Hypothermia and blood coagulation biomarkers and their implications for perioperative nursing: A systematic review

Supplement 1: Search strategies by database

Database	Search strategies
Academic Search Premier	((((Hypothermia*) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative Hypothermia*)) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative OR preoperative)
CINAHL	((((Hypothermia*) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative Hypothermia*)) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative OR preoperative)
Cochrane CENTRAL	((((Hypothermia*) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative Hypothermia*)) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative OR preoperative) in Title Abstract Keyword
Embase	((((Hypothermia*) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative Hypothermia*)) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative OR preoperative)
LILACS	((Hypothermia* OR Hypothermia* OR Hypothermia*) AND (Hemostasis OR Hemostases OR Hemostasis OR Hemostase OR coagulation OR coagulopathy OR coagulation* OR coagulopathy OR coagulopathy* OR coagulation*) AND (perioperative* OR perioperative* OR perioperative* OR surgery* OR cirurg* OR intraoperative* OR intraoperative* OR intraoperative* OR postoperative* OR postoperative* OR postoperativeoperative* OR postoperative* OR preoperative* OR preoperative* OR preoperative*))
PubMed	((((Hypothermia*) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative Hypothermia*)) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative OR preoperative)
Web Of Science Core Collection	((((Hypothermia*) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative Hypothermia*)) AND (Hemostasis OR Hemostases OR coagul*)) AND (perioperative* OR surger* OR intraoperative OR postoperative OR preoperative)
OpenGrey	Hypothermia AND Hemostasis

Supplement 2: Articles eligible for full reading and excluded with their respective reasons for exclusion (n = 35)

Studies excluded because they did not meet the scope of this review – case reports, reviews, letters, personal opinions, book chapters, study protocols, dissertations, theses, institutional manuals and reports or case series, conference proceedings and abstracts (n = 33)	
1	Alam A, Olarte R, Callum J, Fatahi A, Nascimento B, La Flamme C et al. Hypothermia indices among severely injured trauma patients undergoing urgent surgery: A single-centered retrospective quality review and analysis [Internet]. Injury. 2018;49(1):117–23. DOI: 10.1016/j.injury.2017.11.028
2	Allard MA, Dondero F, Sommacale D, Dokmak S, Belghiti J, Farges Ol. Liver packing during elective surgery: An option that can be considered [Internet]. World J Surg. 2011;35(11):2493–8. DOI: 10.1007/s00268-011-1156-x
3	Aromataris E, Lockwood C, Porritt K, Pilla B, Jordan Z, editors. JBI manual for evidence synthesis [Internet]. Adelaide: JBI; 2024. Available from: https://synthesismanual.jbi.global
4	Asensio JA, Kuncir EJ, García-Núñez LM, Petrone P. Femoral vessel injuries: Analysis of factors predictive of outcomes [Internet]. J Am Coll Surg. 2006;203(4):512–20. DOI: 10.1016/j.jamcollsurg.2006.06.020
5	Aucar JA, Norman P, Whitten E, Granchi TS, Liscum KR, Wall MJ et al. Intraoperative detection of traumatic coagulopathy using the activated coagulation time [Internet]. Shock. 2003;19(5):404–7. DOI: 10.1097/01.shk.0000048905.46342.6b
6	Bjertnæs LJ, Næsheim TO, Reierth E, Suborov EV, Kirov MY, Lebedinskii KM et al. Physiological changes in subjects exposed to accidental hypothermia: An update [Internet]. Front Med. 2022;9:824395. DOI: 10.3389/fmed.2022.824395
7	Bontekoe IJ, van der Meer PF, de Korte D. Thromboelastographic as a tool to evaluate blood of healthy volunteers and blood component quality: A review [Internet]. Vox Sang. 2019;114(7):643–57. DOI: 10.1111/vox.12823
8	Brännström A, von Oelreich E, Degerstedt LE,Dahlquist A, Hånell A, Gustavsson J et al. The swine as a vehicle for research in trauma-induced coagulopathy: Introducing principal component analysis for viscoelastic coagulation tests [Internet]. J Trauma Acute Care Surg. 2021;90(2):360–8. DOI: 10.1097/TA.0000000000002997
9	Brasher C, Garcia D, Parravicini,L. Assessment of coagulation status during intraoperative hemorrhage [Internet]. Int Student J Nurse Anesth. 2022;21(1):58–63. Available from: https://ifna.site/app/uploads/2022/08/Vol.211-Spring-2022.pdf
10	Cirocchi R, Abraha J, Montedori A, Farinella E, Bonacini I, Tagliabue L et al. Damage control surgery for abdominal trauma [Internet]. Cochrane Database Syst Rev. 2010;(1):CD007438. DOI: 10.1002/14651858.CD007438.pub2
11	Constantine RS, Kenkel M, Hein RE, Cortez R, Anigiann K, Davis KE et al. The impact of perioperative hypothermia on plastic surgery outcomes: A multivariate logistic regression of 1062 cases [Internet]. Aesthet Surg J. 2015;35(1):81–8. DOI: 10.1093/asj/sju022
12	Differding JA, Underwood SJ, Van PY, Khaki RA, Spoerke NJ, Schreiber MA. First place residents' competition: Trauma induces a hypercoagulable state that is resistant to hypothermia as measured by thrombelastogram [Internet]. Am J Surg. 2011;201(5):585–9. DOI: 10.1016/j.amjsurg.2011.01.012
13	Doufas AG. Consequences of inadvertent perioperative hypothermia [Internet]. Best Pract Res Clin Anaesthesiol. 2003;17(4):535–49. DOI: 10.1016/S1521-6896(03)00052-1
14	Durila M, Lukáš P, Astraverkhava M, Vymazal T. Evaluation of fibrinogen concentrates and prothrombin complex concentrates on coagulation changes in a hypothermic in vitro model using thromboelastometry and thromboelastography [Internet]. Scand J Clin Lab Invest. 2015;75(5):407–14. DOI: 10.3109/00365513.2015.1031694
15	Engström M, Schött U, Romner B, Reinstrup P. Acidosis impairs the coagulation: A thromboelastographic study [Internet]. J Trauma. 2006;61(3):624–8. DOI: 10.1097/01.ta.0000226739.30655.75
16	Fan H, Fei R, Guo C, Li Y, Yan C, Chen F, Zhan Y. Effects of emergency treatment mode of damage-control orthopedics in pelvic fracture complicated with multiple fractures [Internet]. Am J Transl Res. 2021;13(6):6817–26. Available from: www.ncbi.nlm.nih.gov/pmc/articles/PMC8290638/
17	Fries D, Martini WZ. Role of fibrinogen in trauma-induced coagulopathy [Internet]. Br J Anaesth. 2010;105(2):116–21. DOI: 10.1093/bja/aeq161
18	Grottke O, Braunschweig T, Daheim N, Coburn M, Grieb G, Rossaint R et al. Effect of TachoSil in a coagulopathic pig model with blunt liver injuries [Internet]. Journal of Surgical Research. 2011;171:234–9. DOI:10.1016/j.jss.2010.02.002
19	Guan XL, Wang XL, Liu YY, Lan F, Gong M, Li HY et al. Changes in the hemostatic system of patients with acute aortic dissection undergoing aortic arch surgery [Internet]. Ann Thorac Surg. 2016;101(3):945–51. DOI: 10.1016/j.athoracsur.2015.08.047
20	Gupta M, Nimbalkar S, Singla P, Kumaran V, Mohanka R, Mehta N et al. Abdominal packing for surgically uncontrollable haemorrhage [Internet]. Trop Gastroenterol. 2010;31(1):61–4, 2010. Available from: https://journals.lww.com/tg/abstract/2010/01000/abdominal_packing_for_surgically_uncontrollable.17.aspx

21	Jeong S-M, Hahm K-D, Jeong Y-B, Yang H-S, Choi I-C. Warming of intravenous fluids prevents hypothermia during off-pump coronary artery bypass graft surgery [Internet]. J Cardiothorac Vasc Anesth. 2008;22(1):67–70. DOI: 10.1053/j.jvca.2007.04.003
22	Johnson JW, Gracias VH, Schwab CW, Reilly PM, Kauder DR, Shapiro MB et al. Evolution in damage control for exsanguinating penetrating abdominal injury [Internet]. J Trauma Acute Care Surg. 2001;51(2):261–71. Available from: https://journals.lww.com/jtrauma/Fulltext/2001/08000/Intra_abdominal_Hypertension_after.7.aspx?casa_token=WaQMneu0nWwAAAAA:LdDvs7t8XpRXeCY3X5jf7nMMMtGzoyFbVvpAc5Kx5kexejXoC7EvyVyutl93nJWIqV2EyBEOhaWfFVm3pIvd4jEcVFg
23	Kahn HA, Faust GR, Richard R, Tedesco R, Cohen JR. Hypothermia and bleeding during abdominal aortic aneurysm repair [Internet]. Ann Vasc Surg. 1994;8(1):6–9. DOI: 10.1007/BF02133399
24	Lazarus MG, Smul TM, Roewer N, Kranke Pl. Herz- und thorakale Gefaßchirurgie Gerinnungsstorungen: klinische Grundlagen und mechanismenbasierte Therapie [Coagulation disorders in the context of cardiac surgery – clinical basics and mechanism based therapy] [Internet]. Anasthesiol Intensivmed Notfallmed Schmerzther. 2014;49(1):50–7. DOI: 10.1055/s-0033-1363913
25	Martini WZ, Cortez DS, Dubick MA, Park MS, Holcomb JB. Thrombelastography is better than PT, aPTT and activated clotting time in detecting clinically relevant clotting abnormalities after hypothermia, hemorrhagic shock and resuscitation in pigs [Internet]. J Trauma. 2008;65(3):535–43. DOI: 10.1097/TA.0b013e31818379a6
26	Mommsen P, Zeckey C, Frink M, Krettek C, Hildebrand F. Akzidentelle Hypothermie beim Polytrauma [Accidental hypothermia in multiple trauma patients] [Internet]. Zentralbl Chir. [Central Journal of Surgery]. 2012;137(3):264–9. DOI: 10.1055/s-0030-1262604
27	Pollak AN. Management of extremity fractures in patients with multi-organ system gunshot injury [Internet]. Tech Ortho. 2006;21(3):172–80. DOI: 10.1097/01.bto.0000240337.00122.60
28	Reed L, Johnson TD, Hudson JD, Fischer RP. The disparity between hypothermic coagulopathy and clotting studies [Internet]. JTrauma. 1992;33(3):465–70. DOI: 10.1097/00005373-199209000-00022
29	Sitzwohl C, Dumitrescu R-V, Lorber C, Illievich UM. Hypothermie und gerinnung [Hypothermia and coagulation] [Internet]. Infusionstherapie und Transfusionsmedizin [Infusion Therapy and Transfusion Medicine]. 1997;24(1):51–57. DOI: 10.1159/000223463
30	Staikou C, Paraskeval A, Donta I, Theodossopoulos T, Anastassopoulou I, Kontos M. Effects of mild hypothermia on coagulation tests and haemodynamic variables in anaesthetized rabbits [Internet]. West Indian Med J. 2011;60(5):513–8. Available from: www.mona.uwi.edu/fms/wimj/article/1611
31	Trzebicki J, Kuzmińska G, Domagała P. Tromboelastometria – nowa metoda wspomagająca decyzje terapeutyczne w koagulopatii oparta na tromboelastografii Harteta [Thromboelastometry – a new method supporting the therapeutical decisions in the coagulopathy based on the Hartet's thromboelastography] [Internet]. Polski Merkuriusz Lekarski [Polish Medical Journal]. 2009;27(158):85–91. Available from: https://europepmc.org/article/med/19856870
32	Watts DD, Trask A, Soeken K, Perdue P, Dols S, Kaufmann C. Hypothermic coagulopathy in trauma: Effect of varying levels of hypothermia on enzyme speed, platelet function, and fibrinolytic activity [Internet]. J Trauma. 199844(5):846–54. DOI: 10.1097/00005373-199805000-00017
33	Winkelmann M, Soechtig W, Macke C, Schroeter C, Clausen JD, Zeckey C et al. Accidental hypothermia as an independent risk factor of poor neurological outcome in older multiply injured patients with severe traumatic brain injury: a matched pair analysis [Internet]. Eur J Trauma Emerg Surg. 2019;45(2):255–61. DOI: 10.1007/s00068-017-0897-0
Studies excluded because they were conducted with pediatric patients, patients undergoing surgical procedures with induced hypothermia and emergency surgeries (n = 2)	
34	Hanke AA, Dellweg C, Schöchl H, weber CF, Jüttner B, Johanning K et al. Potential of whole blood coagulation reconstitution by desmopressin and fibrinogen under conditions of hypothermia and acidosis – an in vitro study using rotation thrombelastometry [Internet]. Scand J Clin Lab Invest. 2011;71(4):292–8. DOI: 10.3109/00365513.2011.561870
35	Kheirabadi BS, Crissey JM, Deguzman R, Holcomb JB. In vivo bleeding time and in vitro thrombelastography measurements are better indicators of dilutional hypothermic coagulopathy than prothrombin time [Internet]. J Trauma. 2007;62(6):1352–9. DOI: 10.1097/TA.0b013e318047b805

Supplement 3: Summary of the studies included in the systematic review (n = 5)

Authors (year)	Title	Study design, sample, control and experimental groups, type of anaesthesia	Objective (control and experimental treatment)	Temperature parameter (average), place of measurement, blood assessments, time of collection	Main results
Cavallini et al.[1] (2005)	Effects of mild hypothermia on blood coagulation in patients undergoing elective plastic surgery	• randomised clinical trial • n = 76 • general anaesthesia	To evaluate the effects of coagulation and the use of warming methods during plastic surgery lasting more than two hours. The control group received passive heating with cotton sheets and sterile fields. The experimental group received active heating with fluid heating.	Pre-operative: • control group 36.0 °C • experimental group 36.1 °C End of procedure: • control group 34.0 °C • experimental group 36.0 °C Temperature measurement site: tympanic membrane. Temperature was measured when blood samples were collected. Blood assessments were coagulation activity, PT, APTT, ACT, plasma fibrinogen concentration. Samples were collected one hour before anaesthesia induction and at the end of surgery.	Pre-operative temperature in both groups did not differ significantly. At the end of the procedure, the control group had a lower core temperature (34.0±1.0 °C) than the experimental group (36.6±0.6 °C). The two groups showed no differences in PT and plasma fibrinogen concentrations. Patients in the control group had a longer activated thromboplastin time (36.8–3.5 s) compared to those kept normothermic (34.0–2.9 s). Maintaining intra-operative normothermia allows patients to maintain normal coagulation function, reducing complications. The control group had a significantly higher APTT and longer bleeding time than normothermic patients. Bleeding time is a useful test for diagnosing haemostatic disorders, guiding therapy and warning of bleeding complications during and after surgery. Bleeding time is related to reduced platelet aggregation function.
Luo et al.[2] (2020)	Beneficial effect of fluid warming in elderly patients with bladder cancer undergoing da Vinci robotic assisted laparoscopic radical cystectomy	• randomised clinical trial • n=108 • general anaesthesia	To investigate the effectiveness of fluid warming in elderly patients with bladder cancer undergoing robotic laparoscopic radical cystectomy. Participants were randomly divided into a warm-up group (n =53) and a control group (n=55).	The patient's body temperature was recorded during the pre-, intra- and post-operative periods. During the intra-operative period, body temperature was higher in the experimental group than in the control group. Six hours after the start of surgery, the temperature dropped to 34.9°C in the control group and remained at 36.1°C in the experimental group. Blood assessments were PT, APTT, TT, fibrinogen, white blood cells, platelets, total bilirubin, pH, glucose and lactose. The samples were collected during the perioperative period (exact times not specified).	No significant differences were observed in demographic and clinical characteristics between the groups (p > 0.05). Post-operative complications included chills, pneumonia, pulmonary embolism, urinary fistula and intestinal obstruction. All data were compared, and significant differences in pre-operative fibrinogen, white blood cells, total bilirubin, intra-operative lactose and post-operative TT were detected between the control and warm-up groups. TT was the only factor that was altered between the groups, with the warming group having a lower TT than the control group. The warming group had a higher post-operative PLT than the control group, as well as a shorter TT than the control group, which suggests the possibility that warming fluids improve post-operative coagulation function. Patients in the experimental group (who received warmed fluids) had shorter hospital stays than those in the control group.
Pu et al.[3] (2014)	Warming with an underbody warming system reduces intra-operative hypothermia in patients undergoing laparoscopic gastrointestinal surgery: A randomised controlled study	• randomised clinical trial • n=110 • general anaesthesia	To analyse the feasibility and efficacy/effectiveness of intra-operative cutaneous warming therapy with a lower-body warming system, heated forced air system (thermal blanket), during laparoscopic gastrointestinal surgery. This study included and analysed 55 patients in the control and 55 patients in the intervention group.	Core body temperature was measured before anaesthesia, immediately after anaesthesia, immediately after the start of the operation and every ten minutes until the end of anaesthesia. Measurements were performed using a nasopharyngeal thermometer. The room temperature ranged between 22°C and 24°C. The blood assessments were PT, APTT, TT and haemoglobin. PT, APTT and TT were measured at the start of anaesthesia induction, at the start of the operation, 30–60 minutes after the start of surgery and at the end of surgery. Haemoglobin levels were measured pre-operatively and on post-operative day 1.	Skin heating with a lower-body heating system is a viable and effective method for preventing hypothermia during laparoscopic gastrointestinal surgery. During the intra-operative period, when evaluating the effectiveness of active skin heating on the coagulation index and shivering, significant differences were observed between the groups in terms of the coagulation function 30–60 minutes after the start of surgery and at the end of surgery. PT, APTT and TT were unaltered from the start of anaesthesia to the start of the operation. Anaesthesia and operating time increased, although no significant changes were observed in PT, activated partial PT, thromboplastin time or TT between the groups. A change in intra-operative coagulation was observed, as evidenced by intra-operative bleeding between the two groups. Reduced intra-operative bleeding was observed after hypothermia prevention in the intervention group compared with that in the control group.

Authors (year)	Title	Study design, sample, control and experimental groups, type of anaesthesia	Objective (control and experimental treatment)	Temperature parameter (average), place of measurement, blood assessments, time of collection	Main results
Schmied et al.[4] (1996)	Mild hypothermia increases blood loss and transfusion requirements during total hip arthroplasty	• randomised clinical trial • n=60 • general anaesthesia	To test the hypothesis that mild hypothermia increases blood loss and the need for transfusions during hip arthroplasty. Participants were assigned to two groups – normothermia (core temperature maintained near 36-5 °C) or mild hypothermia (core temperature allowed to decrease to about 35 °C).	The patient's core temperature was monitored in the tympanic region, with measurements obtained every 20 minutes during surgery and every 30 minutes post-operatively for two hours. The room temperature was kept at 21°C. The blood assessments were haemoglobin, PT, TT, APTT, fibrinogen, antithrombin concentration, platelets and haematocrit. Samples to assess haemoglobin, PT, TT, fibrinogen, antithrombin concentration and platelets were collected pre-operatively, immediately after surgery and on post-operative day 1. Samples to determine the haematocrit were collected at 30-minute intervals during surgery.	The primary results of the study revealed that patients with hypothermia experienced significantly greater intra-operative and post-operative blood loss: 2.2 (0.5) L vs. 1.7 (0.3) L ($p < 0.001$). Of the 30 patients, seven required 8 units of red blood cells, whereas only one normothermic patient required 1 unit of blood. A typical drop in core temperature in patients undergoing hip arthroplasty increased blood loss by approximately 500 mL. Therefore, maintaining normothermia during the intra-operative period reduces blood loss and the need for transfusions in patients undergoing total hip arthroplasty. Intra-operative core temperature was approximately 1.5 °C higher in patients with extra warming. Of these, the final core temperature exceeded 36 °C in all but one patient. Among the unwarmed patients, all but two patients had final core temperatures below 36 °C. Two hours after surgery, the temperature remained significantly lower in the unwarmed patients. Blood partial thromboplastin times, fibrinogen and antithrombin were normal and similar pre-operatively in both groups, with no significant changes observed during the study. PT decreased from 94% (n=17) pre-operatively to 65% (n=10) immediately after surgery, remaining at 67% (n=9) the following morning. Platelet counts decreased from 244 000/µL pre-operatively to 195 000/µL post-operatively and 162 000/µL the following morning. Patients with hypothermia experienced significantly greater blood loss. Although haemoglobin concentrations at baseline were similar, they were slightly lower in patients with hypothermia on post-operative day 1, with significantly larger differences observed between the groups.
Zheng et al.[5] (2020)	Preventive intervention for hypothermia in patients undergoing thoracic surgery reduces complications	• case control study • n=128 • type of anaesthesia unclear	To investigate the factors that lead to hypothermia in patients undergoing thoracic surgery. A total of 128 patients undergoing thoracic surgery at a single hospital participated in the study. The control group (n=58) received routine preventive approaches, and those in the case group (n=70) received preventive measures aimed at controlling risk factors associated with hypothermia.	Temperature was measured every 15 minutes during the operation using a nasopharyngeal thermometer. Operating room temperature ranged between 24°C and 26°C. Blood assessments were PT, APTT and fibrinogen. The study does not mention when the laboratory tests were taken.	Identified as risk factors for hypothermia in patients undergoing thoracic surgery were age >60 years, operating time >two hours, intra-operative infusion volume >2000 mL, open operation, operating room temperature <24 °C and rinse solution volume >2000 mL. Based on these risk factors, targeted measures to prevent hypothermia, using warming methods, could elicit better therapeutic effects and greater patient satisfaction than routine prevention. Compared with the control group, PT and APTT were higher, while fibrinogen was lower in the case group ($p<0.05$). Targeted preventive measures for hypothermia based on identified risk factors demonstrate better preventive effects and higher patient satisfaction than routine preventive measures.

PT = prothrombin time, APTT = activated partial thromboplastin time, ACT = activated clotting time, TT = thrombin time, PLT = platelet count

Supplement 4: Critical appraisal of included studies

Table 1: Critical appraisal of randomised controlled trials using JBI appraisal tool for randomised controlled trials

Study	Q1: Was true randomization used for assignment of participants to treatment groups?	Q2: Was allocation to treatment groups concealed?	Q3: Were treatment groups similar at the beginning of the study?	Q4: Were participants blinded to the treatment assignment?	Q5: Were those administering treatment blind to treatment assignment?	Q6: Were the treatment groups treated identically except for the intervention of interest?	Q7: Were the outcome assessors blinded to treatment assignment?	Q8: Were the results measured in the same manner across the treatment groups?	Q9: Are the results reliable?	Q10: Was the follow-up complete and, if not, were the differences between the groups in terms of follow-up adequately described and analysed?	Q11: Were the participants analysed in the groups to which they were randomised?	Q12: Was appropriate statistical analysis used?	Q13: Was the trial design appropriate, and any deviations from the standard RCT design (individual randomisation, parallel groups) taken into account in the conduct and analysis of the trial?	Score
Cavallini et al.[1]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	U	N	11/13
Luo et al.[2]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	13/13
Pu et al.[3]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	13/13
Schmied et al.[4]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	13/13
Percentage	100	100	100	100	100	100	100	100	100	100	100	75	75	

Y = yes, N = no, U = unclear, N/A = not applicable

Table 2: Critical appraisal of case control studies using JBI case control study checklist

Study	Q1: Were the groups comparable except for the presence of disease in the cases or the absence of disease in the controls?	Q2: Are the cases and controls appropriately matched?	Q3: Were the same criteria used to identify the cases and controls?	Q4: Was exposure measured in a standardised, valid and reliable manner?	Q5: Was the exposure measured in the same manner for both cases and controls?	Q6: Were the confounding factors identified?	Q7: Were strategies for addressing the confounding factors stated?	Q8: Were the results assessed in a standardised, valid and reliable manner for cases and controls?	Q9: Was the exposure period sufficiently long to be meaningful?	Q10: Was the appropriate statistical analysis used?	Score
Zheng et al.[5]	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	9/10
Percentage	100	100	100	100	100	0	100	100	100	100	

Y = yes, N = no, U = unclear, N/A = not applicable

References

1. Cavallini M, Preis FWB, Casati A. Effects of mild hypothermia on blood coagulation in patients undergoing elective plastic surgery [Internet]. Plast Reconstr Surg. 2005[cited 2025 May 13];116(1):316–21. DOI: 10.1097/01.prs.0000170798.45679.7a
2. Luo J, Zhou L, Lin S, Yan W, Huang L, Liang S. Beneficial effect of fluid warming in elderly patients with bladder cancer undergoing Da Vinci robotic-assisted laparoscopic radical cystectomy [Internet]. Clinics (Sao Paulo). 2020[cited 2025 May 13];75:e1639. DOI: 10.6061/clinics/2020/e1639
3. Pu Y, Cen G, Sun J, Gong J, Zhang Y, Zhang M et al. Warming with an underbody warming system reduces intraoperative hypothermia in patients undergoing laparoscopic gastrointestinal surgery: A randomized controlled study [Internet]. Int J Nurs Stud. 2014[cited 2025 May 13];51(2):181–9. DOI: 10.1016/j.ijnurstu.2013.05.013
4. Schmied H, Kurz A, Sessler DI, Kozek S, Reiter A. Mild hypothermia increases blood loss and transfusion requirements during total hip arthroplasty [Internet]. Lancet. 1996[cited 2025 May 13];347(8997):289–92. DOI: 10.1016/s0140-6736(96)90466-3
5. Zheng P, Ye D, Yin X, Yin L, Zhong Y, Gong R. Preventive intervention for hypothermia in patients undergoing thoracic surgery reduces complications [Internet]. Int J Clin Exp Med. 2020[cited 2025 May 13];13(12):9664–72. Available from: https://e-century.us/files/ijcem/13/12/ijcem0118203.pdf