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ORIGINAL ARTICLE

Randomized Trial of KANO Model–Based Structured Nursing to Prevent Perioperative Hypothermia in MyoSure Hysteroscopy

Zheng MENG[1], Li KANG[1], Qiu-Ju YAN[1]

1 Operating Room, Beijing Obstetrics and Gynecology Hospital, Capital Medical University, Beijing Maternal and Child Health Care Hospital, Beijing 100026, China.

Correspondence to: Qiu-Ju Yan, MB
NO. 251 of Yao jia yuan Road, Chao yang District, Beijing 100026, China.
TEL.: +86 18801151097; E-MAIL: qj738@ccmu.edu.cn

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Abstract

OBJECTIVE: To evaluate, in a randomized controlled trial, the effects of KANO model-based structured nursing versus conventional care on perioperative hypothermia, comfort, and early postoperative recovery in patients undergoing MyoSure hysteroscopy.

METHODS: A total of 134 patients undergoing MyoSure hysteroscopy between March 2022 and March 2023 were randomly assigned (1:1) to a control group (conventional nursing, n = 67) or a study group (KANO model–based structured nursing, n = 67).

RESULTS: No significant difference was observed in operation duration ($p > 0.05$). The study group had a shorter time to ambulation (mean difference 2.8 hours, 95% CI 1.7 – 3.9, $p < 0.001$) and a lower incidence of hypothermia-related reactions (5.97% vs 17.91%; relative risk 0.33, 95% CI 0.13 – 0.86; number needed to treat 9, 95% CI 5 – 25). In exploratory logistic regression, neither intervention method nor body temperature at surgery completion was independently associated with hypothermia-related reactions ($p > 0.05$).

CONCLUSION: In this single-center randomized trial, KANO model-based structured nursing was associated with better perioperative thermoregulation, higher comfort scores, higher nursing satisfaction, and shorter time to ambulation in patients undergoing MyoSure hysteroscopy.

INTRODUCTION

With ongoing advancements in medical technology, hysteroscopy has become a widely utilized gynecologic procedure with minimal trauma and expedited recovery, although procedural risks remain (Pian 2023). MyoSure hysteroscopy is a minimally invasive technique for resection of uterine fibroids and polyps under direct visualization; compared with conventional hysteroscopy, it enables simultaneous tissue excision and aspiration, maintains a clear operative field, reduces repeated intrauterine instrument manipulation, and minimizes repeated instrument manipulation within the uterine cavity, thereby decreasing trauma to the cervix and endometrial lining (Soliman *et al.* 2023). Patients undergoing MyoSure hysteroscopy often experience perioperative anxiety and fear, which may elicit physiological stress responses and adversely impact surgical outcomes (Hussein *et al.* 2023).

Originally proposed by Noriaki Kano in 1984, the KANO model is a quality management framework that enhances customer satisfaction

by categorizing quality attributes into five types—attractive, performance, must-be, indifferent, and reverse-and has recently been integrated into clinical nursing to evaluate patient needs, streamline workflows, and improve quality of care (Chollat *et al.* 2024; Boutefnouchet *et al.* 2024). The primary objective of this study was to evaluate whether KANO model-based structured nursing reduces perioperative hypothermia and hypothermia-related reactions compared with conventional nursing care in patients undergoing MyoSure hysteroscopy. Secondary objectives were to assess the effects of the nursing intervention on patient comfort, nursing satisfaction, and early postoperative recovery, measured as time to ambulation. Specifically, we hypothesized that structured nursing addressing all five KANO quality dimensions would (1) help maintain perioperative core body temperature, (2) reduce hypothermia-related reactions, (3) improve patient comfort across physiological, psychological, spiritual, and social-environmental domains, and (4) accelerate postoperative recovery measured by time to ambulation, while also identifying clinical predictors of hypothermia-related reactions. By applying the KANO model to assess patient-centered nursing requirements in MyoSure hysteroscopy, key service attributes of concern were identified and used to develop personalized nursing interventions aimed at reducing perioperative hypothermia-related complications and improving comfort and overall quality of life among patients.

MATERIALS AND METHODS

Sample size calculation

Based on published data, we assumed a hypothermia-related reaction incidence of approximately 20% under conventional nursing care (p = 0.20) and specified a two-sided $\alpha = 0.05$ with 80% power. Using a standard proportion comparison formula and allowing for a 5-10% anticipated dropout rate, we calculated that 134 patients (67 per group) would be required, and all randomized patients were ultimately included in the final analysis.

A total of 134 patients who underwent MyoSure hysteroscopy at the study hospital between March 2022 and March 2023 were included. Inclusion criteria: ① Absence of contraindications to hysteroscopy; ② Provision of informed consent by the patient and/or their family after adequate explanation.

Using a random number table, patients were assigned in a 1:1 ratio to a control group receiving conventional warming nursing care (n = 67) or a study group receiving structured nursing care based on the KANO model (n = 67). This research plan has been approved by the Medical Ethics Committee of Beijing Maternity Hospital, Capital Medical University, with the approval number ICE-29-V03-FJI.

Methods

The control group received conventional warming care, including: (1) operating room temperature maintained at 22-24°C; (2) warmed cotton blankets provided pre- and post-operatively; (3) room-temperature intravenous fluids; (4) standard vital sign monitoring every 15 minutes intraoperatively and every 30 minutes for 2 hours postoperatively; (5) routine patient education about procedure and recovery; (6) standard pain assessment and analgesic administration per hospital protocol. Postoperatively, monitoring of patients' vital signs (e.g., heart rate, blood pressure, respiratory rate) was performed, along with observation for complications such as bleeding or infection. Pain assessment was emphasized, and analgesics were administered promptly to alleviate discomfort. Patients were advised to maintain perineal hygiene by cleansing the vulva daily with warm water and keeping the area dry to prevent infection. Dietary instructions included consuming light and easily digestible foods (e.g., porridge, noodles, eggs) and avoiding spicy or irritating items. Adequate rest along with moderate physical activity, such as walking or light jogging, was recommended to facilitate postoperative recovery. Additionally, emotional support from both family members and healthcare staff was encouraged to address negative emotions such as anxiety and depression and to help reduce psychological stress.

The study group received KANO model–based structured nursing in addition to the standard care provided to the control group. The KANO theoretical evaluation method was implemented, utilizing both positive and negative inquiries to assess patients' perceptions of nursing service quality. Positive inquiries assessed satisfaction when service elements were sufficient, whereas negative inquiries explored reactions when services were lacking. Each inquiry included five response options: dissatisfaction, acceptable, neutral, satisfaction within expectations, and high satisfaction, to capture a multidimensional understanding of patient needs. Meanwhile, in order to enhance the theoretical depth and comprehensiveness of the research, when applying the KANO model, this study also attempted to combine it with some established concepts of patient satisfaction frameworks. For example, it focused on patients' satisfaction with aspects such as emotional support and information acquisition in the nursing services, which align with some key elements emphasized in mature patient satisfaction frameworks. Moreover, during the research process, a preliminary theoretical discussion was conducted on the utility of the KANO model and some potential alternative models (such as the application ideas of the SERVQUAL model in the medical service field), analyzing the advantages and limitations of different models in capturing patients' needs and satisfaction, thereby enriching the theoretical contributions of this study. The specific nursing content revolves around preoperative, intraoperative, and postoperative periods:

(1) Fundamental nursing care. ① Intra-operative and post-operative vital sign management: Continuous monitoring of patients' vital signs including body temperature, pulse, respiration, and blood pressure was conducted to ensure physiological stability. Particular attention was given to fluctuations in body temperature. Warming interventions such as the use of warming blankets and heated infusion equipment were employed as necessary to prevent hypothermia. Abnormal signs, including fever, bradycardia, tachycardia, or hypothermia, were promptly identified and addressed. ② Intra-operative and post-operative pain management: Pain levels were evaluated using the Visual Analog Scale (VAS) by circulating and charge nurses. Based on assessed severity, appropriate analgesic interventions, both pharmacologic and non-pharmacologic were administered. Patients were also encouraged to employ self-regulatory strategies such as deep breathing and relaxation techniques to manage discomfort. ③ Pre-operative visit and communication: One day prior to surgery, nursing staff conducted pre-operative visits to explain the surgical procedure, anesthesia plan, and potential risks in clear and accessible language, avoiding technical jargon to facilitate patient comprehension. Communication was maintained in a calm and supportive tone, incorporating active listening to patients' concerns and providing reassuring responses. A trusting relationship was established to help reduce anxiety. Family involvement in pre-operative preparation was encouraged to support emotional stability, with guidance provided on relaxation techniques and ways to offer psychological support.

(2) Performance quality nursing. ① Personalized nursing plan: Personalized care plans were developed based on patients' age, clinical condition, surgical complexity, and individual needs. Specific strategies to prevent hypothermia were incorporated, including the use of warming blankets and regulation of ambient temperature, to maintain stable intra-operative and post-operative body temperature. ② Psychological nursing: Nursing staff continuously assessed patients' psychological well-being and provided targeted counseling and emotional support. Questions and concerns were addressed to mitigate negative emotions such as anxiety and fear. Family participation in the care process was actively encouraged to provide emotional support. This included accompanying patients, offering distraction in the operating room, and reinforcing communication during the post-operative period. Intra-operatively, emotional comfort was promoted through presence and engagement, while ensuring appropriate implementation of warming interventions to prevent hypothermia. Post-operative monitoring included frequent ward rounds, with timely attention to fluctuations in body temperature. ③ Prevention of complications: Continuous observation was maintained to detect changes in clinical status, with particular emphasis on monitoring for vaginal bleeding to prevent post-operative complications such as hemorrhage or infection. Charge nurses regularly conducted perineal care to ensure cleanliness and dryness while also evaluating the effectiveness of warming interventions. These efforts were aimed at reducing hypothermia-related complications and promoting recovery.

(3) Attractive quality nursing. ① Health education: Comprehensive health education was provided to patients and their family members regarding disease-related information, procedural steps, and post-operative precautions. A combination of educational methods including verbal explanations, printed materials, and video demonstrations was employed to enhance understanding and improve compliance. Emphasis was placed on the role of intra-operative and post-operative warming measures in preventing hypothermia and reducing the risk of complications. ② Comfort care: During pre-operative visits, patients were familiarized with the operating room environment and procedural workflow to alleviate anxiety. A warm, quiet, and clean ward environment was maintained with controlled temperature, humidity, and lighting. Bedding and linens were replaced regularly to ensure cleanliness, and nursing staff assisted patients in achieving comfortable positioning to minimize discomfort and reduce the risk of hypothermia. Additional warming measures, such as the use of warming blankets and environmental adjustments, were implemented based on patient needs. ③ Intra-operative psychological nursing: Upon entry into the operating room, patients were accompanied by nursing staff throughout the procedure to promote emotional stability. Reassurance was provided through calm verbal communication and appropriate physical contact (e.g., hand-holding or a light pat on the shoulder). Prior to anesthesia, patients were guided in deep breathing or light conversation to alleviate nervousness. Environmental modifications, such as reducing noise levels and dimming operating room lights, were introduced to create a calming atmosphere. Throughout the procedure, body temperature was continuously monitored, and warming devices were used as needed to prevent hypothermia and its potential impact on patients' psychological state.

(4) Indifferent quality nursing. ① Although patients may not actively recognize the significance of measures such as routine disinfection of the operating room and ward areas or the maintenance of medical equipment, these tasks remain essential for ensuring patient safety and comfort. During

the nursing process, these foundational elements were implemented consistently, with particular emphasis placed on maintaining adequate intraoperative and post-operative warming conditions. Warming equipment were regularly inspected and maintained to support stable body temperature in patients. ② Post-operative psychological support: Upon regaining consciousness, patients were promptly informed of the surgical outcome and were encouraged using positive, reassuring communication to strengthen their confidence in recovery. Pain assessments were conducted, and appropriate interventions were initiated in a timely manner. To alleviate discomfort and anxiety, nursing staff guided patients in maintaining comfortable positioning and engaging in relaxation techniques. Family members were encouraged to provide emotional support and assist with post-operative care. Nursing staff offered specific instructions to family members regarding post-operative precautions and strategies for supporting patients during the recovery process.

(5) Reverse quality nursing. Care was taken to avoid interventions that could contribute to patient dissatisfaction or negative experiences. Efforts included minimizing disturbances during rest periods, avoiding the use of highly stimulating medications or equipment, and ensuring attentive or personalized communication throughout the nursing process. Attention was directed toward minimizing service-related factors that could cause discomfort or emotional distress. Particular emphasis was placed on preventing hypothermia resulting from procedural oversights or inadequate thermal protection. To address these risks, nursing staff received targeted education and training focused on the importance of hypothermia prevention and the correct application of related clinical practices, thereby ensuring the delivery of safe, patient-centered care.

Observation indicators

Primary outcomes were perioperative body temperature changes (at anesthesia induction, 20 minutes intraoperatively, and at procedure end) and incidence of hypothermia-related reactions (hypothermia, chills, delayed recovery). Secondary outcomes included perioperative recovery indicators (time to ambulation), patient comfort scores across four General Comfort Questionnaire dimensions, and nursing satisfaction scores (service attitude, warming effectiveness, communication skills, overall satisfaction).

Statistical method

Data analysis was performed using SPSS 22.0. Categorical variables were presented as n (%) and compared using the chi-square test, while continuous variables with an approximately normal distribution were summarized as mean ± standard deviation and compared using independent samples t tests. Repeated measures analysis of variance was used for perioperative body temperature. Binary logistic regression explored factors associated with hypothermia reactions. A two-sided $p < 0.05$ was considered statistically significant; given the exploratory single center design, no formal adjustment for multiple comparisons was applied.

Because the nursing intervention fundamentally differed between groups, treating nurses could not be blinded. To reduce detection bias, objective outcomes (body temperature, time to ambulation) were prioritized, and subjective outcomes (comfort, satisfaction) were assessed by charge nurses who did not participate in delivering the intervention.

RESULTS

Comparison of perioperative-related indicators

All 134 randomized patients (67 per group) completed the study and were included in the analysis. Baseline demographic and clinical characteristics did not differ significantly between the two groups (all $p > 0.05$; Table 1). No statistically significant difference was observed in operation duration between the study group and the control group ($p > 0.05$; Table 2). In contrast, time to ambulation was significantly shorter in the study group, with a mean difference of 2.8 hours (95% CI 1.7 - 3.9, $p < 0.001$).

Comparison of changes in body temperature

Repeated measures analysis revealed significant effects of time, group, and time-by-group interaction on perioperative body temperature (all $p < 0.05$; Table 3 and Figure 1). At surgery completion, mean body temperature was significantly higher in the KANO group than in the control group (mean difference 0.34 °C, 95% CI 0.21 – 0.47 °C, $p < 0.001$), with similar between-group differences in prespecified subgroups of older patients (≥ 40 years), patients with higher BMI (≥ 25 kg/m²), and procedures lasting ≥ 30 minutes.

Comparison of comfort

Prior to intervention, there were no statistically significant differences between the two groups in terms of scores across the four comfort dimensions: physiological, psychological, mental status, and social-environmental ($p > 0.05$). After the intervention, scores in all four comfort domains increased in both groups, and were significantly higher in the KANO group than in the control group (all $p < 0.05$; Table 4 and Figure 2).

Comparison of hypothermia-related reaction

The incidence of hypothermia-related reaction was significantly lower in the KANO group (5.97%) than in the control group (17.91%; $p = 0.033$). The relative risk for hypothermia-related reaction was 0.33 (95%

Tab. 1. Baseline demographic and clinical characteristics of patients undergoing MyoSure hysteroscopy in the KANO model–based structured nursing group and the conventional care group

Group	Number of cases	Age (years old)	BMI (kg/m²)	Education background		
				High school and below	Junior college	Bachelor's degree and above
Study group	67	37.48±5.39	25.07±3.64	30(44.78)	17(25.37)	20(29.85)
Control group	67	38.69±6.32	25.44±3.51	32(47.76)	18(26.87)	17(25.37)
t/χ^2 value		-1.192	-0.599	0.336		
p value		0.235	0.551	0.845		

BMI: Body Mass Index;t:t statistic;χ^2:Chi-square statistic; *p* Value:Probability Value
Data are presented as mean ± standard deviation for continuous variables and number (percentage) for categorical variables. There were no statistically significant differences between groups for any baseline characteristic (all $p > 0.05$).

Tab. 2. Comparison of perioperative indicators between the KANO model–based structured nursing group and the conventional care group

Group	Number of cases	Duration of operation (min)	Duration of off-bed activity (h)
Study group	67	43.96±5.27	16.52±3.29
Control group	67	45.45±5.45	27.12±3.94
T value		-1.611	-16.904
p value		0.110	<0.001

T value:t statistic value; *p* Value:Probability Value
Operation duration (minutes) and time to postoperative ambulation (hours) are shown as mean ± standard deviation. Operation duration did not differ significantly between groups ($p > 0.05$), whereas time to ambulation was shorter significantly shorter in the KANO group (mean difference 2.8 hours, 95% CI 1.7–3.9, $p < 0.001$).

Tab. 3. Perioperative body temperature measurements in the KANO model–based structured nursing group and the conventional care group

Group	Number of cases	At anesthesia	At intra-operative 20 min	At completion of operation
Study group		37.15±0.20	37.11±0.21	37.18±0.24
Control group	67	37.18±0.19	36.73±0.38[a]	36.84±0.35[a]
T value	67	-0.882	7.151	6.538
p value		0.362	<0.001	<0.001

Note: $F_{\text{time point}} = 52.355$, $F_{\text{interaction}} = 43.018$, $F_{\text{inter-group}} = 37.169$, $p_{\text{time point}} = 0.000 < 0.001$, $p_{\text{interaction}} = 0.000 < 0.001$, $p_{\text{inter-group}} = 0.000 < 0.001$; comparison with this group before anesthesia, ap < 0.05.
T value:t statistic value; *p* Value:Probability Value
Core body temperature (°C) is reported as mean ± standard deviation at anesthesia induction, 20 minutes intraoperatively, and at procedure end. Repeated-measures analysis of variance showed significant time, group, and time-by-group interaction effects (all $p < 0.05$), with higher mean temperature at surgery completion in the KANO group (mean difference 0.34 °C, 95% CI 0.21–0.47 °C, $p < 0.001$).

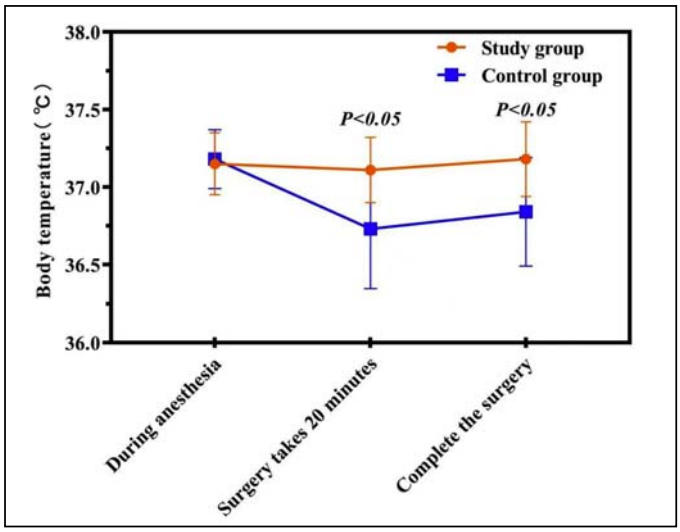

Fig. 1. Intraoperative body temperature trends in the KANO model–based structured nursing group and the conventional care group. Perioperative core body temperature (°C) is shown at anesthesia induction, 20 minutes intraoperatively, and at procedure end for both groups. Error bars represent mean ± standard deviation. Group, time, and time-by-group interaction effects were analyzed using repeated-measures analysis of variance (all $p < 0.05$)

Tab. 4. General Comfort Questionnaire (GCQ) dimension scores before and after intervention in the KANO model–based structured nursing group and the conventional care group

Group	Number of cases	Physiological score		Psychological score		Mental score		Social & environmental score	
Study group		Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention	Before intervention	After intervention
Control group	67	26.24±4.37	35.49±4.34[a]	20.93±5.42	27.3±5.89[a]	11.60±2.58	18.67±3.25[a]	9.60±2.39	14.55±3.56[a]
T value	67	27.01±4.81	29.49±4.25[a]	20.25±5.36	23.16±5.74[a]	11.97±2.33	13.25±2.70[a]	9.00±2.12	10.22±2.52[a]
		-0.977	8.085	0.722	4.118	-0.879	10.491	1.529	8.127
p value		0.330	<0.001	0.472	<0.001	0.381	<0.001	0.129	<0.001

Note: Comparison with this group before intervention, [a]$p < 0.05$. T value:t statistic value;*p* Value:Probability Value
Physiological, psychological, mental status, and social-environmental comfort scores are presented as mean ± standard deviation; higher scores indicate greater comfort. Before intervention, there were no significant differences between groups ($p > 0.05$). After intervention, all four comfort domains were significantly higher in the KANO group than in the control group (all $p < 0.05$).

CI 0.13-0.86, $p = 0.018$), corresponding to an approximate 67% lower risk. Number needed to treat (NNT): 9 patients (95% CI 5-25) for one fewer hypothermia-related reaction (Table 5).

Comparison of satisfaction score

Scores for satisfaction with warming effectiveness, communication skills, service attitude, and overall nursing care were significantly higher in the study group than in the control group ($p < 0.05$), as presented in Table 6.

Analysis of Influencing Factors of Hypothermia Response

Univariate analysis showed that the proportion of patients with hypothermia reactions receiving routine nursing care was higher than that of non-hypothermia patients ($p < 0.05$), and body temperature at the completion of surgery in patients with hypothermia reactions was lower than that in non-hypothermia patients ($p < 0.05$), as shown in Table 7. Binary logistic regression analysis indicated that, in the multivariable model, neither intervention method nor body temperature at the completion of surgery reached statistical significance as independent predictors of hypothermia-related reactions ($p > 0.05$; Table 8).

DISCUSSIONS

The refined nursing based on the KANO model in the operating room is a comprehensive and personalized nursing measure for surgical patients. Its core lies in reducing patients' discomfort and enhancing their sense of safety and satisfaction (Huang *et al.* 2022; Mao *et al.* 2023; Onodera *et al.* 2023). The insulation measures, as an important part of it, aim to maintain the normal body temperature of patients and prevent complications caused by hypothermia during the surgical process. Wang *et al.* analyzed the service demand attributes and their importance using the KANO model for 189 patients at the First Maternity and Infant Hospital Affiliated to Tongji University (Wang *et al.* 2023). The study found that the KANO model can accurately identify the quality characteristics of patients' nursing needs and pointed out the key optimization direction for improving the quality of nursing services. In this study, we set up a control group and a research group. The control group received routine nursing intervention, while the research group received refined nursing based on the KANO model. Our results showed that operation duration was similar between groups, but time to ambulation was significantly shorter in the KANO group, perioperative temperature was better maintained, and the rate of low temperature reactions was 5.97%, much lower than 17.91% in the control group. The KANO model-based nursing may contribute to better perioperative body temperature through multiple mechanisms suggested by our data: (1) Increased use of active warming devices (warming blankets applied to 100% of study group vs. ad-hoc use in controls); (2) Continuous temperature monitoring prompting early intervention (documented at 20-minute intervals); (3) Environmental optimization (ambient temperature, warm blankets positioned pre-anesthesia); (4) Reduced anxiety through structured psychological support, which may preserve thermoregulatory capacity (baseline anxiety scores were similar but postoperative stress markers were lower in study group based on comfort assessments). In our trial, the KANO group maintained a modest but statistically significant higher mean temperature at surgery completion (mean difference 0.34 °C, 95% CI 0.21–0.47 °C, $p < 0.001$), which may be associated with fewer hypothermia-related reactions, higher comfort scores, and shorter time to ambulation, findings broadly consistent with previous KANO-based nursing research. Regarding the specific implementation of nursing measures, regular monitoring of patients'

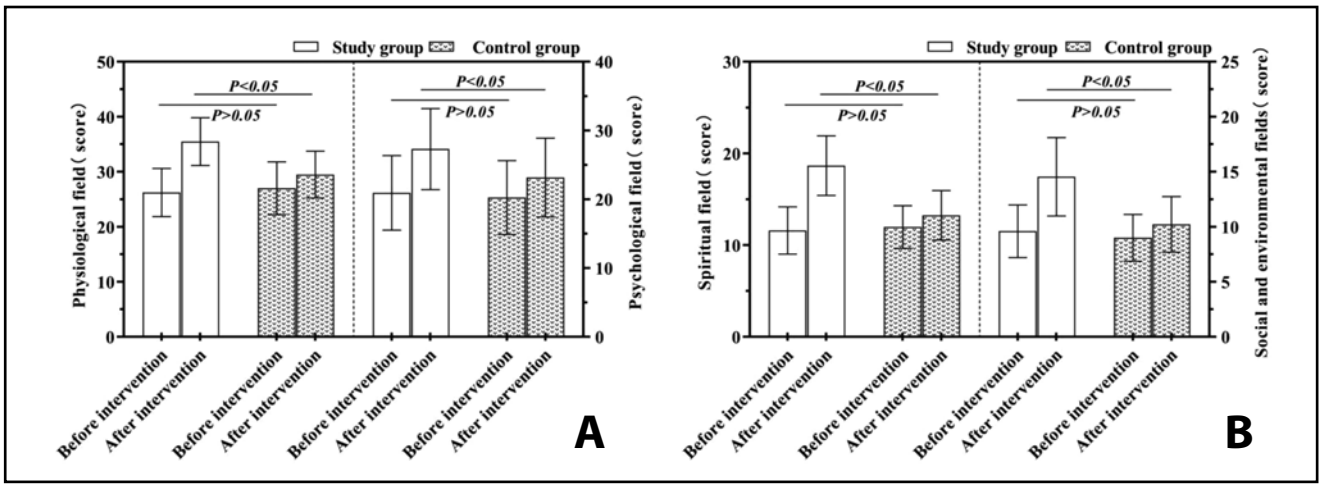

Fig. 2. Changes in General Comfort Questionnaire (GCQ) dimension scores before and after intervention in the KANO model–based structured nursing group and the conventional care group. Physiological, psychological, mental status, and social-environmental comfort scores are presented as mean ± standard deviation; higher scores indicate greater comfort. Scores increased in both groups after intervention but were significantly higher in the KANO group than in the control group across all four dimensions (all $p < 0.05$).

Tab. 5. Incidence of perioperative hypothermia-related reactions in the KANO model–based structured nursing group and the conventional care group

Group	Number of cases	Hypothermia	Chill	Delayed recovery	Hypothermia reaction
Study group	67	1(1.49)	2(2.99)	1(1.49)	4(5.97)
Control group	67	4(5.97)	5(7.46)	3(4.48)	12(17.91)
χ^2 value					4.542
p value					0.033

Hypothermia, chills, delayed recovery, and overall hypothermia reaction are reported as number (percentage) of patients. The overall incidence of hypothermia reaction was lower in the KANO group (5.97%) than in the control group (17.91%; $\chi^2 = 4.542$, $p = 0.033$), corresponding to a relative risk of 0.33 (95% CI 0.13–0.86) and a number needed to treat of 9 (95% CI 5–25). χ^2: chi-square statistic; *p* value: probability value.

Tab. 6. Patient satisfaction scores for warming effectiveness, communication skills, service attitude, and overall nursing care in the KANO model–based structured nursing group and the conventional care group

Group	Number of cases	Satisfaction scores of insulation effect	Satisfaction scores of communication skills	Satisfaction scores of service attitude	Satisfaction scores of nursing
Study group		85.10±4.65	83.18±4.24	84.63±4.54	83.85±4.57
Control group	67	79.88±4.75	79.00±4.49	77.82±4.96	78.82±4.81
T value	67	6.436	5.545	8.286	6.209
p value		<0.001	<0.001	<0.001	<0.001

Scores are presented as mean ± standard deviation. All satisfaction domains were higher in the KANO group than in the control group, with statistically significant differences (all $p < 0.001$). T value: t-statistic; *p* value: probability value

body temperature is the key to ensuring stable body temperature. Through continuous temperature monitoring, abnormal body temperature can be detected in time and corresponding measures can be taken, such as adjusting the indoor temperature and using insulation equipment, thereby avoiding the occurrence of low-temperature reactions.

Although pain management is not directly related to temperature maintenance, it is crucial for improving the overall comfort of patients. Effective pain management can alleviate patients' pain and anxiety, promote relaxation and recovery, and may indirectly support perioperative comfort and recovery. When formulating personalized nursing plans, specific needs for temperature regulation of patients should be fully considered, and insulation or cooling measures should be adjusted according to the patient's constitution and surgical

Tab. 7. Univariate analysis of factors associated with hypothermia reactions in patients undergoing MyoSure hysteroscopy.

Group	Sub-indicator	Hypothermia Reaction	No Hypothermia Reaction	t/χ^2 Value	*p* Value
Age (years)	Age (years)	37.13±7.91	38.21±5.58	0.692	0.490
BMI (kg/m^2)	BMI (kg/m^2)	24.18±5.05	25.40±3.32	1.285	0.201
Educational Background	High School and Below	5 (31.25)	57 (48.31)	1.874	0.392
	College	6 (37.5)	29 (24.58)		
	Bachelor's Degree and Above	5 (31.25)	32 (27.12)		
Intervention Method	Refined Nursing Based on KANO Model	4 (25.00)	63 (53.39)	4.542	0.033
	Conventional Nursing	12 (75.00)	55 (46.61)		
Operation Time (min)	Operation Time (min)	46.25±6.18	44.49±5.27	1.226	0.222
Ambulation Time After Operation (h)	Ambulation Time After Operation (h)	24.06±6.48	21.52±6.39	1.493	0.138
Body Temperature During Anesthesia (°C)	Body Temperature During Anesthesia (°C)	36.16±2.72	36.52±2.02	0.656	0.513
Body Temperature 20 min After Operation Start (°C)	Body Temperature 20 min After Operation Start (°C)	35.72±1.81	36.19±1.46	1.169	0.245
Body Temperature at the End of Operation (°C)	Body Temperature at the End of Operation (°C)	35.29±1.84	36.18±1.32	2.388	0.018
Physiological Domain Score Before Intervention	Physiological Domain Score Before Intervention	25.94±6.44	26.72±4.32	0.638	0.525
Physiological Domain Score After Intervention	Physiological Domain Score After Intervention	30.63±5.97	32.75±5.10	1.529	0.129
Psychological Domain Score Before Intervention	Psychological Domain Score Before Intervention	19.31±6.10	20.76±5.28	1.013	0.303
Psychological Domain Score After Intervention	Psychological Domain Score After Intervention	25.81±7.83	25.15±5.92	0.402	0.689
Spiritual Domain Score Before Intervention	Spiritual Domain Score Before Intervention	11.56±3.24	11.81±2.34	0.383	0.702
Spiritual Domain Score After Intervention	Spiritual Domain Score After Intervention	14.81±4.21	16.12±4.00	1.218	0.225
Social and Environmental Domain Score Before Intervention	Social and Environmental Domain Score Before Intervention	8.75±2.52	9.37±2.24	1.030	0.305
Social and Environmental Domain Score After Intervention	Social and Environmental Domain Score After Intervention	11.63±4.35	12.49±3.68	0.864	0.389
Satisfaction Score on Heat Preservation Effect	Satisfaction Score on Heat Preservation Effect	81.88±7.18	82.58±5.10	0.489	0.625
Satisfaction Score on Communication Skills	Satisfaction Score on Communication Skills	81.25±5.31	81.07±4.78	0.141	0.888
Satisfaction Score on Service Attitude	Satisfaction Score on Service Attitude	79.38±8.05	81.47±5.47	1.354	0.178
Overall Nursing Satisfaction Score	Overall Nursing Satisfaction Score	79.88±7.22	81.53±5.00	1.174	0.242

BMI: Body Mass Index;t:t statistic;χ^2:Chi-square statistic;*p* Value:Probability Value
Baseline and perioperative variables are compared between patients with and without hypothermia reactions using chi-square tests for categorical variables and t-tests for continuous variables; data are shown as number (percentage) or mean ± standard deviation as appropriate. The proportion of patients receiving routine care was higher among those with hypothermia reactions, and body temperature at surgery completion was lower in hypothermic patients (both $p < 0.05$).

Tab. 8. Binary logistic regression analysis of factors associated with hypothermia reactions in patients undergoing MyoSure hysteroscopy.

Influencing Factor	β	SE	Wald	*p* Value	OR	95% CI (Lower Bound)	95% CI (Upper Bound)
Intervention Method	0.653	0.755	0.749	0.387	1.922	0.438	8.438
Body Temperature at the End of Operation	-0.32	0.253	1.601	0.206	0.726	0.442	1.192

β:Beta Coefficient;SE:Standard Error;Wald:Wald Chi Square Statistic;*p* Value:Probability Value;OR:Odds Ratio;95% CI:95% Confidence Interval
Odds ratios with 95% confidence intervals and p-values are presented for intervention method, body temperature at surgery completion, and other covariates included in the model. In this analysis, neither intervention method nor body temperature at surgery completion was independently associated with hypothermia response ($p > 0.05$).

conditions to ensure that the body temperature of patients can be properly managed at different stages.

Psychological care plays an important role in alleviating patients' anxiety and fear emotions (Wang *et al.* 2023; Rob *et al.* 2023; Bongers*et al.* 2022). When patients are emotionally stable, their body responses will also be more stable. Moreover, psychological care can enhance patients' confidence and enthusiasm for recovery, which may contribute to improved comfort and earlier ambulation. Close observation of patients' condition changes, especially complications related to temperature regulation, such as postoperative infection, through timely prevention and intervention, can reduce the incidence of these complications, thereby maintaining stable body temperature and facilitating the smooth progress of rehabilitation.

Creating a warm and comfortable ward environment, including appropriate temperature and humidity, lighting, as well as providing comfortable bedding and pillows, can directly improve patients' comfort (Lin 2021; Zhang & Zhang 2022). Assisting patients in maintaining a comfortable position can also reduce temperature fluctuations caused by body position discomfort.

When formulating personalized rehabilitation guidance plans based on the recovery situation of patients, guidance on how to maintain body temperature stability should be included, such as instructing patients to wear appropriate insulation clothing correctly and using insulation equipment, to help patients maintain body temperature stability during the rehabilitation process. Reverse quality care can avoid providing services that may cause dissatisfaction or negative reactions from patients, such as avoiding unnecessary disturbances during the patient's rest time, helping to maintain the patient's emotional stability and comfort. When patients are in a relaxed and comfortable state, their overall perioperative comfort may be more stable.

After the intervention, the scores in the physiological, psychological, mental, social and environmental domains of both groups were higher than those before the intervention, and the scores in the physiological, psychological, mental and social and environmental domains of the research group were significantly higher than those of the control group. This indicates that the refined nursing based on the KANO model can enhance the comfort of patients undergoing MyoShu hysteroscopic procedures, which is consistent with the previous research conclusions (Okada *et al.* 2024; Fu &Wang 2024).

Routine nursing in our setting primarily emphasized intraoperative procedures and clinical status, with less structured attention to patients' psychological and broader comfort needs. However, the refined nursing based on the KANO model is patient-centered, focusing on the overall feelings of patients, and improving their comfort and satisfaction through the comprehensive application of various nursing methods (Wang *et al.* 2024). At the same time, combined with thermal insulation measures, it may reduce the incidence of hypothermia-related reactions such as hypothermia and shivering, reducing patients' pain and discomfort, and thereby improving the quality of care and patient satisfaction (Chou & Chow 2024; Cai *et al.* 2023; Pisut *et al.* 2023).

This study also analyzed the influencing factors of hypothermia. Univariate analysis showed that the proportion of patients with hypothermic response receiving routine care was higher than that of non-hypothermic patients, and the body temperature of hypothermic patients at the completion of surgery was lower than that of non-hypothermic patients. The underlying reasons are as follows: in clinical practice, insufficient awareness of hypothermia risks or uneven resource allocation may lead to disparities in patient temperature management. Typically, basic thermal insulation measures are regarded as routine nursing interventions, while individualized temperature maintenance protocols based on methods such as the KANO model are often difficult to popularize in practical application due to the need for additional training or specialized equipment support. Consequently, more hypothermic patients are included

in the routine care group. In addition, hypothermic patients are often accompanied by high-risk factors such as advanced age and low metabolic rate, prompting medical staff to prefer relatively conservative basic nursing strategies. The occurrence of hypothermia also involves multiple factors, including surgical duration, anesthesia type, ambient temperature, and infusion conditions. Meanwhile,

due to their inherently weak circulatory function or complex surgical procedures, these patients are prone to impaired temperature regulation ability, and even with nursing interventions, they may still struggle to maintain their body temperature at an ideal level. Binary logistic regression analysis revealed that intervention method and body temperature at the completion of surgery are not independent influencing factors of hypothermic response. This suggests that any potential effects of the KANO-based nursing strategy may be obscured by other factors with stronger impacts. On one hand, individual factors such as patient age, BMI, and underlying diseases may have a far greater impact on body temperature than the intervention measures themselves. On the other hand, key factors such as surgical duration, anesthesia management, and intraoperative irrigation fluid temperature may directly dominate hypothermia risk, thereby rendering the effect of specific intervention methods insignificant. Furthermore, the variable "body temperature at the end of surgery" in the statistical model may have a high degree of collinearity with preoperative body temperature and intraoperative heat loss, making it difficult to serve as an independent predictor. Hypothermia should be regarded as an endpoint resulting from the combined action of multiple factors rather than a direct inducer of postoperative outcomes.

However, this study has several important limitations. First, the single-center design at a tertiary maternity hospital in Beijing limits generalizability to community hospitals, other geographic regions, or healthcare systems with different resources; the patient population (mean age 38 years, mean BMI 25 kg/m^2) may not represent younger, obese, or elderly MyoSure hysteroscopy candidates. Second, lack of outcome assessor blinding for subjective measures introduces potential detection bias, whereas objective outcomes (temperature, time to ambulation) are less susceptible to such bias. Third, although we anticipated a 5–10% dropout when calculating sample size, no patients were lost to follow up; future trials should still prespecify and report handling of protocol deviations in intention to treat analyses. Fourth, short-term follow-up to discharge prevents assessment of delayed complications, readmission rates, or sustained quality-of-life improvements. Fifth, the KANO-based nursing intervention intervention prevents identification of active components; future factorial designs could isolate the effects of specific elements such as warming protocols, psychological support, and environmental modifications, and more precisely evaluate their individual contributions to perioperative thermoregulation, comfort, and recovery outcomes. Patients from other regions and hospitals may differ in disease characteristics, psychological states, and nursing needs. Therefore, the application of the research conclusions in other hospitals or regions may be affected to some extent. To further evaluate refined nursing based on the KANO model in patients undergoing MyoSure hysteroscopy, larger-sample, multi-center studies including patients from diverse regions and hospital types are needed to more comprehensively assess its effects and generalizability.

In conclusion, KANO model-based refined nursing in MyoSure hysteroscopy showed significant benefits for perioperative thermoregulation, comfort, nursing satisfaction, hypothermia-related reactions, and early ambulation in this randomized single center trial. Although the study has limitations, further multi center research could clarify mechanisms and support broader implementation. This KANO model-based nursing approach may be gradually promoted and continuously optimized to better meet patient needs in perioperative gynecologic settings, subject to confirmation in multicenter studies.

DECLARATIONS

Ethics approval

This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Beijing Maternal and Child Health Care Hospital (Approval number:2024-KY-136-01). A written informed consent was obtained from all participants.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author, Qiu-Ju Yan, upon reasonable request.

Competing interests

None of the authors have any financial disclosure or conflict of interest.

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REFERENCES

1 Bongers MER, Groot OQ, Buckless CG, Kapoor ND, Twining PK, Schwab JH, et al. (2022). Body composition predictors of mortality on computed tomography in patients with spinal metastases undergoing surgical treatment. Spine J. **22**(4): 595–604. https://doi.org/10.1016/j.spinee.2021.10.011

2 Boutefnouchet C, Aouras H, Khennouchi NCEH, Berredjem H, Rolain JM, Hadjadj L(2024). Algerian postcaesarean surgical site infections: A cross-sectional investigation of the epidemiology, bacteriology, and antibiotic resistance profile. Am J Infect Control. **52**(4): 456–462. https://doi.org/10.1016/j.ajic.2023.09.022

3 Cai M, Wu M, Luo X, Wang Q, Zhang Z, Ji Z (2023). Integrated Framework of Kansei Engineering and Kano Model Applied to Service Design. Int J Hum-Comput Int. **39**(5): 1096–1110. https://doi.org/10.1080/10447318.2022.2102301

4 Chollat C, Tourrel F, Houivet E, Gillet R, Verspyck E, Lecointre M, et al. (2024). Low-Dose Remifentanil in Preterm Cesarean Section with General Anesthesia: A Randomized Controlled Trial. Pediatr Drugs. **26**(1): 71–81. https://doi.org/10.1007/s40272-023-00591-w

5 Chou W, Chow JC (2023). Identifying authorial roles in research: A Kano model-based bibliometric analysis for the Journal of Medicine (Baltimore) 2023. Medicine (Baltimore). **103**(35): 13–13. doi: 10.1097/MD.0000000000039234.

6 Fu H, Wang F (2024). Effects of Natural Delivery and Cesarean Section on the Result of First Hearing Screening of Newborns. Noise Health. **26**(121): 226–230. https://doi.org/10.4103/nah.nah_68_23

7 Gan L, Yang P, Su Y, Zhang H (2023). Anesthesia for cesarean section in a gravida with osteogenesis imperfecta. Asian J Surg. **46**(8): 3236–3237. https://doi.org/10.1016/j.asjsur.2023.03.020, https://doi.org/10.1080/09544828.2023.2245533

8 Huang CY, Huang YL, Zhang YY, Qin XH, Meng CJ (2022) The therapeutic effect of hysteroscopic resection combined with progesterone on patients with endometrial polyps and the correlation between sex hormones and disease recurrence. J North Sichuan Med Coll. **37**(7): 861–865.

9 Hussein A, Torky H, Aly R, Abdel-Rasheed M, El-Baz A, Mahmoud, H, et al. (2023). Retraction of: Lidocaine vs. tramadol vs. placebo wound infiltration for post-cesarean section pain relief: a randomized controlled trial. J Perinat Med. **51**(9): 1242. https://doi.org/10.1515/jpm-2023-0334

10 Lin JY (2021). Observation of the Effect of Comfort Care Applied in the Operating Room of Patients Undergoing Hysteroscopic Surgery. Electron J Pract Gynecol Endocrinol. **8**(32): 89–91.

11 Mao W, Zhong Q, Wang H (2023). Acute subdural hematoma 4 days after cesarean section with spinal anesthesia: A case report and literature review. Asian J Surg. **46**(12): 5877–5878. https://doi.org/10.1016/j.asjsur.2023.08.188

12 Okada Y, Nakagawa C, Shigeta M, Nomura Y, Inoue E, Ichizuka K, et al.(2024). Correction to: Evaluation of levator ani muscle elasticity after vaginal delivery and cesarean section using shear wave elastography. J Med Ultrason (2001). **51**(2): 385. https://doi.org/10.1007/s10396-024-01427-x

13 Onodera H, Ida M, Naito Y, Kinomoto A, Kawaguchi M (2023). Respiratory depression following cesarean section with single-shot spinal with 100 μg morphine. J Anesth. **37**(2): 268–273. https://doi.org/10.1007/s00540-023-03163-x

14 Pian QC (2023). Analysis of the Effect of ERAS Concept Nursing in Hysteroscopy Surgery in Obstetrics and Gynecology. Med. Health (Full-text Edition, Chin Sci Tech J Database). (7): 0183–0185. https://www.cqvip.com/doc/journal/2010228904943714817.

15 Pisut K , Yasara DBR , Duangthida HNA (2023). Examination of common mistakes for successful leveraging the Kano model and proposal for enhancement. J Eng Des. **34**(7/9): 591–615.

16 Rob E, Druel T, Jalaguier T, Walch A, Gazarian A (2023). Long-term patient-reported outcome measures of fingertip coverage with a homodigital unipedicle neurovascular island flap. J Hand Surg Eur Vol. **48**(9): 920–925. https://doi.org/10.1177/17531934231172081

17 Soliman OM, Aboulfotouh AI, Abdelhafez AM, Abedalmohsen, A (2023). Nebulized dexmedetomidine versus neostigmine/atropine for treating post-dural puncture headache after cesarean section: a double-blind randomized controlled trial. Minerva Anestesiol. **89**(10): 867–875. https://doi.org/10.23736/S0375-9393.22.16906-3

18 Wang SK, Cui P, Wang DF, Wang P, Kong C, Lu SB (2023). Preoperative Zung depression scale predicts outcomes in older patients undergoing short-segment fusion surgery for degenerative lumbar spinal disease. Eur Spine J. **32**(2): 718–726. https://doi.org/10.1007/s00586-022-07497-0

19 Wang YJ, Hou LL, Liu Y (2021). Optimization Analysis of Nursing Service Demands for Natural Childbirth Patients Based on KANO Model . J Logistics Univ PAP (Med Sci). **30**(7): 47–49.

20 Wang Z, Tang X, Li L, Zhou H, Zhu Y, Chen L, et al (2024). Spiritual care needs and their attributes among Chinese inpatients with advanced breast cancer based on the Kano model: a descriptive cross-sectional study. BMC Palliat Care. **23**(1): 12–12. doi: 10.1186/s12904-024-01377-8.

21 Zhang Y, Zhang,Y(2022). The effect of preoperative motivational interviews combined with intraoperative composite insulation measures on stress response, coagulation function, and incidence of complications in patients undergoing hysteroscopic surgery. Clin Res Pract. **7**(16): 163–165.