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ORIGINAL RESEARCH

Analysis of Current Pain Management in Total Knee Arthroplasty in 8 Tertiary Hospitals in China Based on the Theory of Planned Behavior

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Video Abstract

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Purpose: To investigate the current status of perioperative pain management for patients undergoing total knee arthroplasty (TKA) among medical personnel and to identify influencing factors in eight tertiary hospitals in China, thereby providing evidence for optimizing TKA pain management protocols.

Methods: Guided by the Theory of Planned Behavior, a cross-sectional survey was conducted among nurses and physicians involved in the care of TKA patients across multiple healthcare institutions. A validated questionnaire assessing perioperative pain management practices in TKA was administered between March and April 2024 to 333 healthcare professionals responsible for the diagnosis, treatment, and nursing care of TKA patients. Data were analyzed using univariate analysis and multiple stepwise linear regression to identify factors influencing current perioperative pain management practices.

Results: The mean score for perioperative pain management behaviors among medical staff was 77.45 ± 10.39, corresponding to a score rate of 86.0%. Self-evaluation emerged as a significant predictor of pain management behavior during the perioperative period of TKA. Additionally, age, experience in systematic training for TKA pain management, and professional category (operating room nurse, orthopedic nurse) were identified as influencing factors of current pain management practices.

Conclusion: Medical professionals demonstrate a positive attitude toward perioperative pain management in TKA. However, discrepancies exist between their attitudes and actual practices. Variations in subjective norms were observed, and documentation of pain management requires standardization.

Keywords: medical personnel, theory of planned behavior, tertiary hospital, total knee arthroplasty, postoperative pain management, cross-sectional study

Introduction

In 2020, approximately 86.7 million new cases of knee osteoarthritis occurred globally among individuals over 20 years old. The prevalence and incidence varied substantially between individual countries and increased with age.[1] Total Knee Arthroplasty (TKA), as an important treatment method, can effectively relieve the pain caused by the disease, improve the function of the knee joint, and thereby enhance the quality of life of patients.[2] However, studies have shown that about two-thirds of patients will experience severe pain after the operation, which seriously reduces life quality of the patients during the perioperative period.[3–5] While pain affects the overall therapeutic effect of the patient, some patients might even give up the surgery due to the fear of pain.[6,7] The latest TKA pain management guideline for the Chinese mainland was released by Joint Surgery Branch of Chinese Orthopaedic Association in 2022. It integrates evidence from leading international guidelines,

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high-quality literature, and traditional Chinese medicine.[8] However, as the only such guideline in China, its reputation needs to be strengthened, and a gap remains with actual clinical practice. Therefore, as the main implementators of perioperative pain management in TKA, the pain management behaviors of medical personnel affect the quality of postoperative pain management for TKA patients directly. Behavioral intention can influence behavior, the theory of planned behavior (TPB) provides an effective framework for analyzing pain management behavior mechanism of medical staff.[9] Behavioral intention is determined by three dimensions: attitude (an individual's positive or negative evaluation of a certain behavior), subjective norms (the social pressure perceived by the individual as whether to perform a certain behavior), and perceived behavioral control (the perceived difficulty of performing a certain behavior by the individual).[10]

Pain, recognized as one of the five vital signs, is a clinical priority, and the concept of pain-free hospitals has been widely promoted globally.[11–13] However, due to its subjective nature, effective pain monitoring remains challenging despite technological advances.[12] Although researchers have explored objective pain indicators—such as physiological sensors, photoplethysmographic (PPG) signals, and tools from biomedical informatics and artificial intelligence—these methods are limited by patient variability, lack of generalizability, and high technical requirements, preventing widespread use.[14–16] Therefore, simple and practical tools like the Visual Analogue Scale (VAS), Numerical Rating Scale (NRS), Verbal Rating Scale (VRS), and Faces Pain Scale (FPS) remain the most widely used for pain assessment.[17] Pain management based on these scores requires comprehensive evaluation of patients' psychological and clinical status and depends on collaboration among physicians, nurses, patients, and caregivers,[17] increasing demands on healthcare resources.[18,19] Nurses play a key role in monitoring hospitalized patients,[20,21] identifying pain, communicating needs to physicians (eg, requesting analgesics or specialist support), and implementing pain-related orders.[22] In China, tertiary hospitals—the highest-level institutions under current regulations—typically employ well-trained staff but face strain from high patient volumes and limited personnel.[23] Amid acute medical emergencies, pain is often deprioritized,[24] which may weaken pain management education in clinical training,[25] hindering the translation of knowledge into practice. TPB was developed from the theory of rational behavior proposed by Ajzen and Fishbein. Ajzen's research found that human Behavior is not 100% voluntary but rather under Control. Therefore, he expanded the TRA and added a new concept of "Perceived Behavior Control", thus developing it into a new research model for behavior theory.[9] In addition to the 3 dimensions mentioned earlier,[10] it also includes 5 key points: Attitude, Subjective Norm, Perceived Behavioral Control, Behavior Intention and behavior. According to TPB, individuals are more likely to act on their behavioral intentions, and present intentions aligned with their attitudes and subjective norm, when their perceived behavioral control is high.[26] This might have implications for clinical pain management.

Our study defines the behaviors of medical personnel in the perioperative period (from preoperative to one month after surgery) of TKA patients in terms of disease, social/role, emotion/psychology and other related management behaviors to prevent complications and reduce pain scores as perioperative pain management behaviors. Based on TPB, a questionnaire on perioperative pain management behaviors in TKA was developed to analyze current practices and influencing factors among healthcare professionals across eight tertiary hospitals in Chongqing, China. Meanwhile, it also extends to understand the challenges in the pain management within the comprehensive medical system, emphasizes the importance of pain management, thereby provides insights to enhance clinical education and practice of pain management for clinical nursing and therapy, ultimately optimizing perioperative pain management for TKA patients.

Material and Methods

Design

This observational study is a cross-sectional study conducted through an online questionnaire survey. The advantages of online survey lie in creating a questionnaire, contacting the sample population, storing the responses, visualisation of survey results that can be done online. Online surveys can be conducted at a low cost and in a short period. The researcher can start and pause the survey whenever he wants.[27] Cross-sectional design usually has the advantages of low cost, flexibility and high efficiency. It can quickly recruit different samples without being restricted by time and place, ensuring the universality of research results.[28] This study involved different departments in 8 different hospitals and included both types of personnel, nurses and physicians, and its potential variability made this design a key strategy to address the research question.

Study Setting

The 8 tertiary hospitals included in this study are all several large teaching hospitals in Chongqing, China, including 6 affiliated hospitals of 3 different medical universities and 2 affiliated hospitals of 1 medical school of a comprehensive university. Due to the differences in the scale of their campuses, the number of TKA ranged from 237 to 516 in 2024. These hospitals undertake the medical treatment of nearly two-thirds of the orthopedic inpatients in Chongqing every year, and the medical personnel involved in the relevant departments are generally experienced.

Sample/Participants

From March to April 2024, most fully staffed and avoid Chinese New Year and International Labor Day, by using the convenience sampling method, nurses and physicians from orthopedics, anesthesiology, operating rooms and pain management departments who were responsible for the diagnosis, treatment and nursing of TKA patients were selected from 8 tertiary hospitals in Chongqing, China, for investigation. The sample size was calculated at 10 times the number of questionnaire items. Considering a 20% invalid questionnaire rate, the final sample size was 216 cases.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria for the study participants are as followed.

Inclusion criteria: (I) Registered doctors or registered nurses, with at least one year of working experience in the above-mentioned departments. (II) With experience in diagnosing, treating or caring for TKA patients. (III) Informed consent and voluntary participation in this study.

Exclusion criteria: (I) Refresher doctors or refresher nurses. (II) Currently not on duty due to maternity leave, marriage leave or other reasons.

Methods

General Information Questionnaire

Self-designed general information questionnaire, including demographic data such as age, gender, ethnicity, department, occupation, professional title, and years of work experience, learning of pain management knowledge and experience of relevant training, as well as self-evaluation of current perioperative pain management in TKA.

Questionnaire on Perioperative Pain Management Behavior of Medical Personnel in TKA

Based on a systematic search of TKA pain management guidelines and expert consensus, the researchers independently compiled the initial draft of the questionnaire based on TPB and in combination with the actual clinical situation.[29–31] The questionnaire was discussed and revised by 15 experts from the orthopedics department, anesthesiology department and pain management department. The experts included 7 physicians with doctoral degrees or senior professional titles and 8 nurses with bachelor's degrees or above and professional titles of senior nurse or above. All of them had at least 10 years of clinical work experience. The final questionnaire consists of 18 items across 4 dimensions: Behavioral attitude (4 items), subjective norms (3 items), perceived behavioral control (4 items), and behavioral intention (7 items) were scored using the Likert 5-level scoring method. The questionnaire was shown on Figure 1. From "strongly disagree" to "strongly agree", 1 to 5 points were assigned, respectively, with a total score ranging from 18 to 90 points. The score rate of each dimension is equal to the actual score of that dimension divided by the total score of that dimension. The total score rate is the actual score of the questionnaire divided by the total score. Higher scores indicate better perioperative pain management behavior. The questionnaire was pre-surveyed by three physicians and ten nurses from the orthopedics and anesthesiology departments of the tertiary hospital. The content validity of the questionnaire is 0.894. The internal consistency reliability Cronbach's α coefficient of our questionnaire was 0.931, and the Cronbach's α coefficients of each dimension ranged from 0.789 to 0.934.

Data Collection

The questionnaire was filled out online, only once per IP address. The researcher first got in touch with the head of the investigation department, introducing the purpose of the investigation and the precautions for filling out the

Behavioral attitude dimension (1 to 5 points)	1. I think it is important to manage pain for TKA patients.
	2. I think it is easy to implement pain management for TKA patients.
	3. I think it is necessary to conduct TKA pain management training for doctors/nurses.
	4. I believe that pain management for TKA patients is beneficial to their recovery.
Subjective norms dimension (1 to 5 points)	5. I look forward to strengthening the pain management of TKA patients.
	6. I expect the nurses and doctors in the department will approve of my pain management for TKA patients.
	7. I hope that the TKA patients and their family will agree to my pain management.
Perceived behavioral control dimension (1 to 5 points)	8. Once a patient experiences pain, I will promptly provide pain management for TKA patients.
	9. I am familiar with the current TKA pain management methods and can implement them correctly.
	10. I can effectively grasp the timing of pain management for TKA patients.
	11. I have sufficient time to manage the pain of TKA patients.
Behavioral intentional dimension (1 to 5 points)	12. I will proactively assess the pain condition of TKA patients.
	13. I will record the pain of TKA patients in time.
	14. I will encourage TKA patients to report their pain conditions voluntarily.
	15. I will handle the pain of TKA patients timely in accordance with the guidelines or medical advice.
	16. I will evaluate the effect of pain management in TKA patients.
	17. I will provide pain management education to TKA patients.
	18. I will conduct regular follow-ups for patients with perioperative pain during TKA.

Figure 1 Perioperative Pain Management Behavior Questionnaire.

questionnaire. The head of the department then distributed the Quick Response code of the questionnaire to the nurses and physicians' communication group of the department. The questionnaires were collected within one week. After collection, two researchers checked the responses to each questionnaire one by one. Questionnaires with the same answer for all items or incomplete responses were regarded as invalid and excluded. A total of 380 questionnaires were distributed, 361 were retrieved, and 333 were valid, with a recovery rate of 87.63%.

Statistical Analysis

Statistical analysis was conducted by SPSS 27.0. Count data were expressed as frequency and composition ratio. The measurement data of normal distribution were described as mean ± standard deviation. Univariate analysis was conducted by *t*-test or variance analysis, and multivariate analysis was performed using multiple stepwise linear regression. P value < 0.05 indicated a statistically significant difference.

Ethical Consideration

All participants were voluntary. The relevant information of the participants is in strictly confidentiality. Since data collection was conducted by an online survey, explicit written consent was not required. The participants were informed of their right to withdraw at any time, and all responses were anonymised. This study was determined to be negligible risk research. This study was approved by the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (2024-492-01).

Results

Characteristics of the Sample and Univariate Analysis

About 333 valid questionnaires were finally collected and included in the analysis. The flowchart is shown in Figure 2. The age of the 333 survey subjects was (34.39 ± 6.82) years old. Other general information was shown in Table 1. The total score of the TKA perioperative pain management behavior questionnaire was (77.45 ± 10.39) points, the average score of each item was (4.30 ± 0.92) points, and the score rate was 86.0%. The score of the behavioral attitude dimension was (18.34 ± 1.77) points, with an average score of (4.59 ± 0.44), and the score rate was 91.7%. The item with the lowest score was "I think it is easy to implement pain management for TKA patients". The score of the subjective norm dimension was (13.76 ± 1.86), the average score was (4.59 ± 0.62) points, and the score rate was 91.7%. The score of the perceptual behavior control dimension was (15.87 ± 3.47) points, the average score was (3.97 ± 0.87) points, and the score rate was 79.4%. Item 10 "I can effectively grasp the timing of pain management for TKA patients" and item 11 "I have sufficient time to manage the pain of TKA patients" were the two items with the lowest scores in the entire questionnaire. The score of the behavioral intention dimension was (29.47 ± 5.49) points, the average score was (4.21 ± 0.78), and the score rate was 84.2%.

The total score of the pain management behavior of the survey subjects and the scores of each dimension are shown in Table 1. The results of univariate analysis showed that the differences in the total score of the variables such as age, gender, years of work experience, personnel category, educational background, professional title, experience in systematic training for TKA pain management, pain management knowledge training experience, and self-evaluation of current TKA perioperative pain management (self-evaluation) were statistically significant ($P < 0.05$).

Multivariate Stepwise Linear Regression Analysis

Taking the total score of pain management behavior and the scores of each dimension as dependent variables, and the variables with statistically significant differences in the univariate analysis as independent variables, they were included in the multiple stepwise linear regression. The results show that self-evaluation is an important factor for behavioral attitude dimension and the whole perioperative period of TKA pain management behavior. Personnel category (operating room nurse), self-evaluation and age are the influencing factors of the subjective norms dimension. Self-evaluation, personnel category (operating room nurse), age, and experience in systematic training for TKA pain management are the influencing factors of the perceived behavioral control dimension. Self-evaluation, personnel category (operating room nurse), years of working and pain management knowledge training experience are the influencing factors of the behavioral intention dimension. Self-evaluation, personnel category (operating room nurse), age, experience in

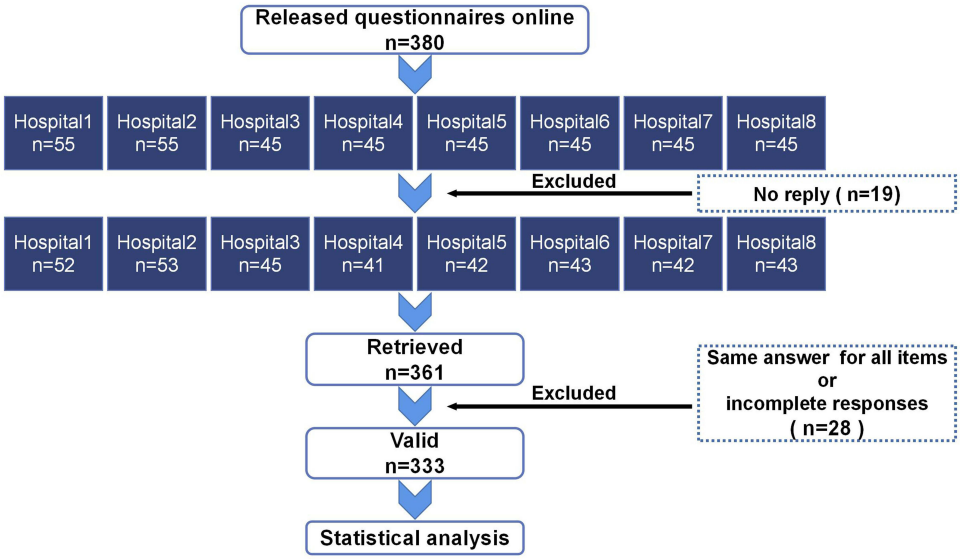

Figure 2 Flow Diagram for Collection of Perioperative Pain Management Behavior Questionnaire.

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Table 1 Univariate Analysis of Pain Management Behavior Score (n = 333, Mean ± SD)

Items	n (%)	Behavioral Attitude Dimension	Subjective Norms Dimension	Perceived Behavioral Control Dimension	Behavioral Intentional Dimension	Total Score
Gender						
Male	94(28.2)	4.58 ± 0.37	4.70 ± 0.47	4.15 ± 0.76	4.32 ± 0.74	79.31 ± 9.473
Female	239(71.8)	4.59 ± 0.47	4.54 ± 0.66	3.89 ± 0.90	4.17 ± 0.80	76.72 ± 10.69
t value		0.081	−2.467	−2.701	−1.611	−2.052
P value		0.935	0.014	0.008	0.108	0.041
Age (years old)						
20~30	109(32.7)	4.53 ± 0.39	4.48 ± 0.61	3.84 ± 0.77	4.10 ± 0.72	75.59 ± 9.58
31~40	178(53.5)	4.61 ± 0.48	4.62 ± 0.65	3.97 ± 0.93	4.21 ± 0.82	77.60 ± 11.00
41~50	36(10.8)	4.63 ± 0.44	4.72 ± 0.45	4.30 ± 0.75	4.54 ± 0.70	81.69 ± 8.81
≥51	10(3.0)	4.68 ± 0.24	4.73 ± 0.44	4.20 ± 0.87	4.30 ± 0.78	79.80 ± 9.74
F Value		0.964	2.096	2.827	3.025	3.413
P value		0.410	0.101	0.039	0.030	0.018
Years of Working (years)						
1~5	89(27.4)	4.51 ± 0.38	4.48 ± 0.58	3.83 ± 0.83	4.05 ± 0.73	75.13 ± 9.17
6~15	188(54.7)	4.61 ± 0.43	4.63 ± 0.61	3.96 ± 0.90	4.23 ± 0.79	77.76 ± 10.48
>15	56(16.8)	4.62 ± 0.57	4.61 ± 0.71	4.22 ± 0.83	4.43 ± 0.80	80.16 ± 11.51
F Value		1.998	1.886	3.467	3.989	4.185
P value		0.137	0.153	0.032	0.019	0.016
Personnel Category						
Orthopedist	35(10.5)	4.64 ± 0.34	4.75 ± 0.52	4.35 ± 0.62	4.54 ± 0.55	81.97 ± 7.96
Orthopedic Nurse	38(11.4)	4.70 ± 0.39	4.86 ± 0.35	4.34 ± 0.75	4.64 ± 0.54	83.24 ± 6.79
Anesthesiologist	65(19.5)	4.61 ± 0.37	4.64 ± 0.49	4.00 ± 0.95	4.22 ± 0.73	77.91 ± 10.01
Operating Room Nurse	159(47.8)	4.52 ± 0.52	4.45 ± 0.71	3.79 ± 0.90	4.02 ± 0.87	74.77 ± 11.44
Anesthesia Nurse	20(6)	4.65 ± 0.34	4.67 ± 0.54	3.86 ± 0.61	4.17 ± 0.66	77.25 ± 7.97
Pain Specialist	16(4.8)	4.66 ± 0.24	4.63 ± 0.57	4.02 ± 0.73	4.33 ± 0.56	78.88 ± 6.63
F Value		1.408	3.783	4.426	5.854	6.339
P value		0.221	0.002	0.001	< 0.001	< 0.001
Education background						
Junior College	33(9.9)	4.55 ± 0.52	4.53 ± 0.63	4.08 ± 0.89	4.31 ± 0.79	78.27 ± 10.23
Bachelor	209(62.8)	4.58 ± 0.46	4.56 ± 0.65	3.85 ± 0.90	4.12 ± 0.82	76.25 ± 10.90
Master or Above	91(27.3)	4.62 ± 0.37	4.68 ± 0.54	4.19 ± 0.73	4.38 ± 0.66	79.91 ± 8.853
F Value		0.365	1.375	5.233	3.820	4.115
P value		0.695	0.254	0.006	0.023	0.017
Professional title						
Primary	159(47.8)	4.54 ± 0.45	4.54 ± 0.62	3.89 ± 0.85	4.13 ± 0.75	76.30 ± 9.91
Medium	123(36.9)	4.60 ± 0.48	4.58 ± 0.64	3.96 ± 0.92	4.19 ± 0.88	77.28 ± 11.51
Senior	51(15.3)	4.71 ± 0.31	4.75 ± 0.53	4.23 ± 0.74	4.50 ± 0.59	81.45 ± 8.10
F Value		2.819	2.096	2.883	4.315	4.861
P value		0.061	0.125	0.057	0.014	0.008

(*Continued*)

Table 1 (Continued).

Items	n (%)	Behavioral Attitude Dimension	Subjective Norms Dimension	Perceived Behavioral Control Dimension	Behavioral Intentional Dimension	Total Score
Experience in Systematic Training for TKA Pain Management						
Yes	234(70.3)	4.61 ± 0.44	4.62 ± 0.61	4.04 ± 0.87	4.28 ± 0.73	78.34 ± 9.947
No	94(29.7)	4.54 ± 0.44	4.52 ± 0.64	3.81 ± 0.84	4.06 ± 0.88	75.35 ± 11.21
t Value		1.282	1.264	2.197	2.158	2.408
P value		0.201	0.207	0.029	0.032	0.017
Pain Management Knowledge Training Experience						
Yes	279(83.8)	4.60 ± 0.44	4.62 ± 0.61	4.03 ± 0.85	4.28 ± 0.76	78.29 ± 10.28
No	54(16.2)	4.54 ± 0.43	4.41 ± 0.62	3.67 ± 0.92	3.86 ± 0.83	73.09 ± 10.08
t Value		0.881	2.354	2.771	3.626	3.414
P value		0.379	0.019	0.006	< 0.001	0.001
Self-evaluation Of the Current Perioperative Pain Management of TKA						
Very Satisfied	35(10.5)	4.89 ± 0.23	4.96 ± 0.18	4.79 ± 0.37	4.85 ± 0.41	87.54 ± 3.52
Satisfied	178(53.5)	4.60 ± 0.43	4.59 ± 0.61	4.01 ± 0.83	4.23 ± 0.78	77.84 ± 10.14
Dissatisfied	114(34.2)	4.46 ± 0.46	4.46 ± 0.68	3.63 ± 0.85	3.98 ± 0.79	73.61 ± 10.23
Very Dissatisfied	6(1.8)	4.71 ± 0.37	4.72 ± 0.44	4.25 ± 0.67	4.29 ± 0.43	80.00 ± 6.75
F Value		9.302	6.379	19.275	12.158	18.980
P value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

systematic training for TKA pain management, and personnel category (orthopedic nurse) are the influencing factors of the total score. The results of the multiple stepwise linear regression in each dimension are shown in Table 2.

Discussion

The schematic representation of TPB can be presented as Figure 3, three core beliefs drive human actions: personal evaluation (behavioral beliefs) shaping attitude; perceived social expectations (normative beliefs) forming subjective norm; and recognition of facilitating or hindering factors (control beliefs) leading to perceived behavioral control. All these beliefs also influence each other. Perceived behavioral control acts as a moderator in the relationship between attitude toward the

Table 2 Multivariate Stepwise Linear Regression Analysis of Influencing Factors of Perioperative Pain Management Behavior Scores in TKA (n = 333)

Dependent Variable	Independent Variable	Standardizing R^2	Regression Coefficient	Standard Error	Standardized Regression Coefficient	*t Value*	*P* Value
Behavioral Attitude Dimension	Self-evaluation	0.054	−0.159	0.035	−0.240	−4.535	< 0.001
Subjective Norms Dimension	Personnel category (operating room nurse)	0.054	−0.180	0.049	−0.194	−3.654	< 0.001
	Self-evaluation	0.034	−0.067	0.027	−0.133	−2.487	0.013
	Age	0.065	0.100	0.045	0.118	2.205	0.028

(*Continued*)

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Table 2 (Continued).

Dependent Variable	Independent Variable	Standardizing R^2	Regression Coefficient	Standard Error	Standardized Regression Coefficient	*t Value*	*P* Value
Perceived Behavioral Control Dimension	Self-evaluation	0.107	−0.418	0.065	−0.322	−6.406	< 0.001
	Personnel category (operating room nurse)	0.144	−0.131	0.035	−0.186	−3.703	< 0.001
	Age	0.161	0.210	0.068	0.158	3.102	0.002
	Experience in systematic training for TKA pain management	0.168	−0.197	0.097	−0.104	−2.023	0.044
Behavioral Intentional Dimension	Self-evaluation	0.072	−0.303	0.060	−0.258	−5.051	< 0.001
	Personnel category (operating room nurse)	0.109	−0.114	0.033	−0.179	−3.461	0.001
	Years of working	0.130	0.172	0.061	0.144	2.817	0.005
	Pain Management Knowledge Training Experience	0.143	−0.268	0.111	−0.126	−2.425	0.016
Total Score	Self-evaluation	0.106	−4.952	0.777	−0.318	−6.374	< 0.001
	Personnel category (operating room nurse)	0.147	−1.658	0.423	−0.196	−3.921	< 0.001
	Age	0.169	2.872	0.807	0.180	3.561	< 0.001
	Experience in systematic training experience for TKA pain management	0.180	−2.702	1.162	−0.119	−2.326	0.021
	Personnel category (orthopedic nurse)	0.231	4.201	1.732	0.128	2.516	0.026

behavior, subjective norm, and intention. These elements jointly influence behavioral intention, which, alongside actual control, directly determines behavior.[9,32] Based on the theory, we will conduct the discussion from the following aspects.

Firstly, clinical medical personnel have a positive behavioral attitude towards TKA pain management, but there are difficulties in implementation process. Our study shows that medical personnel hold positive attitudes toward TKA pain management (mean score 4.59 ± 0.44), exceeding scores reported in prior Chinese studies[33]—likely due to our higher proportion of tertiary-hospital participants, where standardization and awareness of perioperative pain management tend to be stronger. However, in the behavioral attitude dimension, the lowest-rated item "I think it is easy to implement pain management for TKA patients", reveals a clear attitude–practice gap. Key barriers might include resource constraints (personnel, time, equipment), variable patient cooperation, insufficient pain management knowledge among clinicians, inaccurate pain assessment, lack of individualized treatment plans, and inconsistent implementation protocols.[34] The results of multiple linear regression analysis identified self-evaluation of perioperative pain management in current TKA as an influencing factor of behavioral attitude ($P < 0.05$): higher self-evaluation of perioperative pain management correlated with more positive behavioral attitude. To bridge the gap, future efforts should prioritize practical and feasible improvements, such as streamlining workflows, implementing quality monitoring systems, developing optimized pain management protocols, clarifying division of responsibilities, and enhancing multidisciplinary collaboration.[35,36]

Secondly, subjective norms in perioperative pain management for TKA vary significantly among different type of clinical medical personnel. The average score of the subjective norm dimension was 4.59 ± 0.62, indicating a relatively

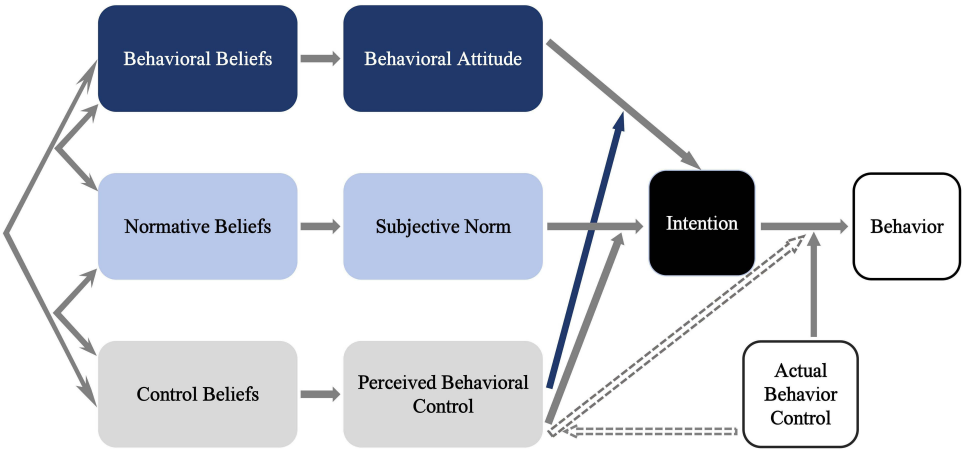

Figure 3 Schematic Diagram of the Theory of Planned Behavior.

high level of adherence to the norms for perioperative pain management of TKA patients. Our study found that professional role influences these norms: orthopedic nurses scored slightly higher than orthopedic doctors, suggesting stronger alignment with pain management practices, which aligns with Bouri's findings.[34] The possible reason might be that orthopedic nurses, as primary observer of TKA patients' pain, observe the pain symptoms more meticulously, while doctors might tend to focus more on functional recovery and treatment outcomes, paying relatively less attention to pain.[37] Additionally, anesthesiologists scored lower than orthopedists, orthopedic nurses, and pain specialists. This could reflect their current focus on intraoperative and immediate postoperative care (within 24 hours), with limited involvement in long-term follow-up.[31,38,39] As professionals in pain management, anesthesiologists, anesthesia and operating room nurses should strengthen their engagement in perioperative pain care. Multiple stepwise linear regression analysis identified age as a significant factor ($P < 0.05$): older personnel demonstrated clearer understanding of pain management standards and greater recognition of factors influencing the subjective norms, enabling continuous quality improvement.[40] Therefore, senior clinicians should play a benchmark role by establishing a structured "clinical-model-teaching-supervisory-management" system to enhance perioperative pain care delivery in TKA.[41,42]

Thirdly, clinical medical personnel exhibit insufficient perceived behavioral control over perioperative pain management in TKA. Our study found a relatively low average score (3.97 ± 0.87) in the dimension of perceived behavioral control, with the two lowest-scoring items (items 10 and 11) both belonging to this dimension. This indicates that many medical personnel struggle to determine the appropriate timing for pain interventions and feel constrained by time pressure, making it difficult to fully meet patients' pain management needs. A key reason may be inadequate training: current TKA pain management protocols often fail to equip staff with clear guidance on when and how to implement interventions. In China, most hospitals rely on mentorship models, which may teach standard procedures but often omit the rationale and significance behind them.[43,44] Higher perceived behavioral control increases the likelihood that behavioral intentions align with attitudes and subjective norms.[32] Therefore, targeted training should be strengthened to help medical personnel better assess the type, severity, and duration of pain and select appropriate strategies.[45] Hospital departments should also optimize work schedules and staffing levels to ensure adequate time for pain care and consider using telemedicine or smart devices to reduce workload of medical personnel.[46–48] Notably, we found that staff who received formal and systematic pain management education or on-the-job training scored higher in perceived control. In high-resource healthcare systems, advanced practiced nurses specialize in pain management, typically function within well-defined regulatory and educational frameworks that support autonomy, prescriptive authority and interdisciplinary collaboration.[49] In contrast, pain management training of specialized medical personnel in China is still in the exploration stage,[50,51] with most programs focusing on the field of cancer pain rather than perioperative pain, especially chronic perioperative pain.[52–54] This suggests that it is necessary to strengthen curricular teaching, professional training, and the development of specialist pain nurses in perioperative care.[45,55]

Fourthly, clinical medical personnel have a strong behavioral intention for perioperative pain management in TKA, but the actual implementation rate is relatively low. The average score of the behavioral intentional dimension of the research subjects was (4.21 ± 0.78), which was at a relatively high level. This might correlate with pain management knowledge training experience. And it indicates that most medical personnel tend to proactively assess, record, encourage reporting, handle, evaluate the effect, educate and follow up on the pain conditions of TKA patients. However, despite the positive attitude and behavioral intention of medical personnel towards the management of perioperative pain in TKA, the dynamic recording of pain problems by medical personnel is not ideal, possibly due to a series of problems such as clinical burden and recording standards, which shows low efficiency of pain management.[56–58] Inaccurate assessments, nonstandard tools, or variable documentation methods further compromise record quality.[59–61] Nursing records are a true reflection of changes in patients' conditions, and they also reflect the dynamic process of nurses observing patients' conditions. They can also provide an objective basis for clinical medical decisions.[62,63] Therefore, strengthening the TKA pain management record norms can provide clear and accurate information, helping medical personnel better understand patients' pain conditions, formulate personalized pain management plans, and track the effectiveness of pain management.

Lastly, subjective norms, department-specific work cultures and shared expectations, are the primary drivers of pain management behaviors. Our study showed that the unique work atmosphere and code of conduct of different departments, namely subjective norms, had a direct impact on the clinical practice of medical personnel. The results of multiple linear regression analysis indicate that personnel category (especially operating room nurses) is a significant influencing factor for the subjective norm dimension ($P < 0.001$) and the total behavioral score ($P = 0.006$). Univariate analysis revealed role differences: Compared to the orthopedic nurses, the score of operating room nurses was relatively low (4.45 ± 0.71), reflecting their work focus on intraoperative cooperation and vital sign monitoring, thus their standardized cognition of full-course pain management was relatively weak. The result indicated that pain management behavior is less about individual knowledge or attitude but more about alignment with team-level norms.[10] Therefore, in the future, to optimize perioperative pain management in TKA, it is necessary to enhance individual cognition (perceived behavioral control), focus on building and strengthening a collective atmosphere and behavioral norms that support pain management, establish unified pain management norms at the departmental and hospital levels, and clarify the responsibilities of each position. And through the demonstration and supervision of senior medical personnel, effective subjective norms are internalized into the perceived behaviors of team members, thereby systematically improving the overall quality of pain management.

Strengths and Limitations

Our study was carried out in several large metropolitan tertiary teaching hospitals affiliated with different schools, the findings are relevant to the China healthcare context, which is a major strength. The online questionnaire is based on TPB, has a mature theoretical foundation, good universality, and is conducive to quantitative analysis. It not only explains behavior but also provides ideas for behavioral intervention.[9] It is beneficial for improving the current clinical situation of pain management and also for the future construction of the pain management system and pain management education work. Moreover, the medical personnel group targeted by this research is not limited to nurses but also includes some clinical physicians, which meets the modern concept of multidisciplinary collaboration. However, there are still some limitations in this study. Firstly, the research is limited to the current situation of TKA pain management TKA, and there are still more orthopedic and even other major surgical pain management needs to be paid attention to. Secondly, although our study collected data from multiple medical centers, the sample size was still relatively small. In future studies, the scope of the investigation can be expanded to include ordinary tertiary hospitals and even secondary general hospitals. Thirdly, this study's reliance on single-region convenience sampling and potential bias from online self-reporting may affect universality. Observational studies on the consistency between the perception and actual behavior of medical personnel in pain management will be very necessary in the future. Fourthly, although TPB concerns goal-directed behavior under conscious self-regulation, random measurement error may still exist in the TPB construct,[64] as the intention-behavior correlation can vary considerably. Finally, the cross-sectional design only reveals a "static snapshot" of a certain point in time, which limits reflecting the trajectory and continuity of pain management status. Longitudinal studies are needed to examine the dynamic and long-term changes.

Recommendations for Further Research

Pain is a major direction that clinical medicine urgently needs to explore in both clinical work and scientific research in the future. Besides the comprehensive research on postoperative pain management in more surgical clinical departments, the related research on improving the efficiency of pain management through working mode, personnel compatibility setting, and hospital information system optimization should also be paid attention to. Previous studies have suggested that globally, education on pain management among medical personnel is generally lacking.[65] However, the effectiveness of professional pain education for clinical pain management has been confirmed.[66,67] As the current professional education based on pain management is generally lack of systematization, and the conclusions of different studies vary greatly, well-designed, implemented, and reproducible evidence-based pain education intervention is required in the future.[67]

Implications for Policy and Practice

When this research was carried out, it once again drew the attention of medical personnel in the involved clinical departments to pain management. The anesthesiology department of the author's hospital also established a postoperative pain follow-up team led by nurses and anesthesiologists at the time of the study. The purpose of this measure is to make up for the inadequate pain assessment and management that may be caused by overly busy clinical work. But this did not essentially address the shortcomings that still exist in the cognition of some medical personnel on pain management. In some countries rich in medical resources, such as the Netherlands, transitional pain services often consist only of a pain specialist and a nurse pain consultant or nurse practitioner, and acute pain services are organised according to the nurse-anaesthesiologist-supervised model.[68] It highlights the significant impact of nurses, specially professional pain nurses as a central professional within the interdisciplinary team. However, professional pain nurse, especially in the context of developing countries, is a relatively blank concept due to the limitations of medical resources and disciplinary settings. Yet, with the progressive refinement of China's hierarchical medical system, these issues are likely to be addressed gradually.[69] Anyway, the radiation of relevant functional personnel by this study, thereby generating thoughts on pain management, which also positively implies that there may be multi-dimensional optimization policies and measures in future clinical work.

Conclusion

To sum up, in the perioperative pain management of TKA, the behavioral attitude of medical personnel is positive, but there is a deviation between the management attitude and practice. There are significant differences in subjective norms, the control of perceptual behavioral ability needs to be improved, and the records of pain management are not standardized. These are obstacles to eliminating or controlling pain management behaviors during the perioperative period of TKA. Self-evaluation of current perioperative pain management in TKA, personnel category, age, and experience in systematic training for TKA pain management are the influencing factors of pain management behaviors during the perioperative period of TKA. However, at present, clinical medical personnel urgently need to establish a standardized TKA pain management model to clarify the assessment, timing, and operational details of pain management, and improve the pain management process. Standardize the medical records, implement the details of pain management, then ensure that TKA pain management is traceable and feasible. Nursing records objectively reflect patients' evolving pain status and inform clinical decisions, but systematic training on standard pain management protocols is relatively lacking, so standardizing TKA pain documentation is key to personalized care and effective intervention monitoring. The improvement of the hierarchical medical system, regularization of pain management training, emphasis on multidisciplinary collaboration, and establishment of pain nurse training and post settings may yield significant benefits.

Abbreviations

TKA, Total knee arthroplasty; TPB, theory of planned behavior; PPG, photoplethysmographic; VAS, visual analogue scale; NRS, numerical rating scale; VRS, verbal rating scale; VDS, verbal descriptor scale; FPS, faces pain scales.

Data Sharing Statement

The data of this manuscript are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (2024-492-01) prior to the data collection.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

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