

# RISK OF PERIOPERATIVE HYPOTHERMIA: AN INTEGRATIVE REVIEW

*Risco de hipotermia perioperatória: revisão integrativa*

*Riesgo de hipotermia perioperatoria: Una revisión integradora*

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**ABSTRACT: Objective:** To identify the occurrence and the risk factors that determine the development of the nursing diagnosis ‘risk for perioperative hypothermia’. **Method:** Integrative review, using the acronym PIO (patients, intervention, outcomes), in which P=adult and older adults; I=elective surgeries; O=risk factors associated with perioperative hypothermia. The review was conducted and reported based on the Check-list Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), following the seven steps proposed by the PRISMA method. **Results:** The search generated 854 articles, excluding duplicates and non-relevant titles. After applying the exclusion criteria, 13 articles were submitted to the final analysis. Low body mass index, advanced age and prolonged surgical time were the factors most related to the development of hypothermia in surgical patients. The management of hypothermia helps to reduce the risk of adverse cardiac events, infectious complications, and bleeding, besides bringing greater comfort to patients. **Conclusion:** Nurses need to act before the hypothermic condition sets in, recognizing the risk factors inherent to each patient and identifying which care technologies to apply. **Keywords:** Perioperative nursing. Nursing diagnosis. Hypothermia. Nursing process. Intraoperative care.

**RESUMO: Objetivo:** Identificar a ocorrência e os fatores de risco determinantes para o desenvolvimento do diagnóstico de enfermagem risco de hipotermia perioperatória. **Método:** Revisão integrativa, usando o acrônimo PIO (pacientes, intervenção, *outcomes* / desfecho), em que P=pacientes adultos e idosos; I=cirurgias eletivas; O=fatores de risco associados à hipotermia perioperatória. A revisão foi conduzida e reportada com base no Check-list Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), seguindo-se as sete etapas propostas pelo método PRISMA. **Resultados:** A busca gerou 854 artigos, sendo retirados os duplicados e os sem relevância. Após aplicação dos critérios de exclusão, 13 artigos foram submetidos à análise final. Índice de massa corporal baixo, idade avançada e tempo cirúrgico prolongado foram os fatores mais relacionados ao desenvolvimento de hipotermia nos pacientes cirúrgicos. O manejo da hipotermia colabora para diminuição dos riscos de eventos adversos cardíacos, complicações infecciosas, sangramentos e traz maior conforto para o paciente. **Conclusão:** O enfermeiro precisa agir antes do quadro hipotérmico se instalar, reconhecendo os fatores de risco inerentes ao paciente e identificando quais tecnologias do cuidado aplicar.

**Palavras-chave:** Enfermagem perioperatória. Diagnóstico de Enfermagem. Hipotermia. Processo de Enfermagem. Cuidados intraoperatórios.

**RESUMEN: Objetivo:** Identificar la ocurrencia y los factores de riesgo que determinan el desarrollo del Diagnóstico de Enfermería Riesgo de Hipotermia Perioperatoria. **Método:** Revisión integrativa, utilizando el acrónimo PIO (Pacientes, Intervención, *Outcomes* / Resultado), donde P=pacientes adultos y ancianos; I=cirugías electivas; O=factores de riesgo asociados a hipotermia perioperatoria. La revisión se llevó a cabo y se informó utilizando los elementos de informe preferidos de la lista de verificación para revisiones sistemáticas y metaanálisis (*Check-list Preferred Reporting Items for Systematic Reviews and Meta-Analyses – PRISMA*), siguiendo los siete pasos propuestos por el método PRISMA. **Resultados:** La búsqueda generó 854 artículos, eliminando los duplicados y los no relevantes. Tras aplicar los criterios de exclusión, se sometieron 13 artículos al análisis final. El bajo índice de masa corporal, la edad avanzada y el tiempo quirúrgico prolongado fueron los factores más relacionados con el desarrollo de hipotermia en los pacientes quirúrgicos. El manejo de la hipotermia ayuda a reducir los riesgos de eventos cardíacos adversos, complicaciones infecciosas, hemorragias y brinda mayor comodidad al paciente. **Conclusión:** La enfermera debe actuar antes de que se presente la condición hipotérmica, reconociendo los factores de riesgo inherentes al paciente e identificando qué tecnologías de atención aplicar.

**Palabras clave:** Enfermería perioperatoria. Diagnóstico de enfermería. Hipotermia. Proceso de enfermería. Cuidados intraoperatorios.

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## INTRODUCTION

Every year, approximately 63 million people undergo surgical treatment for traumatic injuries; another 10 million procedures are performed for complications related to pregnancy; and another 31 million, to treat malignancies.<sup>1</sup> Although the procedures are intended to save lives, failures in the surgical care process can cause considerable damage, stressing that about half of them could be prevented. The perioperative care team is the party responsible for improving communication and reducing damage to patients.

In addition, surgical care has been an essential component of health care around the world for almost a century. As the incidences of traumatic injuries, cancers, and cardiovascular diseases continue to increase, the impact of surgical intervention on public health systems will also grow. However, the lack of access to high quality surgical care has been a significant problem, even though surgical interventions can be beneficial in terms of saved lives and prevented disabilities.<sup>1</sup>

Prevention and treatment of hypothermia are extremely important to prevent increased morbidity related to adverse cardiac events, surgical site infection, impaired platelet function, changes in protein metabolism, changes in drug metabolism, variations in serum potassium levels, peripheral vasoconstriction, reduction of subcutaneous oxygen tension, coagulation abnormalities, among other harm.<sup>2</sup>

According to the North American Nursing Diagnosis Association (NANDA-I), the nursing diagnosis of risk of perioperative hypothermia was approved in 2013, being reviewed in 2017, published in several countries and in many languages,<sup>3</sup> demonstrating the importance of deepening the evidence of diagnosis validity in clinical nursing practice, comparing different locations, participants or interventions, specifying means of measuring effectiveness, efficacy and costs related to possible health complications due to perioperative hypothermia.

The nursing diagnosis (00254) risk of perioperative hypothermia (2013, 2017, level of evidence 2.1) is defined as “susceptibility to an inadvertent drop in central body temperature below 36°C, which occurs in the period between one hour before 24 hours after surgery, which can compromise health”.<sup>3</sup> It is inserted in the taxonomic structure in domain 11, safety and protection, class 6, thermoregulation.<sup>3</sup>

Thus, it can be highlighted as risk factors, that is, determinants for the development of perioperative hypothermia: “Low ambient temperature; excessive heat transfer by

conduction; excessive heat transfer by convection; excessive heat transfer by radiation”.<sup>3</sup> Therefore, this diagnosis allows thinking about classifying patients with or without risk, anticipating complications, enabling early intervention, estimating prevalence and incidences.<sup>3</sup>

The population at risk of developing perioperative hypothermia is the group of individuals who have one or more characteristics that increase the likelihood of developing perioperative hypothermia, such as: “Low preoperative temperature (<36°C); low body weight; classification score>1 for physical status by the American Society of Anesthesiologists (ASA).<sup>3</sup> This diagnosis leads a reflection on preventive measures before, during, and after the surgery, a situation in which the patient will be more likely to present a risk of hypothermia.

According to a study by the Association of periOperative Registered Nurses (AORN), nurses should be alert to demographic factors (such as age and sex) and surgical factors (type of surgery, for example).<sup>4</sup> In addition, anemia, sepsis, and postoperative mortality are factors significantly associated with hypothermia. Thus, perioperative nurses must understand the risk factors and complications associated with perioperative hypothermia to develop and test evidence-based initiatives, improving care and promoting better results for patients.<sup>4</sup>

The associated conditions include: “Combined local and general anesthesia; cardiovascular complications; diabetic neuropathy; surgical procedure”.<sup>3</sup> The deepening of these questions aims to better understand the diagnosis and its influence on the recovery of patients in the postoperative period. And, mainly, to contribute to the effective implementation of quality care, as an influencing factor in the reduction of health costs and in the full recovery of patients, in order to guarantee their safety.

Through a validation study, the existence of an indicator/determining factor for the diagnosis is verified and, in a certain way, the construction of characteristics that better define the existing clinical manifestations, the causal contributing factors of that diagnosis, and the predisposing risk factors for the phenomenon also are, thus encouraging evidence-based nursing practice.

The present study can help to improve care provided by perioperative nurses and is also relevant for institutions providing this type of care, as hypothermia increases the risk of intra and postoperative complications, increasing hospitalization time and hospital expenses.

## OBJECTIVE

To identify the occurrence and risk factors determinant to the development of the nursing diagnosis ‘risk of perioperative hypothermia’.

## METHOD

This is an integrative review conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA—Statement)<sup>5</sup> tool, based on seven main steps:

- construction of a research protocol;
- formulation of the question in evidence-based practice (EBP), using the acronym PIO (patients, intervention, outcomes);
- definition of descriptors, search strategies in each of the databases selected by the researcher, which must be varied;
- determination, selection, and review of inclusion and exclusion criteria;
- critical evaluation of studies;
- data collection using tools that can analyze in pairs (two researchers simultaneously);
- summary of results/ data grouped by similarity.

## Eligibility criteria

In order to meet the first stage of the review, the researchers developed a research protocol, in which they included: how the studies would be found, the inclusion and exclusion criteria of articles, the definition of the outcomes of interest, the verification of the accuracy of the results of articles, and determination of the quality of studies.

In the second stage, the construction of the research question was carried out, using the PICO strategy, which represents an acronym for patients, intervention, comparison, and outcomes. In the present study, as there was no comparison, PIO was used, in which P=patient/problem, I=intervention, O=outcome/result:

P – adult and older patients;

I – elective surgeries;

O – risk factors associated with perioperative hypothermia.

The following research question was then formulated: What are the risk factors associated with perioperative hypothermia in adult patients undergoing elective surgery?

## Information sources

The third stage consisted of establishing the descriptors drawn based on the thesaurus Medical Subject Headings – MESH (PubMed), Health Sciences Descriptors (*Descritores em Ciências da Saúde*) – DeCS (Latin American and Caribbean Literature in Health Sciences – LILACS), TreeTerm (EMBASE), and Cumulative Index to Nursing and Allied Health Literature (CINAHAL): “adult”, “older adult”, “risk factors”, “operative surgical procedures”, “hypothermia”, “perioperative period”, “adults”, “older adults”, “elective surgical procedures”; both in Portuguese and in English and associated with each other. As a search strategy, the Boolean operators OR and AND were used for associations.

Online searches in databases Medical Literature and Retrieval System Online (MEDLINE) via PubMed, LILACS via BVS, CINAHAL, and EMBASE via Elsevier began on February 18, 2020; March 6, 2020; and March 11, 2020, respectively.

In the fourth stage, the determination, selection, and review of the inclusion and exclusion criteria took place. The inclusion criteria of the study were: articles that address perioperative hypothermia in adults and older adults. And the exclusion criteria were: articles without a clear methodology, articles that do not address risk factors, studies from secondary sources, guidelines, research protocols, theses, dissertations, and previous notes. As filters, the studies considered had to be published between 2015 and 2020, age (adults and older adults), type of publication (articles), and in Portuguese and English.

In the fifth stage, a critical evaluation of studies was carried out. Scientific papers were selected according to their concepts, collected by a tool, with the following items: data identifying the article (authors and year of publication), country, database in which it was found, quality of studies regarding the level of evidence, methodology, and risk factors for perioperative hypothermia (Figure 1).

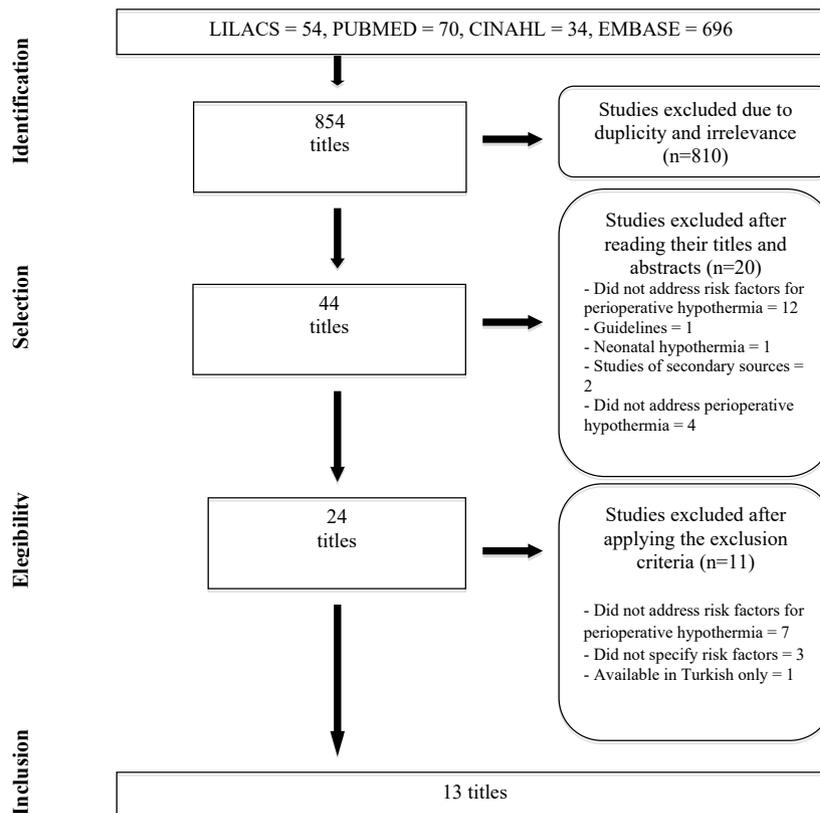
The included studies were classified according to the level of evidence and the strength of recommendation, proposed by the Centre for Evidence-Based Medicine (CEBM), Oxford, 2009 (Charts 1 and 2).

In the sixth stage, data collection was performed using tools, in an Excel spreadsheet, for peer analysis (two researchers simultaneously) of the studies according to the inclusion and exclusion criteria adopted.

In the seventh and last stage, interpretation and discussion of results were carried out, highlighting the studies that brought, in a more clear and concise way, the risk factors for perioperative hypothermia. After that, the review and synthesis of the knowledge produced about the established outcomes was presented.

## RESULTS

Figure 1 details the flowchart for selecting articles, from the initial search to the final inclusion of studies. The search strategy used generated 854 publications, 54 in LILACS, 70 in PubMed, 34 in CINAHL, and 696 in EMBASE. A total of



**Figure 1.** Flowchart of the selection process and inclusion of studies according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2009). Niterói City, Rio de Janeiro State, 2020.

**Chart 1.** Level of evidence for treatment studies — Oxford Center for Evidence-based Medicine.

Classification	Type of study
1A	Systematic review (SR) of homogeneous controlled and randomized clinical trials (RCT) of good methodological quality.
1B	ECR with small confidence interval.
2A	SR with homogeneity of cohort studies.
2B	Cohort studies; RCT of low methodological quality.
2C	Observational studies of therapeutic studies (research outcomes) and ecological studies.
3A	SR with homogeneity of control case studies.
3B	Control case studies.
4	Case series; cohort or case studies of low methodological quality.
5	Expert opinion without critical evaluation.

Source: adaptation of the Centre for Evidence-Based Medicine (CEBM). Free translation by the authors.

810 articles were excluded due to duplicity and irrelevance. When analyzing the titles and abstracts, 20 were excluded. After reading the articles in full and applying the exclusion criteria, 11 were not related to the theme, which led to their exclusion. Therefore, 13 articles were considered for final analysis, which made up the sample of this study.

In chart 3, the 13 articles included in the study are presented, highlighting authors, year, country in which the study was developed, database, level of evidence, method, and risk factors for perioperative hypothermia. Of the 13 articles included in the study, eight were available in the EMBASE database, and five, in PubMed. The years of publication vary from 2016 to 2020, with one article published in 2020, five in 2019, three in 2018, two in 2017, and two in 2016.

The oldest studies were “Warming before and after epidural block before general anesthesia for major abdominal

surgery prevents perioperative hypothermia” and “Effect of perioperative inadvertent hypothermia on the ECG parameters in patients undergoing transurethral resection”, published in 2016; and the most recent, “Prevalence and multi-variable factors associated with inadvertent intraoperative hypothermia in video-assisted thoracoscopic surgery: a single-center retrospective study”, published in 2020.

Publications were found in nine different countries. Germany was the country with the largest number of articles related to the topic, totaling three publications. The United States and Canada had two publications each. China, Brazil, France, Spain, Greece, and Turkey had one study included. Regarding the language, all studies are in English. Most studies are observational.

All the studies analyzed exposed the intrinsic and extrinsic factors to patients, and their correlations with the incidence and prevalence of hypothermia in the perioperative period.

**Chart 2.** Degree of Recommendation — Oxford Center for Evidence-based Medicine.

Classification	Type of study
A	Level 1 studies with consistent results. Example: Systematic review (RS) of controlled and randomized clinical trials (RCT).
B	Level 2 studies with consistent results. Example: Cohort RS; cohort; research outcomes; ecological studies; SR of case control and case control studies.
C	Series or case reports.
D	Expert opinion or studies classified at any other level that present inconsistent or inconclusive results.

Source: adaptation of the Centre for Evidence-Based Medicine (CEBM). Free translation by the authors.

**Chart 3.** Articles selected as a sample, according to authors, year, country of origin, database, level of evidence, method, and risk factors for hypothermia.

Author	Year	Country	Database	Level of Evidence	Method	Risk factors for perioperative hypothermia
Akers et al. <sup>4</sup>	2019	United States	EMBASE	3B	Observational Cross-sectional Retrospective Documentary	Age >60; Colectomy; Hysterectomy; Laparoscopic cholecystectomy; Hernia repair.
Li et al. <sup>6</sup>	2020	China	EMBASE	3B	Observational Cross-sectional Retrospective Documentary	Age 51 and 66; BMI <24 kg/m <sup>2</sup> ; Surgery duration >2h; Surgeries in the morning shift (8 am to 2 pm); Combined general anesthesia.
Kleimeyer et al. <sup>7</sup>	2018	United States	EMBASE	3B	Observational Cross-sectional Retrospective Documentary	Female; Low BMI (<18.5 kg/m <sup>2</sup> ); Advanced age (average =51.4 years); Hip arthroscopy; Low preoperative temperature (minimum 36°C).
Emmert et al. <sup>8</sup>	2018	Germany	PUBMED	3B	Observational Cross-sectional Retrospective Documentary	Anesthesia induction time (mean = 75.26 min); Smaller body surface area (mean = 1.92 m); Infusion of fluids intraoperatively; Thoracotomy; Epidural catheter; Low BMI (<18.5 kg/m <sup>2</sup> ).

Continue...

**Chart 3.** Continuation.

Author	Year	Country	Database	Level of Evidence	Method	Risk factors for perioperative hypothermia
Mendonça et al. <sup>9</sup>	2019	Brazil	EMBASE	2B	Observational Longitudinal Prospective Multicentric	Older adults (average = 70 years); Combined anesthesia.
Chalari et al. <sup>10</sup>	2019	Greece	EMBASE	1A	Prospective randomized clinical trial	Transurethral resection in saline solution (TURi); Transurethral resection (TUR); BMI <26.9 kg/m <sup>2</sup> ; Advanced age >86.
Bayir et al. <sup>11</sup>	2016	Turkey	PUBMED	2C	Observational Longitudinal Prospective	Transurethral resection of the prostate; Transurethral resection of the bladder.
Alfonsi et al. <sup>12</sup>	2019	France	EMBASE	2B	Observational Prospective Multicentric	Age ≥70; Anesthesia duration (one to two hours); Decrease in temperature of >0.5°C induction of anesthesia and surgical incision.
Becerra et al. <sup>13</sup>	2019	Spain	EMBASE	2C	Observational Longitudinal Prospective	Transurethral resection (TUR); Male; Infusion of liquids at room temperature.
Horn et al. <sup>14</sup>	2016	Germany	PUBMED	1A	Prospective randomized clinical trial	Long duration of abdominal surgery (≥120 min).
Ziegler et al. <sup>15</sup>	2019	Germany	EMBASE	3B	Observational Cross-sectional Retrospective Documentary	Sedatives; Mechanical ventilation; Extensive burn; Inhalation injury; Third-degree burns.
Ziolkowski et al. <sup>16</sup>	2017	Canada	PUBMED	3B	Observational Longitudinal Retrospective Documentary	Surgery duration ≥3h.
Desgranges et al. <sup>17</sup>	2017	Canada	PUBMED	2C	Observational Longitudinal Prospective	Total volume of fluids infused 650 mL; Patient temperature on arrival at the operating room <37.1°C; Patient's skin incision temperature <36.6°C.

## DISCUSSION

Most articles included in the present study cited low body mass index (BMI), advanced age, and prolonged surgical time as significant factors for the development of hypothermia.<sup>4,6-10,12</sup> One study cited the use of heating devices for 15 minutes before surgery as an important procedure in preventing hypothermia.<sup>12</sup> Transurethral prostate resection surgery was the most related to postoperative hypothermia situations.<sup>10-13</sup>

One study showed that the prevalence of hypothermia in video-assisted thoracoscopy surgeries was 72.7% and these cases were correlated with risk factors such as: advanced age, preparation time, long surgeries, low ambient temperature, surgeries that occurred in the morning, and combination of general anesthesia with paravertebral block before intubation. Overweight proved to be a protective factor against hypothermia.<sup>6</sup>

In addition to the risk factors mentioned, other authors also identified low preoperative temperature, female gender, low BMI, and pelvic and hip procedures in this category.<sup>7</sup> People who have any of these risk factors need specific interventions to prevent hypothermia and to limit their morbidity.

Hypothermia was also found to be more common in patients who have already undergone orthopedic surgery. Impaired lung function was related to perioperative hypothermia as well.<sup>8</sup>

In another publication, in which the authors studied 78 patients, 69.2% had hypothermia at the time of admission to the post-anesthesia care unit (PACU); of these, 65.4% had a temperature between 34 and 35.9°C, and 3.8% had a temperature below 34°C.<sup>9</sup> The group that presented hypothermia had received predominantly regional anesthesia

associated with morphine and sufentanil; the normothermia group had received only fentanyl. Patients were predominantly male, aged between 30 and 70, and classified as ASA II and III. As to older adults, the predominant surgery was transurethral resection of the prostate; in younger patients, cesarean surgery predominated. Regarding the type of anesthesia, young people were submitted to regional or general anesthesia, whereas most older adults was submitted to regional anesthesia.

Patients undergoing transurethral resection are at high risk for developing hypothermia. The cases of hypothermia in these surgeries were slightly higher (64.1%) than in those who underwent transurethral resection of the prostate (60%).<sup>10</sup> The postoperative temperature is considerably lower than the preoperative temperature in all patients. The reduction of hypothermia contributes to the reduction of the risk of adverse cardiac events.<sup>11</sup>

According to a multicenter study conducted in France, the drop in body temperature occurs after the anesthetic induction process and remains until admission to the PACU.<sup>12</sup> The authors emphasized that the heating systems, in most cases, are used poorly, in which professionals simply put the thermal blanket on patients, which is not enough to prevent perioperative hypothermia. Combining preheating before surgery in addition to warming up during surgery is necessary. Therefore, professionals should make better use of these heating mechanisms and perform intermittent monitoring of patients' temperature to early identify hypothermia.

Preheating is an important technique, performed before the operation. The preheating times before the transurethral resection of the prostate with spinal anesthesia were related. Patients were divided into: group 1 (without preheating), group 2 (preheating for 15 minutes), group 3 (preheating for 30 minutes), and group 4 (preheating for 45 minutes). Patients in groups 1 and 4 had more hypothermia at the end of the surgical procedure, 96.4 and 90.5%, respectively. Patients in groups 2 and 3 had similar rates for developing hypothermia (approximately 74.0%).<sup>13</sup>

Thus, preheating for 15 minutes proved to be more effective than longer preheating times or no preheating. Episodes of tremors in the PACU were mostly observed (42.9%) in patients who did not suffer pre-heating and in those who underwent heating for 45 minutes (9.5%); patients in groups 2 and 3 did not show tremors. The time spent in the PACU was shorter for groups 2 and 3, compared to group 1.<sup>13</sup> In another study, the benefit of preheating for 15 minutes before placing the

epidural catheter was evidenced as being sufficient to prevent hypothermia in all patients analyzed.<sup>14</sup>

Hypothermia is also a triggering factor for worse outcomes in patients with burns, and may cause a number of other harm. Temperature monitoring should be performed with special rigor in patients with burns, as hypothermia determines the need for more attention in their primary treatment.<sup>15</sup>

Patients with hypothermia had major burns and a higher incidence of respiratory problems. Hypothermia increases the risk of infectious complications, such as sepsis, pneumonia, urinary tract infections, and injuries.<sup>16</sup>

In cesarean surgeries, obesity, active heating, and the administration of oxytocin during labor are factors associated with a reduced risk of hypothermia. The infusion of more than 650 mL of liquids was a major risk factor for the occurrence of hypothermia.<sup>17</sup>

Nurses have a primary role in preventing hypothermia, associating the patient's risk factors and the complications that perioperative hypothermia can cause, focusing their interventions on an evidence-based practice, in order to promote better outcomes for surgical patients.<sup>18</sup>

As a study limitation, search systems, which are flawed and may have failed to include potentially eligible studies, as well as the fact that no searches were made in other databases can be mentioned.

## CONCLUSION

The present study identified the occurrence and risk factors determining the development of the nursing diagnosis 'risk of perioperative hypothermia', exposing the intrinsic and extrinsic factors that predispose patients, their correlations with the incidence and prevalence of hypothermia in the perioperative period. In the 13 articles analyzed, low BMI, advanced age, and prolonged surgical time were the factors most related to the development of hypothermia in surgical patients. Managing hypothermia contributes to reducing the risks of adverse cardiac events, infectious complications and bleeding, and brings greater thermal comfort to patients.

Promoting nurses' knowledge to identify factors that threaten patients in groups at risk of hypothermia is of utmost importance. Nurses must know how to act even before hypothermia sets in, recognizing the risk factors inherent to patients and knowing which care technologies to apply to reduce this frequent surgical complication.

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