



BMJ Open Knowledge and practice of nurses with respect to perioperative hypothermia prevention in the Northwest Amhara Regional State Referral Hospitals, Ethiopia: a cross-sectional study

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To cite: Woretaw AW, Yimer Mekonnen B, Tsegaye N, *et al.* Knowledge and practice of nurses with respect to perioperative hypothermia prevention in the Northwest Amhara Regional State Referral Hospitals, Ethiopia: a cross-sectional study. *BMJ Open* 2023;**13**:e068131. doi:10.1136/bmjopen-2022-068131

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-068131>).

Received 15 September 2022
Accepted 30 November 2023



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ABSTRACT

Objectives It has been reported that maintaining a normal body temperature among surgical patients can reduce the length of hospitalisation by up to 40%, decrease the risk of surgical site infection by 64% and reduce mortality by fourfold. Nurses are primarily responsible for preventing the occurrence of hypothermia among surgical patients. This study assessed nurses' knowledge and practices with respect to perioperative hypothermia prevention in Northwest Ethiopia, and investigated the factors associated with good knowledge and practice.

Design Cross-sectional study.

Setting Northwest Amhara Regional State Referral Hospitals, Northwest Ethiopia, 25 March–20 May 2021.

Participants 413 nurses working in the perioperative units of five referral hospitals.

Outcome measures Perioperative hypothermia prevention knowledge and practice among nurses.

Results Nearly three-fifths (59.1%; 95% CI: 54.7% to 63.7%) of respondents had good knowledge and about half (50.4%; 95% CI: 45.5% to 55.0%) had good practice with respect to perioperative hypothermia prevention. Factors associated with nurses' knowledge of prevention of perioperative hypothermia included male sex (adjusted OR (AOR): 1.61, 95% CI: 1.02 to 2.53), having a bachelor's degree (AOR: 2.50, 95% CI: 1.25 to 5.00), having a master's degree (AOR: 4.39, 95% CI: 1.45 to 13.20) and training participation (AOR: 3.68, 95% CI: 2.14 to 6.33). Factors associated with nurses' practice of prevention of perioperative hypothermia included working in recovery (AOR: 2.87, 95% CI: 1.08 to 7.58) and intensive care units (AOR: 2.39, 95% CI: 1.09 to 5.22), training participation (AOR: 2.64, 95% CI: 1.53 to 4.57), being satisfied with their job (AOR: 2.15, 95% CI: 1.34 to 3.43) and having good knowledge (AOR: 2.64, 95% CI: 1.63 to 4.27).

Conclusion Nurses' knowledge and practice of the prevention of perioperative hypothermia were inadequate. Hospital managers need to design and strengthen training programmes and work to enhance job satisfaction.

INTRODUCTION

Hypothermia is a common health problem in patients having surgery that is characterised

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This cross-sectional study used a stratified random sampling method and had a high response rate.
- ⇒ The study might be prone to social desirability bias, although this was minimised through the use of a self-administered questionnaire.
- ⇒ The content validity of the questionnaire was not formally assessed using independent experts.
- ⇒ The study results were not triangulated with findings from qualitative approaches, which could have enhanced our findings.
- ⇒ The research findings may not be generalised beyond the limited study setting.

as a body temperature below 36°C (96.8°F), and it is usually caused by too much heat loss from cold weather exposure, anaesthetic effects, and the administration of cold intravenous or irrigation fluids.^{1–3} Hypothermia decelerates all physiological roles, including metabolic rate, mental awareness, nerve conduction, neuromuscular reaction times, and cardiovascular and respiratory systems, disturbing patients' comfort and leading to longer hospitalisation, higher costs and increasing mortality.¹⁴

Different studies conducted in different areas revealed that the magnitude of perioperative hypothermia in Brazil was 56.7%⁵; in Australia, 74%⁶; and in Turkey, in the Research Hospital of Ankara and Trakya University Hospital, 78.6% and 63.3%, respectively.^{7,8} In other studies conducted in Thailand, the incidence of preoperative, intraoperative and postoperative hypothermia was 0.4%, 73.5% and 11.9%, respectively.⁹ While the study was conducted in Germany to evaluate the hypothermia rates achieved with pre-warming and without pre-warming methods, the results

revealed patients subjected to pre-warming showed an intraoperative hypothermia rate of 15.8% and a postoperative hypothermia rate of 5.1%. In comparison, patients without pre-warming showed an intraoperative hypothermia rate of 30.4% and a postoperative hypothermia rate of 12.4%, a 52% reduction in the intraoperative hypothermia rate and a 41% reduction in the postoperative hypothermia rate for patients who received pre-warming.¹⁰ Furthermore, in studies conducted in Ethiopia at Tikur Anbessa Specialized Hospital, the overall magnitude of preoperative, intraoperative and postoperative hypothermia was 16.2%, 53.2% and 31.3%, respectively.¹¹ In contrast, at the University of Gondar Comprehensive Specialized Referral Hospital (UoGCSRH), preoperative, intraoperative and postoperative hypothermia incidence was 23.4%, 49.7% and 50.6%, respectively.¹² However, available literature shows that nurses' knowledge and practice towards perioperative hypothermia prevention are low despite the high incidence, serious consequences and availability of effective interventions to prevent and treat this frequent surgical complication.^{2 13} In intervention studies conducted on perioperative hypothermia prevention in Brazil and Turkey, 55.9% and 61.77% of nurses had good knowledge before training.^{4 14} Another cross-sectional study was done in Ethiopia regarding perioperative hypothermia prevention in trauma patients; only 52.1% of nurses had good knowledge.¹⁵ In studies conducted in South Africa and Gambia, 46% and 19% of nurses had good perioperative hypothermia prevention practices, respectively.^{13 16}

According to the Association of Perioperative Register Nurses (AORN) guidelines, nurses must have knowledge and skills in preventing hypothermia during the perioperative phase. This includes measuring the patient's body temperature, selecting methods to prevent unintended hypothermia, and implementing the selected insulation and warming interventions.¹⁷ Warming intervention measures include warming patients before, during and after surgery using passive insulation and active warming methods such as warm cotton blankets, surgical draping, thermal garments, forced air warming devices, electric warming blankets and warm fluids.^{18 19}

Preventing heat loss and maintaining a normal body temperature are essential nursing tasks in the early resuscitation phase, as metabolic changes accompanied by injury cannot be corrected when patients are hypothermic.²⁰ Nurses need to be cognisant of the risks associated with each perioperative phase of the patient in the prevention of hypothermia.²¹ Preserving a normal body temperature during the surgical experience enhances the patient's chance of preventing postoperative complications.²² A lot of evidence reported that maintenance of a normal body temperature decreases the length of hospitalisation by approximately up to 40% and the risk of surgical site infection by 64%, may prevent the costs of potential stay in the intensive care unit by \$1000 and a prolonged hospital stay by \$465 per day, and also decreases mortality rate by fourfold.^{23–25}

If nurses do not have adequate knowledge and skill in the prevention of perioperative hypothermia, its occurrence is inevitable. Even if nurses' knowledge and practice are important in preventing perioperative hypothermia and its complications, available literature revealed that nurses had significant knowledge and practice gaps.^{13 15} Different sociodemographic and institutional factors affect nurses' knowledge and practice, such as age, marital status, educational level, work experience, guidelines and risk assessment protocols, training, reading of updated evidence and job satisfaction.^{2 13 15 26 27}

In Ethiopia, there is limited evidence regarding the knowledge and practice of nurses on perioperative hypothermia prevention. Therefore, this study assessed nurses' knowledge and practice with respect to perioperative hypothermia prevention in Northwest Amhara Regional State Referral Hospitals, Northwest Ethiopia, and investigated the factors associated with good knowledge and practice.

METHODS

Study design and settings

An institutional-based cross-sectional study was conducted in five referral hospitals' perioperative units or wards from 25 March to 20 May 2021.

The study was conducted in Northwest Amhara Regional State Referral Hospitals, Northwest Ethiopia. Northwest Amhara is found in the northwestern part of Ethiopia. There are five governmental referral hospitals in Northwest Amhara Regional State, namely the UoGCSRH, Felege Hiwot Referral Hospital (FHRH), Tibebe Gion Specialized Referral Hospital (TGSRH), Debre Markos Referral Hospital (DMRH) and Debre Tabor Comprehensive Referral Hospital (DTCRH). All of these hospitals provide both outpatient and inpatient services.

The surgical department is one of the actively serving departments that provide emergency and elective surgery among hospital services. All five hospitals have different surgical units in their surgical departments, such as surgical emergency, operating room, recovery ward, surgical ward, orthopaedics ward and surgical intensive care unit (ICU). According to information obtained from the administrative offices of these hospitals, 1682 nurses provide services. Among these, 725 nurses (153 in UoGCSRH, 220 in FHRH, 144 in TGSRH, 127 in DMRH and 81 in DTCRH) are working in surgical departments.^{28–32} Nurses in the perioperative unit provide different hypothermia preventive activities like covering patients with linens and blankets, measuring patients' temperatures, warming intravenous fluids, adjusting room temperature and so on, because preventing perioperative hypothermia is crucial for nurses.

Participants

All nurses working in the emergency ward, operating room, recovery ward, surgical ward, orthopaedics ward and surgical ICU of Northwest Amhara Regional State

Referral Hospitals were the source populations. On the other hand, nurses who were working in an emergency ward, operating room, recovery ward, surgical ward, orthopaedics ward and surgical ICU of UoGCSRH, DTCRH, DMRH, TGSRH and FHRH during the data collection period were the study population.

All nurses working in the surgical emergency room, operating room, recovery ward, surgical ICU, surgical ward and orthopaedics ward of Northwest Amhara Regional State Referral Hospitals, Northwest Ethiopia were included in this study. However, matron and ward coordinator nurses were excluded because those nurses are primarily responsible for coordinating, monitoring and evaluating the staff nurses rather than doing routine activities.

Sample size and sampling procedure

The sample size was calculated using the single population proportion formula ($n = Z\alpha / 2^2 \times P(1-P) / d^2$). A 50% proportion of nurses' knowledge and practice on hypothermia prevention, 95% confidence level and 5% expected margin of error (d) were used. By considering a 10% non-response rate, the final sample becomes 423.

The study participants were recruited using a stratified sampling technique. Initially, the study participants are stratified by hospital and working ward or unit, and the required sample for each stratum is allocated proportionally. According to all hospitals' human resources and administration reports, the total number of nurses working in these units or wards was 725. The calculated sample size was then proportionally allocated to each hospital according to the number of nurses working in the respective departments or wards (ie, from 153, 89 in UoGCSRH; from 144, 84 in TGSRH; from 220, 128 in FHRH; from 81, 48 in DTCRH; and from 127, 74 nurses in DMRH). Finally, study participants were chosen using a simple random sampling technique from each sampling frame (online supplemental figure 1).

Variables and measurements

Knowledge of nurses on hypothermia prevention was assessed using 27 questions derived from the association of perioperative register nurse guidelines and literature.^{3 13 21} If the study participants answered the knowledge questions above or were equal to the computed median score, they were considered to have good knowledge.

Practice of nurses on hypothermia prevention is activity performed by nurses to prevent hypothermia. It was measured by 14 items with Likert scale containing three response options with a code of 0=never, 1=sometimes and 2=always.^{3 13 15} Participants who answered above or equal to the computed median of practice questions were considered to have good practice.

Job satisfaction is the nurses' degree of negative or positive views about their job or job experience. It was measured using 27 items of a 5-point Likert scale (1=strongly disagree–5=strongly agree).³³ When their total score for

the job satisfaction questionnaire was greater than or equal to the computed median, they were satisfied.

Data collection instruments and procedure

A self-administered structured questionnaire was used to collect the data. The questionnaires were developed based on AORN and National Institute for Health and Care Excellence (NICE) perioperative hypothermia prevention guidelines and other literature.^{3 13 15 21 34 35} In addition to the outcome variable, the tool contains socio-demographic, institutional and other factors^{13 15 26 27 33 36} (online supplemental file 1). Five BSc nurses working outside the study wards and two MSc nurses were recruited for the data collection and supervision, respectively. Overall, the principal investigator coordinated and supervised the data collection process.

Data quality control

To assure the quality of the data, the questionnaire was first prepared in English, then translated to Amharic (local language) and then translated back to English to check its consistency. One-day training on the purpose of the study and the data collection procedure was provided to the data collectors and supervisors. Additionally, the tool was pretested at Woldia Comprehensive Referral Hospital with 5% of the sample size. For the dependent variable and job satisfaction questionnaires, internal consistency was checked using Cronbach's alpha test, and its values were in the acceptable range with a minimum value of 0.77. Supervisors and primary investigators conducted routine supervision to verify the consistency and completeness of the questionnaires that were filled out.

Data processing and analysis

After the data were checked for consistency and completeness, data were entered into Epi Info V.7 and exported into SPSS V.25 for analysis. A frequency table described the participant's characteristics, knowledge and practice scores. Multicollinearity among the dependent variables was assessed using the variance inflation factor, and its values were between 1 and 10. Model adequacy was checked using the Hosmer-Lemeshow goodness-of-fit test, and the model was fitted well, indicating 0.856 and 0.993 for knowledge and practice, respectively. Binary logistic regression was used to determine the significant association between the independent and dependent variables. Those independent variables, less than 0.2 in bivariable analysis, were entered into multivariable logistic regression. The association between the independent and dependent variables was considered significant if the p value was less than 0.05 from multivariate logistic regression analysis. Adjusted OR (AOR) with 95% CI and a p value of <0.05 were used to declare associated factors with the knowledge and practice of nurses on hypothermia prevention.

Patient and public involvement

None.

Table 1 Sociodemographic characteristics of nurses on perioperative hypothermia prevention in Amhara Regional State Referral Hospitals, Northwest Ethiopia, 2021 (N=413)

Variable	Response	Frequency (N=413)	Percentage
Sex	Male	213	51.6
	Female	200	48.4
Age (years)	≤25	53	12.8
	26–30	224	54.2
	31–35	86	20.8
	≥35	50	12.1
Marital status	Single	163	39.5
	Married	235	56.9
	Divorced	12	2.9
	Widowed	3	0.7
Educational status	Diploma	59	14.3
	Degree	311	75.3
	Master	43	10.4
Work experience (years)	≤5	157	38
	6–10	181	43.8
	11–15	57	13.8
	≥16	18	4.4
Monthly salary (ETB)	≤5000	42	10.2
	5001–7000	158	38.3
	7001–9000	172	41.6
	≥9001	41	9.9

ETB, Ethiopian birr.

RESULTS

Sociodemographic characteristics of the respondents

In the present study, 413 nurses responded to the self-administered questionnaires with a response rate of 97.6%. The study participants' median age (IQR) was 29 (27–32) years. Two hundred thirteen (51.6%) participants were male, and the majority (235, 56.9%) were married. Regarding their educational status, nearly three-fourths of the respondents had a bachelor's degree (table 1).

Institutional and job-related factors

From 413, 268 (64.9%) of nurses did not receive training in perioperative hypothermia prevention. Half of the respondents reported reading or reviewing updated evidence, and only 121 (29.3%) participants were notified of guidelines or protocols in their working area. Majority of study participants (268, 64.9%) and 342 (82.8%) had a thermometer and warming material shortage, respectively. Nearly half (217, 52.5%) of the participants were satisfied with their jobs (online supplemental table 1).

Knowledge of nurses about hypothermia prevention

The overall knowledge of nurses about perioperative hypothermia prevention was 59.1% (95% CI: 54.7%

to 63.7%); the median knowledge score was 18 (IQR: 16–21). Among the total number of knowledge assessment questions, 359 (86.9%) participants correctly answered the statement about thermoregulation, while 250 (60.5%) answered the complications of hypothermia in surgical patients. Only 83 (20.1%) of the participants correctly responded about the theatre room: the patient's temperature should be measured every 30 min, while in the recovery room, every 15 min (table 2).

Practice of nurses on hypothermia prevention

The overall median practice score of nurses on perioperative hypothermia prevention was 18 (IQR: 14–21), and their overall practice of hypothermia prevention was 50.4% (95% CI: 45.5% to 55.0%). Among practice assessment questions, 258 (62.5%) of the respondents measured temperature as soon as the patient arrived, and 224 (54.2%) always assessed hypothermia's signs and symptoms. Nearly half of the respondents (213, 51.6%) sometimes applied warm intravenous blood products and irrigation fluids. About 185 (44.8%) respondents reported never using forced air warming devices, warm water circulating devices and conductive devices for warming surgical patients (table 3).

Factors associated with the level of knowledge about hypothermia prevention

In the binary logistic regression, 10 of 15 variables had a p value of <0.2 and were candidates for multiple logistic regression. In multiple logistic regression, only three variables were significantly associated with knowledge of perioperative hypothermia prevention. Accordingly, being male (AOR=1.61, 95% CI (1.02 to 2.53)), being a degree and master's holder (AOR=2.50; 95% CI (1.25 to 5.00) and 4.39 (1.45 to 13.20)), respectively, and taking training in perioperative hypothermia prevention (AOR=3.68; 95% CI (2.14 to 6.33)) were significantly associated with their knowledge (table 4).

Factors associated with the level of practice on hypothermia prevention

In bivariate logistic regression analysis, 11 of 16 variables were found to have significant predictors at a p value of <0.2 and were candidates for multiple logistic regression. In multiple logistic regression, only four variables were significantly associated with the practice of nurses on hypothermia prevention (p<0.05).

Working in recovery units and ICUs (AOR=2.87; 95% CI (1.08 to 7.58) and 2.39; 95% CI (1.09 to 5.22)), respectively, having training related to hypothermia prevention (AOR=2.64; 95% CI (1.53 to 4.57)), being satisfied with the job (AOR 2.15; 95% CI (1.34 to 3.43)) and having good knowledge of hypothermia (AOR=2.64; 95% CI (1.63 to 4.27)) were significantly associated with the nurses' practice (table 5).

Table 2 Nurses' responses on knowledge of perioperative hypothermia prevention (N=413)

Statements about perioperative hypothermia prevention	True (T)/false (F)	Correct answer		Wrong answer/I don't know	
		N	%	N	%
The internal environment of humans can be maintained by thermoregulation.	T	359	86.9	54	13.1
PH during the perioperative cycle is characterised as a core body temperature <36°C.	T	288	69.7	125	30.3
Anaesthetic drugs decrease heat loss in surgical patients.	F	311	75.3	102	24.7
Cold IV fluids and blood products increase heat loss.	T	288	69.5	126	30.5
PH is not associated with complications such as changes in drug metabolism, healing complications, shivering, clotting defects, cardiac morbidity and prolonged post-anaesthetic recovery.	F	250	60.5	163	39.5
To minimise postoperative complications, nurses should advise patients to bring along additional clothing to help them stay warm before surgery.	T	339	82.1	74	17.9
The pulmonary artery catheter, distal oesophagus, urinary bladder, rectum and zero heat flux are some of the sites for temperature measurements.	T	174	42.1	239	57.9
Nurses should be well trained and knowledgeable about the use of both temperature recording and warming devices.	T	346	83.8	67	16.2
Forced air warming devices, warm water circulating and conductive devices are not some of the devices for warming surgical patients.	F	241	58.4	172	41.6
The method for temperature monitoring should not be chosen based on the criteria for a procedure.	F	281	68	132	32
To ensure accurate information, the team should take the patient's temperature at 15-minute intervals using different measuring devices at different sites.	F	138	33.4	275	66.6
Patients with a temperature <36.0°C undergoing anaesthesia and those having a high risk of cardiovascular complications are at higher risk of IPH.	T	293	70.9	120	29.1
Measuring patients' temperature an hour before departing the ward is unnecessary since it will be measured at the theatre.	F	279	67.6	134	32.4
Except in urgent circumstances, preoperative patients with temperatures of <36.0°C should be warmed for 30° by using the active warming method.	T	284	68.8	129	31.2
Special attention should be given to the comfort of surgical patients having difficulties expressing themselves.	T	335	81.1	78	18.9
The method for warming patients should be chosen based on the planned procedure, patient position, IV access site and warming equipment constraints.	T	333	80.6	80	19.4
Critical incidence reporting is unnecessary for patients entering into the theatre with a temperature of less than 36.0°C.	F	259	62.7	154	37.3
Induction of anaesthesia should not begin unless the patient's temperature is 36.0°C or above.	T	203	49.2	210	50.8
The theatre room's temperature should be at least 21°C which can be adjusted to allow better working once active warming is initiated.	T	273	66.1	140	33.9
All intraoperative irrigation fluids should be warmed in a thermostatically controlled cabinet to 38–40°C.	T	214	51.8	199	48.2
Fluid warming devices should be used to warm IV fluids (500 mL or more) and blood products to 37°C.	T	260	63	153	37

Continued

Table 2 Continued

Statements about perioperative hypothermia prevention	True (T)/false (F)	Correct answer		Wrong answer/I don't know	
		N	%	N	%
Regardless of patients' temperatures before leaving the ward, they should be warmed using active warming method once in the theatre.	T	256	62	157	38
The surgical patient should be well covered throughout surgery to conserve heat and only be exposed during surgical preparation.	T	310	75.1	103	24.9
During the postoperative period, patients with hypothermia should be warmed using active warming method until they become warm before being transferred to the ward.	T	348	84.3	65	15.7
Patients should be provided with at least one cotton sheet, two blankets or a duvet during the postoperative phase.	T	319	77.2	94	22.8
While in the OR, the patient's temperature should be measured every 15 min and every 30 min while in the RR.	F	83	20.1	330	79.9
The temperature of postoperative patients should be recorded on arrival in the ward and documented as part of a routine 4-hour observation.	T	337	81.6	76	18.4

IPH, inadvertent perioperative hypothermia; IV, intravenous; N, number of participants; OR, operating room; PH, perioperative hypothermia; RR, recovery room.

DISCUSSION

This study showed that the overall knowledge of nurses about perioperative hypothermia prevention was 59.1%. This finding is higher than the result of a study done in Ethiopia (52.1%).¹⁵ The possible reason might be due to sociodemographic differences. In the previous study, most participants had a degree and diploma level of education, and the study area was a single trauma centre setting. In contrast, in the current study, more than 10% of the participants had master's degree, and the study setting was multicentre. The other reason might be the difference in the time of the study because of the advancement of technology, including updated evidence; educational programmes were increased when the time was more recent. So, the participant might have to get more information regarding the topics.

However, this finding is much lower than those of studies conducted in Gambia (82%),¹³ Turkey (77.5%),⁴ Brazil (81.5%),¹⁴ the University of Iowa Hospitals and Clinics, USA (71%),³⁷ Maryland, USA (100%)³⁸ and Ireland.³⁹ Besides, our study finding is lower than the NICE, AORN, and American Society of PeriAnesthesia Nurses (ASPAN) guidelines for perioperative hypothermia prevention.^{3 17 21} The possible justification for this difference might be due to the level of staff training, adopted recommended guidelines, socioeconomic status and sample size. With regard to training in hypothermia prevention in this study, only a few nurses (35.1%) have been trained, while in the comparison group, except in Gambia, almost all participants received training in perioperative hypothermia prevention. In terms of using guidelines or protocols, in the studies conducted in America, participants always used

recommended guidelines and protocols, while in this study, only 29.3% of nurses were reported as having guidelines or protocols. Regarding the difference in socioeconomic status of the participants and the study setting, Ethiopians are in a low-income country compared with those in America, Brazil and Ireland. This indirectly affects the quality of healthcare education and the healthcare setting. In terms of sample size, the present study has a larger sample size (n=413) compared with all the aforementioned studies (Gambia (n=53), Turkey (n=200), Brazil (n=21), the University of Iowa Hospitals and Clinics, USA (n=30), Maryland, USA (n=19), and Ireland (n=198)).

In this study, the overall practice of nurses on perioperative hypothermia prevention was 50.4%. This finding is consistent with the result of studies conducted in Addis Ababa, Ethiopia (52.5%) and Durban, South Africa (46%).^{15 16} However, this result is higher than that of a study done in Gambia (19%).¹³ The possible reason might be the difference in sociodemographic characteristics, in which most participants in the Gambia study had less than 5 years of experience and had not had a master's degree. On the other hand, the result of this study is much lower than that of NICE, AORN and ASPAN recommendation guidelines.^{3 17 21} This discrepancy might be attributed to insufficient warming materials, measurement materials, guidelines or protocol, and nurse training opportunities.

Regarding nurses' knowledge of hypothermia prevention, this study identified that male nurses had more knowledge than female nurses. This might be explained by the fact that females have additional responsibilities at home, such as taking care of children, cooking, cleaning and so on.⁴⁰ As a result, they might not have the time to

Table 3 Nurses' responses on the practice of perioperative hypothermia prevention (N=413)

Hypothermia prevention practices	Never		Sometimes		Always	
	N	%	N	%	N	%
Do you measure temperature as soon as the patient arrives?	21	5.1	134	32.4	258	62.5
Do you measure temperature regularly according to guidelines?	50	12.1	202	48.9	161	39
Do you warm intravenous blood products and irrigation fluids using warming devices before administering them to patients?	112	27.1	213	51.6	88	21.3
Do you cover the mattress plastic sheet with dry linen before patient admission?	59	14.3	200	48.4	154	37.3
Do you use forced air warming, warm water circulating devices and conductive devices for warming patients?	185	44.8	170	41.2	58	14
Do you communicate your assessment findings on factors that could lead to hypothermia to all members of the perioperative team?	57	13.8	160	38.7	196	47.5
Do you advise patients to inform you when they feel cold during their hospitalisation?	53	12.8	195	47.2	165	40
Do you develop and implement care plans for perioperative hypothermia prevention?	73	17.7	217	52.5	123	29.8
Do you document the site for temperature measurement in the patient's file?	63	15.3	156	37.8	194	47
Do you maintain ambient room temperature according to the guidelines?	110	26.6	214	51.8	89	21.5
Do you assess patients for their risk of perioperative hypothermia?	41	9.9	202	48.9	170	41.2
Do you assess for signs and symptoms of hypothermia?	30	7.3	159	38.5	224	54.2
Do you advise patients to stay warm before surgery?	48	11.6	185	44.8	180	43.6
Do you include thermoregulation interventions and patient-related care to thermoregulation in your handover report?	41	9.9	194	47	178	43.1

read books or guidelines that broaden their knowledge in the field.

This study also dictates that nurses who had BSc and master's degrees were more likely to have good knowledge of hypothermia prevention compared with those who only had a diploma. This finding is supported by studies conducted in Iran²⁶ and Brazil.¹⁴ This implies that educational interventions are fundamental for nurses to improve their scientific knowledge, which, in turn, increase the quality of patient care.¹⁴ Furthermore, this can be explained by the possibility that nurses with higher educational status may be exposed to different courses related to preventing hypothermia.

Nurses' knowledge and practice were higher among nurses who received training related to hypothermia prevention compared with those who did not. This finding is supported by other studies in America,³⁸ Brazil,⁴¹ Iran²⁶ and Turkey.⁴ This can be explained by the fact that training plays an important role in improving the quality of patient care. This implies the need to promote on-site and off-site training for nurses, which is an invaluable criterion, as training is necessary to update theoretical and practical knowledge in every aspect of nursing education.⁴⁰

This study also showed that nurses working in recovery units and ICUs were more likely to have good practice than those working in the emergency ward. This finding is inconsistent with the study conducted in Turkey; ICU nurses had more knowledge than nurses working in other wards, but their practice was not changing.⁴ The possible reason recovery and ICU nurses had better practice might be that patients admitted to recovery and ICU wards need close follow-up because of their physiological change or disturbance due to surgery or anaesthesia. So, working in two wards, the nurses perform more activities, which maintain thermoregulation. Another reason might be that the nurse-to-patient ratio is better than in other wards; the standard is in recovery, 1:2; ICU, 1:1; emergency, 1:3; and for surgical and orthopaedic wards, 1:6, in Ethiopia. The other reason might be the better availability of resources like a thermometer and warming materials. Also, most nurses in those two wards received more training than others.

In this study, nurses who were satisfied with their jobs were 2.2 times more likely to have a good level of practice than those who were not satisfied. Job satisfaction among nurses is highly important in building employee interest and efficiency, as higher job satisfaction determines better employee performance.⁴² Therefore, hospital administrators need to improve working environments so that nurses feel comfortable, which will result in a positive attitude toward their jobs.

The other significant variable is that nurses who know about hypothermia prevention were 2.6 times more likely to have good practice than those who do not. This finding is supported by studies conducted in Nigeria⁴³ and the textbook of Brunner and Suddarth.⁴⁴ AORN guideline also supports that surgical team awareness, education and

Table 4 Bivariable and multivariable analyses of factors associated with nurses' knowledge of perioperative hypothermia prevention in Amhara Region Referral Hospitals, Northwest Ethiopia

Variable	Knowledge of nurses		COR (95% CI)	P value	AOR (95% CI)	P value
	Good	Poor				
Sex						
Female	105	95	1		1	
Male	139	74	1.69 (1.14 to 2.52)	0.009	1.61 (1.02 to 2.53)	0.038*
Educational status						
Diploma	19	40	1		1	
Degree	191	120	3.35 (1.85 to 6.05)	0.000	2.50 (1.25 to 5.00)	0.010*
Master	34	9	7.95 (3.18 to 19.8)	0.000	4.39 (1.45 to 13.2)	0.008*
Hospital						
FHRH	67	59	1		1	
UoGCSRH	48	35	1.20 (0.69 to 2.11)	0.314	1.18 (0.631 to 2.21)	0.601
DMRH	51	22	2.04 (1.11 to 3.76)	0.056	1.74 (0.863 to 3.49)	0.118
DTCRH	33	14	2.08 (1.01 to 4.25)	0.046	2.16 (0.933 to 4.94)	0.068
TGSRH	45	39	1.01 (0.58 to 1.77)	0.955	1.20 (0.627 to 2.29)	0.581
Ward						
Emergency	52	51	1		1	
Recovery	31	8	3.8 (1.59 to 9.05)	0.003	2.24 (0.862 to 5.84)	0.098
ICU	34	19	1.75 (0.88 to 3.46)	0.106	1.48 (0.696 to 3.16)	0.307
OR	67	35	1.87 (1.07 to 3.29)	0.028	1.51 (0.799 to 2.86)	0.203
Orthopaedics	26	20	1.27 (0.63 to 2.56)	0.496	1.35 (0.641 to 3.02)	0.402
Surgical	34	36	0.92 (0.50 to 1.70)	0.805	0.850 (0.431 to 1.67)	0.640
Monthly salary (ETB)						
≤5000	18	21	1		1	
5001–7000	90	74	1.41 (0.7 to 2.85)	0.477	1.10 (0.478 to 2.35)	0.885
7001–9000	107	64	1.95 (0.96 to 3.93)	0.075	0.848 (0.492 to 2.49)	0.802
≥9001	29	10	3.38 (1.3 to 8.79)	0.010	1.53 (0.507 to 4.67)	0.447
Having guidelines						
No	124	168	1		1	
Yes	75	46	1.37 (0.88 to 2.1)	0.153	0.848 (0.490 to 1.46)	0.555
Took training						
No	128	140	1		1	
Yes	116	29	4.37 (2.72 to 7.01)	0.000	3.68 (2.14 to 6.33)	0.000*
Reading updated evidence						
No	106	100	1		1	
Yes	138	69	1.88 (1.26 to 2.80)	0.002	1.32 (0.834 to 2.10)	0.234
Shortage of thermometer						
Yes	148	120	1		1	
No	96	49	1.58 (1.04 to 2.41)	0.031	1.27 (0.776 to 2.08)	0.325
Job satisfaction						
Unsatisfied	100	95	1		1	
Satisfied	144	74	1.84 (1.24 to 2.74)	0.002	1.38 (0.873 to 2.20)	0.166

*Statistically significant at a p value of <0.05.

AOR, adjusted OR; COR, crude OR; DMRH, Debre Markos Referral Hospital; DTCRH, Debre Tabor Comprehensive Referral Hospital; ETB, Ethiopian birr; FHRH, Felege Hiwot Referral Hospital; ICU, intensive care unit; OR, operating room; TGSRH, Tibebe Gion Specialized Referral Hospital; UoGCSRH, University of Gondar Comprehensive Specialized Referral Hospital.

Table 5 Bivariable and multivariable analyses of factors associated with the practice of nurses on perioperative hypothermia prevention in Amhara Region Referral Hospitals, Northwest Ethiopia

Variable	Practice of nurses		COR (95% CI)	P value	AOR (95% CI)	P value
	Good	Poor				
Educational status						
Diploma	16	43	1		1	
Degree	159	152	2.81 (1.51 to 5.20)	0.000	1.94 (0.902 to 4.20)	0.089
Master	24	19	3.39 (1.47 to 7.79)	0.002	1.28 (0.411 to 4.00)	0.669
Ward						
Emergency	41	62	1		1	
Recovery	30	9	5.04 (2.1 to 11.71)	0.000	2.87 (1.08 to 7.58)	0.033*
ICU	34	19	2.70 (1.36 to 5.37)	0.004	2.39 (1.09 to 5.22)	0.029*
OR	59	43	2.07 (1.18 to 3.62)	0.010	1.63 (0.856 to 3.12)	0.136
Orthopaedics	20	26	1.16 (0.575 to 2.35)	0.674	1.17 (0.527 to 2.62)	0.693
Surgical	24	46	0.78 (0.419 to 1.48)	0.467	0.657 (0.321 to 1.34)	0.250
Work experience (years)						
≤5	69	88	1		1	
6–10	95	86	1.4 (0.917 to 2.16)	0.118	1.26 (0.713 to 2.23)	0.424
11–15	32	25	1.63 (0.886 to 3.00)	0.116	1.68 (0.735 to 3.86)	0.217
≥16	12	6	2.55 (0.911 to 7.14)	0.075	3.26 (0.85 to 12.44)	0.083
Monthly salary (ETB)						
≤5000	17	25	1		1	
5001–7000	67	91	1.08 (0.542 to 2.16)	0.822	1.01 (0.436 to 2.35)	0.976
7001–9000	98	74	1.94 (0.987 to 3.86)	0.057	1.26 (0.517 to 3.10)	0.604
≥9001	26	15	2.54 (1.05 to 6.17)	0.038	1.05 (0.310 to 3.58)	0.933
Having guidelines/protocol						
No	131	161	1		1	
Yes	77	44	2.15 (1.39 to 3.32)	0.001	1.42 (0.824 to 2.47)	0.205
Took training						
No	104	164	1		1	
Yes	104	41	4.00 (2.58 to 6.19)	0.000	2.64 (1.53 to 4.57)	0.001*
Reading updated evidence						
No	84	122	1		1	
Yes	124	83	2.17 (1.46 to 3.21)	0.000	1.37 (0.853 to 2.21)	0.192
Shortage of thermometer						
Yes	123	145	1.67 (1.11 to 2.51)	0.014	1.10 (0.661 to 1.83)	0.711
No	85	60	1		1	
Shortage of warming materials						
Yes	166	176	1.53 (0.914 to 2.57)	0.105	1.77 (0.923 to 3.39)	0.086
No	42	29	1		1	
Job satisfaction						
Unsatisfied	71	124	1		1	
Satisfied	137	81	2.95 (1.97 to 4.41)	0.000	2.15 (1.34 to 3.43)	0.001*
Knowledge						
Good	157	87	4.17 (2.74 to 6.35)	0.000	2.64 (1.63 to 4.27)	0.000*
Poor	51	118	1		1	

*Statistically significant at a p value of <0.05.

AOR, adjusted OR; COR, crude OR; ETB, Ethiopian birr; ICU, intensive care unit; OR, operating room.

understanding of hypothermia are necessary to change how clinicians provide quality and effective patient care.³⁵

Limitations of the study

The study findings might be prone to social desirability bias, although this was minimised through the use of self-administered questionnaires. In addition, the content validity of the questionnaires was not formally assessed by independent experts. The study results were not triangulated with findings from qualitative approaches, which could have enhanced our findings. Finally, despite being a multicentre study covering a large area, the research findings may not be generalised beyond the study setting.

CONCLUSION

This study revealed that the knowledge and practice of nurses on the prevention of perioperative hypothermia in the study area were inadequate compared with the recommended guidelines. Higher educational status, being male and attending training were significantly associated with good knowledge of nurses about perioperative hypothermia prevention. Concurrently, nurses' working wards, training opportunities, job satisfaction and knowledge were the factors contributing to their good practice in preventing perioperative hypothermia.

Therefore, hospital and healthcare managers need to design in-service training and long-term educational opportunities to improve nurses' knowledge and practice in the area. In addition, hospitals need to fulfil the resources such as warming materials, thermometers, and updated guidelines or protocols, and improve working environments so that nurses become safe and comfortable, resulting in a positive feeling towards their job. Furthermore, we recommend that future researchers conduct a mixed-methods study to provide sufficient evidence for policymakers.

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Acknowledgements We would like to thank the University of Gondar, College of Medicine and Health Sciences, School of Nursing. We are also grateful to the five hospital administrators for their cooperation. Finally, we thank the study participants, data collectors and supervisors for their contribution to the study.

Contributors AWW conceived the study, design the work, draft the manuscript and is responsible for the overall content as guarantor. AWW, BYM, and NT participated in developing the measurement tool, proposal writing, data analysis and interpretation of the result. BYM, NT and ED review and edit the draft manuscript. All authors read and approved the final manuscript before submitting it to the journal for publication.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not required.

Ethics approval This study involves human participants and ethical clearance was obtained from the University of Gondar Institutional Review Board (IRB) (S/R/164/2/2021). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article or uploaded as supplemental information.

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