses to the Nursing Practice Scale of Pain Management (N=695).

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Table 2 | Questionnaire scores (N=695).

Variables		Range	Mean (SD)	Kurtosis	Skewness
Pain management practice		12–60	47.5 (7.1)	0.922	-0.601
Collaboration with physicians in the ward	CSACD-Collaboration	7–49	34.4 (6.2)	0.388	-0.403
Pain management knowledge	J-KASRP total score	0–100	60.0 (8.4)	0.031	0.005
Empathy	JSE total score	20–140	100.7 (12.0)	-0.435	0.169
	JSE-Perspective-taking	10–70	50.0 (7.0)	-0.012	0.002
	JSE-Compassionate care	8–56	42.3 (7.3)	1.634	-0.811
	JSE-Walking in patient's shoes	2–14	8.4 (2.3)	0.144	-0.010

Note: SD, standard deviation; CSACD, Collaboration and Satisfaction about Care Decisions; J-KASRP, Japanese version of the Knowledge and Attitudes Survey Regarding Pain; JSE, Japanese version of the Jefferson Scale of Empathy.

Table 3 | Correlations among participants' characteristics, collaboration with physicians in the ward, pain management knowledge, empathy, and pain management practices (*r*-value, N=695).

Variables		1	2	3	4	5	6	7	8	9	10	11
1	Pain management practices	1.000										
2	Characteristics		1.000									
3	Education level			1.000								
4	Work experience (number of years)				1.000							
5	Clinical pain education					1.000						
6	Exchange of information with a pain specialist team						1.000					
7	Opioid use (previous month)							1.000				
8	Collaboration with physicians in the ward								1.000			
9	Pain management knowledge									1.000		
10	Empathy										1.000	
11	JSE-Perspective-taking											1.000
	JSE-Compassionate care											
	JSE-Walking in patient's shoes											

Note: *** $p < .001$, ** $p < .01$, * $p < .05$. CSACD, Collaboration and Satisfaction about Care Decisions; J-KASRP, Japanese version of the Knowledge and Attitudes Survey Regarding Pain; JSE, Japanese version of the Jefferson Scale of Empathy.

Table 4 | Results of the hierarchical multiple regression analysis of pain management practices (N=695).

Variables		Model 1					Model 2					Model 3				
		B	β	<i>p</i>	95% CI	VIF	B	β	<i>p</i>	95% CI	VIF	B	β	<i>p</i>	95% CI	VIF
Constant		44.126		<.001	42.122-46.129		31.599		<.001	27.887-35.312		20.997		<.001	15.371-26.623	
Characteristics	Education level	0.764	0.057	.135	-0.239-1.768	1.056	0.799	0.058	.110	-0.176-1.733	1.066	0.783	0.059	.106	-0.165-1.730	1.126
	Work experience (number of years)	1.195	0.186	<.001	0.709-1.680	1.056	1.173	0.182	<.001	0.697-1.648	1.132	0.959	0.149	<.001	0.487-1.430	1.191
	Clinical pain education						1.290	0.089	.016	0.238-2.342	1.096	1.064	0.074	.041	0.043-2.085	1.106
	Exchange of information with a pain specialist team						1.549	0.200	<.001	0.972-2.126	1.146	1.533	0.198	<.001	0.974-2.092	1.153
	Opioid use (previous month)						-0.085	-0.006	.875	-1.142-0.973	1.123	-0.078	-0.005	.881	-1.110-0.953	1.144
Collaboration with physicians in the ward	CSACD-Collaboration						0.240	0.207	<.001	0.158-0.323	1.048	0.185	0.159	<.001	0.104-0.266	1.088
Pain management knowledge	J-KASRP total score											-0.020	-0.023	.524	-0.080-0.041	1.132
Empathy	JSE-Perspective taking											0.247	0.242	<.001	0.174-0.320	1.130
	JSE-Compassionate care											0.000	0.000	.994	-0.076-0.075	1.309
	JSE-Walking in patient's shoes											0.222	0.072	.044	0.006-0.438	1.089
R^2		.033					.139					.201				
ΔR^2		.030					.131					.189				
R^2 change		.033					.106					.062				
F		11.759***					21.117***					13.270***				

Appendix Material

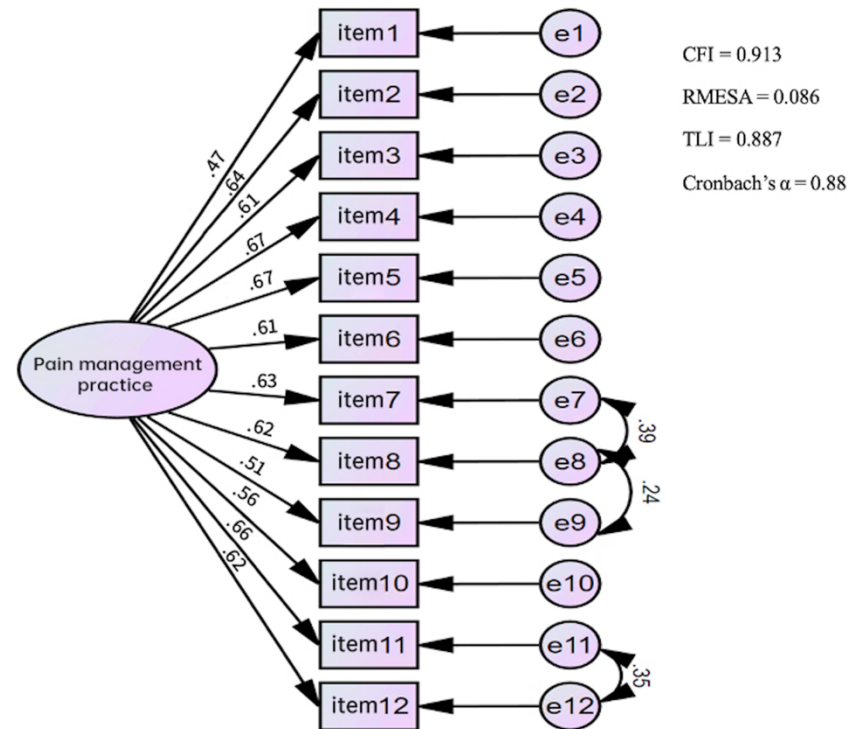


Figure A1 | One-factor model of the Nursing Practice Scale of Pain Management with standardized reestimated. e, error; item1–item12, the specific content of the 12 items in Figure 1; CFI, comparative fit index; RMSEA, root mean square error of approximation; TLI, Tucker–Lewis index. The estimates are based on standardized regression coefficients. Model parameters were estimated using the maximum likelihood method. Paths were added between the error variables (e7–e8, e8–e9, and e11–e12), which were set based on the goodness-of-fit index.

Checklist for Reporting of Survey Studies (CROSS)

Section/topic	Item	Item description	Reported on page #
Title and abstract			
Title and abstract	1a	State the word “survey” along with a commonly used term in title or abstract to introduce the study’s design.	Page 1
	1b	Provide an informative summary in the abstract, covering background, objectives, methods, findings/results, interpretation/discussion, and conclusions.	Page 1
Introduction			
Background	2	Provide a background about the rationale of study, what has been previously done, and why this survey is needed.	Pages 1-4
Purpose/aim	3	Identify specific purposes, aims, goals, or objectives of the study.	Page 4
Methods			
Study design	4	Specify the study design in the methods section with a commonly used term (e.g., cross-sectional or longitudinal).	Page 4
Data collection methods	5a	Describe the questionnaire (e.g., number of sections, number of questions, number and names of instruments used).	Pages 4-7
	5b	Describe all questionnaire instruments that were used in the survey to measure particular concepts. Report target population, reported validity and reliability information, scoring/classification procedure, and reference links (if any).	Pages 5-7
	5c	Provide information on pretesting of the questionnaire, if performed (in the article or in an online supplement). Report the method of pretesting, number of times questionnaire was pre-tested, number and demographics of participants used for pretesting, and the level of similarity of demographics between pre-testing participants and sample population.	-
	5d	Questionnaire, if possible, should be fully provided (in the article, or as appendices or as an online supplement).	-
	6a	Describe the study population (i.e., background, locations, eligibility criteria for participant inclusion in survey, exclusion criteria).	Page 5
Sample characteristics	6b	Describe the sampling techniques used (e.g., single stage or multistage sampling, simple random sampling, stratified sampling, cluster sampling, convenience sampling). Specify the locations of sample participants whenever clustered sampling was applied.	Page 5
	6c	Provide information on sample size, along with details of sample size calculation.	Page 5
	6d	Describe how representative the sample is of the study population (or target population if possible), particularly for population-based surveys.	Page 5
Survey	7a	Provide information on modes of questionnaire administration, including the type and number of contacts, the location where the survey was conducted (e.g., outpatient	Page 5

administration		room or by use of online tools, such as SurveyMonkey).	
	7b	Provide information of survey's time frame, such as periods of recruitment, exposure, and follow-up days.	Page 4
		Provide information on the entry process:	Page 8
	7c	→For non-web-based surveys, provide approaches to minimize human error in data entry.	
		→For web-based surveys, provide approaches to prevent "multiple participation" of participants.	
Study preparation	8	Describe any preparation process before conducting the survey (e.g., interviewers' training process, advertising the survey).	Page 5
Ethical considerations	9a	Provide information on ethical approval for the survey if obtained, including informed consent, institutional review board [IRB] approval, Helsinki declaration, and good clinical practice [GCP] declaration (as appropriate).	Page 5
	9b	Provide information about survey anonymity and confidentiality and describe what mechanisms were used to protect unauthorized access.	Page 5
	10a	Describe statistical methods and analytical approach. Report the statistical software that was used for data analysis.	Page 8
	10b	Report any modification of variables used in the analysis, along with reference (if available).	Page 8
Statistical analysis	10c	Report details about how missing data was handled. Include rate of missing items, missing data mechanism (i.e., missing completely at random [MCAR], missing at random [MAR] or missing not at random [MNAR]) and methods used to deal with missing data (e.g., multiple imputation).	Page 8
	10d	State how non-response error was addressed.	-
	10e	For longitudinal surveys, state how loss to follow-up was addressed.	-
	10f	Indicate whether any methods such as weighting of items or propensity scores have been used to adjust for non-representativeness of the sample.	-
	10g	Describe any sensitivity analysis conducted.	-

Results

Respondent characteristics	11a	Report numbers of individuals at each stage of the study. Consider using a flow diagram, if possible.	Page 8
	11b	Provide reasons for non-participation at each stage, if possible.	-
	11c	Report response rate, present the definition of response rate or the formula used to calculate response rate.	Page 8

Descriptive results	11d	Provide information to define how unique visitors are determined. Report number of unique visitors along with relevant proportions (e.g., view proportion, participation proportion, completion proportion).	-
	12	Provide characteristics of study participants, as well as information on potential confounders and assessed outcomes.	Pages 8-10
	13a	Give unadjusted estimates and, if applicable, confounder-adjusted estimates along with 95% confidence intervals and p-values.	-
Main findings	13b	For multivariable analysis, provide information on the model building process, model fit statistics, and model assumptions (as appropriate).	Pages 9-10
	13c	Provide details about any sensitivity analysis performed. If there are considerable amount of missing data, report sensitivity analyses comparing the results of complete cases with that of the imputed dataset (if possible).	-
Discussion			
Limitations	14	Discuss the limitations of the study, considering sources of potential biases and imprecisions, such as non-representativeness of sample, study design, important uncontrolled confounders.	Pages 12-13
Interpretations	15	Give a cautious overall interpretation of results, based on potential biases and imprecisions and suggest areas for future research.	Pages 10-12
Generalizability	16	Discuss the external validity of the results.	Pages 12-13
Other sections			
Role of funding source	17	State whether any funding organization has had any roles in the survey's design, implementation, and analysis.	In title page.
Conflict of interest	18	Declare any potential conflict of interest.	In title page.
Acknowledgements	19	Provide names of organizations/persons that are acknowledged along with their contribution to the research.	In title page.