National Institute for Health and Care Excellence

FINAL

Caesarean birth

[C] Prevention and management of hypothermia and shivering

NICE guideline NG192

Evidence review

March 2021

Final

This evidence review was developed by the National Guideline Alliance which is a part of the Royal College of Obstetricians and Gynaecologists

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Hypothermia and shivering

Review question

What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

Introduction

Hypothermia and shivering may be seen in people undergoing surgery and may be due to physical causes, such as exposure of skin in a cool operating theatre, the effects of certain anaesthetic agents, and to the release of stress hormones such as adrenaline. Shivering increases oxygen consumption and therefore may increase the risk of cardiac complications, while hypothermia may adversely affect blood clotting and wound healing. In addition, shivering also has practical consequences, as it makes it difficult to monitor blood pressure using non-invasive methods such as oscillometric blood pressure monitors.

Complications due to hypothermia are more of a problem for the elderly, and people with pre-existing cardiac disease, while the majority of the population of women having a caesarean birth are young and healthy. There is little evidence of adverse morbidity for mothers and babies due to hypothermia and shivering, but it is known to be unpleasant and may reduce the quality of the birth experience.

The aim of this review is to identify what procedures can be used to prevent and manage hypothermia and shivering in women having a caesarean birth.

Summary of the protocol

Please see Table 1 for a summary of the Population, Intervention, Comparison and Outcome (PICO) characteristics of this review.

Table 1: Summary of the protocol (PICO table)

Population	For **prevention** of hypothermia/shivering: All women having a caesarean birth For **management** of hypothermia/shivering: Women having a caesarean birth who are identified as having hypothermia and/or shivering • include any of the different modes of anaesthesia (general anaesthesia/epidural anaesthesia/spinal anaesthesia) • include any type of caesarean birth (emergency or planned)
Intervention	• Active warming measures (a process that transfers heat to the patient) ○ forced air warming ○ electric blanket ○ radiant heater ○ warmed cotton blankets ○ fluid warming including - (IV) fluid warmers (including blood/blood products) - other methods of fluid warming ○ heating pad • Thermal insulation measures ○ leg wrapping ○ compression boots ○ room temperature ○ reflective (“space”) blankets • Pharmacological therapy

	○ used to reduce heat redistribution (e.g. vasoconstrictors, such as phenylephrine, metaraminol, noradrenaline/norepinephrine) ○ other post-delivery drugs ○ pethidine
Comparison	• Each of the interventions outlined above • Placebo • No treatment/usual care
Outcomes	**Critical outcomes:** • Incidence of hypothermia • Shivering • Estimated blood loss **Important outcomes** • Rate of change of temperature/ maternal temperature change (increase or decrease) • Maternal temperature at different time points • Thermal comfort • Wound infection

For further details, see the review protocol in appendix A.

Methods and process

This evidence review was developed using the methods and process described in Developing NICE guidelines: the manual (2014). Methods specific to this review question are described in the review protocol in appendix A.

Declarations of interest were recorded according to NICE's 2014 conflicts of interest policy until 31 March 2018. From 1 April 2018, declarations of interest were recorded according to NICE's 2018 conflicts of interest policy. Those interests declared until April 2018 were reclassified according to NICE's 2018 conflicts of interest policy (see Register of Interests).

Clinical evidence

Included studies

Twenty-three studies were included in this review. Twenty-one studies were patient level RCTs, and 2 were cluster RCTs (Duryea 2016, Grant 2015). Cluster RCTs were downgraded once for imprecision as they provided insufficient information available for design effect adjustment. One study examined management of shivering (only intervening with women who were shivering, Casey 1988), and 22 studies assessed prevention of shivering, with measures administered before or during caesarean birth (CB), whether women were shivering or not.

Data were grouped by the comparison of interest, and the intervention type:

ACTIVE WARMING MEASURES (TRANSFER HEAT TO PATIENT) versus CONTROL	
1. Warmed IV fluids versus control	Chan 1989; Chung 2012; Jorgensen 2000; Paris 2014; Smith 2000; Woolnough 2009; Workhoven 1986; Yokoyama 2009
2. FAW versus control	Butwick 2007; Chebbout 2017; Chung 2012; Fallis 2006; Horn 2002; Horn 2014; Munday 2018
3. FAW + warmed IV fluids versus control	Cobb 2016
4. Mattress warming versus control	Chakladar 2014; Chebbout 2017; Paris 2014
ACTIVE WARMING MEASURES versus OTHER ACTIVE WARMING	

ACTIVE WARMING MEASURES (TRANSFER HEAT TO PATIENT) versus CONTROL	
5. FAW versus warmed IV fluids	Chung 2012
6. FAW versus mattress warming	Chebbout 2017
7. Mattress warming versus other warming	Grant 2015; Paris 2014
THERMAL INSULATION MEASURES	
8. Higher (23oC) versus lower (20oC) ambient temperature	Duryea 2016
PHARMACOLOGICAL THERAPY	
9. 5-HT3 antagonist versus control	Browning 2013
10. Pethidine versus morphine (opioid versus opioid)	Hong 2005
11a. Opioid versus control (prevention)	Hong 2005; Roy 2004; Sutherland 1991
11b. Opioid versus control (management)	Casey 1988

FAW: forced air warming; IV: intravenous

Studies were performed in women with a scheduled/elective/non-emergency caesarean birth, or included any caesarean birth:

- Nine studies focused on spinal anaesthesia only (Chebbout 2017, Chung 2012, Cobb 2016, Fallis 2006, Horn 2014, Jorgensen 2000, Paris 2014, Roy 2004, Yokoyama 2009).
- Five studies focused on epidural anaesthesia only (Casey 1988, Chan 1989, Horn 2002, Sutherland 1991, Workhoven 1986)
- Five studies focused on combined spinal-epidural anaesthesia (Browning 2013, Hong 2005, Woolnough 2009), or "regional" anaesthesia (Duryea 2016, Smith 2000)
- Four studies included more than one type of anaesthesia: any neuraxial spinal/epidural (Butwick 2007, Chakladar 2014) or spinal or combined (Munday 2018, unspecified: Grant 2015)
- No studies examined shivering and hypothermia in women having a caesarean birth with general anaesthesia, though 5 studies (Chakladar 2014, Chebbout 2017, Cobb 2016, Duryea 2016, Grant 2015) reported general anaesthetic use or conversion to general anaesthesia where spinal was insufficient or had failed. Conversion was rare (<5% of study participants in studies reporting conversion was necessary). A further 2 studies reported that conversion to general anaesthesia was unnecessary in all women (Butwick 2007, Woolnough 2009).

See the literature search strategy in appendix B and study selection flow chart in appendix C.

Excluded studies

Studies not included in this review with reasons for their exclusions are provided in appendix K.

Summary of clinical studies included in the evidence review

A summary of the studies that were included in this review are presented in Table 2.

Table 2: Summary of included studies

Study	Population	Comparison	Outcomes	Comments
Browning 2013 RCT	Scheduled for elective CB • n=118 ondansetron • n=60 control	Intervention (ondansetron 8mg) versus	• Shivering • Maternal temp at different time points	• Prevention • Combined spinal-epidural

Study	Population	Comparison	Outcomes	Comments
Australia		saline placebo		
Butwick 2007 RCT USA	Scheduled for CB • n=15 forced air-warming unit • n=15 control	Intervention (forced air warming – lower body, 43°C) versus placebo cover (warmer switched off)	• Hypothermia (incidence) • Shivering • Estimated blood loss • Maternal temp at different time points • Maternal temp change • Thermal comfort	• Prevention • Spinal or epidural
Casey 1988 RCT Canada	• n=46 studied overall (23 per group); • n=40 treated for shivering (20 per group)	Intervention: intravenous meperidine 50 mg versus control IV 0.9% saline	• Shivering at different time points • Maternal temp at different time points	• Management • Epidural • Of the 46 observed, only 40 were analysed as they were treated for shivering.
Chakladar 2014 RCT UK	Elective CB • n=59 mattress warming • n=60 control	Intervention (mattress warmer set at 40°C) versus placebo mattress (identical with warmer switched off)	• Hypothermia (incidence) • Shivering • Estimated blood loss • Maternal temp at different time points	• Prevention • Spinal or epidural
Chan 1989 RCT Canada	Elective CB • n=21 warmed group • n=19 control group	Intervention: IV fluid warmer (36.5°C) + cleansers warmed (42°C) + extra gowns/socks /blankets versus control: unwarmed fluids, with single hospital gown	• Shivering • Estimated blood loss • Maternal temp at different time points • Maternal temp change	• Prevention • Epidural
Chebbout 2017 RCT	Elective CB • n=44 standard care (IV fluid warming group)	Standard care (inc warmed IV fluids) versus	• Hypothermia (incidence) • Estimated blood loss	• Prevention • Spinal • 3-arm trial; • All participants

Study	Population	Comparison	Outcomes	Comments
UK	• n=44 forced air-warming • n=44 conduction mattress warming	Conduction mattress warming versus Forced air warming (38ºC)	• Maternal temp at different time points • Thermal comfort • Wound infection	received warmed IV fluid, delivered through a fluid warmer set to 40°C
Chung 2012 RCT South Korea	Elective CB • n=15 fluid warming • n=15 forced air-warming • n=15 standard care	Fluid warming (warming cabinet 40^{0}C) versus Forced air warming (upper body at 43ºC) versus Control (no additional warming/standard care)	• Shivering • Estimated blood loss • Maternal temp at different time points • Maternal temp change • Thermal comfort	• Prevention • Spinal • 3-arm trial
Cobb 2016 RCT USA	Scheduled CB • n=23 warmed IV fluid and forced air-warming • n=23 no warming	Intervention: received IV fluid warmed to 41ºC through a fluid warmer + air-warming blanket (lower body) versus no warming (blanket provided but not switched on)	• Shivering • Estimated blood loss • Maternal temp at different time points • Thermal comfort	• Prevention • Spinal
Duryea 2016 Cluster RCT USA	CB in high risk labour ward • n=419 lower ambient temp 20°C • n=406 higher ambient temp 23°C	Operating room temperature was set at either 20°C or 23°C	• Hypothermia (incidence) • Wound infection	• Prevention • Regional
Fallis 2006 RCT Canada	Elective CB • n=32 forced air-warming group • n=30 standard care	Forced air warming (upper body) 43 C versus standard care (warmed	• Shivering • Maternal temp at different time points • Maternal temp change • Thermal comfort	• Prevention • Spinal

Study	Population	Comparison	Outcomes	Comments
		cotton blankets)		
Grant 2015 Cluster RCT USA	Any CB • n=243 warming mattress • n=241 standard care	Warming mattress set to 37°C versus standard care (tinfoil hat + warmed blankets + warmed IV fluids	• Hypothermia (incidence) • Maternal temp at different time points • Wound infection	• Prevention • Unspecified (results state 3% had general anaesthetic)
Hong 2005 RCT South Korea	Elective CB • n=30 control (B) • n=30 (BM0.1) • n=30 (BM0.2) • n=30 (BP)	Control (B) group: 8-10mg of 0.5% bupivacaine versus BM0.1: 0.1mg morphine versus BM0.2: 0.2mg morphine versus BP: 10mg pethidine	• Shivering • Maternal temp at different time points	• Prevention • Combined spinal-epidural • 4-arm trial; • All groups used 8-10mg of 0.5% bupivacaine
Horn 2014 RCT Germany	Any CB • n=19 active forced-air warming • n=21 control	Forced air cover (upper body) 44°C versus control (warmed blanket from 40°C heating cabinet)	• Hypothermia (incidence) • Shivering • Maternal temp at different time points • Thermal comfort	• Prevention • Spinal
Horn 2002 RCT USA	Any CB • n=15 forced-air heating • n=15 control	Forced air cover (upper body) “high” versus Control (single cotton blanket).	• Shivering • Maternal temp at different time points • Thermal comfort	• Prevention • Epidural
Jorgensen 2000 RCT Denmark	Any CB • n= 60 warm saline • n= 60 control	Warm saline versus cold saline	• Shivering	• Prevention • Spinal
Munday 2018 RCT	Any CB • n=25 pre-warming • n=25 control	20mins forced air warming at 43°C	• Shivering • Maternal temp at different time points	• Prevention • Spinal or combined

Study	Population	Comparison	Outcomes	Comments
Australia		versus control (no warming)	• Maternal temp change • Thermal comfort	spinal-epidural
Paris 2014 RCT USA	• n=73 warmed IV fluids • n=77 warmed under body pad • n=76 control/ usual care	Warmed IV fluids: IV fluids warmed to 41ºC versus foam warming pad at 40.3 C versus control: standard hospital linens and no warming	• Hypothermia (incidence) • Estimated blood loss • Maternal temp at different time points	• Prevention • Spinal • 3-arm trial
Roy 2004 RCT Canada	Non-emergency CB • n=40; 20 per group	Intervention: meperidine (0.2mg/kg) versus control/ placebo: saline (0.2mg/kg)	• Shivering	• Prevention • Spinal • Both groups received hyperbaric bupivacaine (0.75%; 10.5 mg), morphine 0.15 mg
Smith 2000 RCT USA	Scheduled CB • n=35 intervention (warmed fluids) • n=32 control (room temperature fluids)	Warmed fluids/hotline 42ºC versus control: IV room temp fluids (20-22ºC)	• Hypothermia (incidence) • Shivering • Estimated blood loss • Maternal temp at different time points	• Prevention • Regional (spinal or epidural)
Sutherland 1991 RCT Australia	Any CB • n=47 pethidine • n=47 control	Intervention: pethidine 25mg versus control/ placebo: saline solution	• Shivering	• Prevention • Epidural
Woolnough 2009 RCT UK	Any CB • n=25 room temperature (control) • n=25 cabinet • n=25 hotline	Room temperature fluids versus cabinet: pre-warming cabinet at 45ºC versus	• Shivering • Thermal comfort	• Prevention • Combined spinal-epidural • 3-arm trial

Study	Population	Comparison	Outcomes	Comments
		hotline: continuous IV warming at 42°C		
Workhoven 1986 RCT USA	Any CB • n=22 warmed IV fluids • n=22 control/ room temperature IV fluids	Intervention: Pre-warming cabinet at 30-34°C versus control: fluids at room temp 20-22°C	• Shivering • Maternal temp at different time points	• Prevention • Epidural
Yokoyama 2009 RCT Japan	Any CB • n=15 warmed fluid group • n=15 control	Pre-warmed in cabinet (41°C) + infused through warmer coil versus Control: stored in room at 25°C	• Estimated blood loss • Maternal temp at different time points	• Prevention • Spinal

CB: caesarean birth; IV: intravenous; N: number of women; RCT: randomised controlled trial

See the full evidence tables in appendix D and the forest plots in appendix E.

Quality assessment of clinical outcomes included in the evidence review

See the clinical evidence profiles (GRADE tables) in appendix F.

Economic evidence

Included studies

A systematic review of the economic literature was conducted but no economic studies were identified which were applicable to this review question.

See the literature search strategy in appendix B.

Economic model

No economic modelling was undertaken for this review because the committee agreed that other topics were higher priorities for economic evaluation.

Evidence statements

When subgroups have been assessed, these statements are presented as bullet points below the main comparison

Active warming measures versus control

Comparison 1. Warmed IV fluids versus control

Critical outcomes

Incidence of hypothermia

- Very low quality evidence from 2 RCTs (n=216) shows no clinically important difference in the incidence of hypothermia between the group who received warmed IV fluids and the control group.

Incidence of shivering

- Low quality evidence from 6 RCTs (n=369) shows a clinically important difference between groups, with a lower incidence of shivering in the group who received warmed IV fluids compared to the control group.

Subgroup analysis:

  - Very low quality evidence from 3 RCTs (n=255) shows no clinically important difference in the incidence of shivering between the group who received warmed IV fluids (maintained fluid warming 37-42°C) and the control group.
  - Very low quality evidence from 1 RCT (n=30) shows a clinically important difference in the incidence of shivering between the groups, with a lower incidence of shivering in the group who received warmed IV fluids (pre-warmed fluids at 37-42°C) compared to the control group.
  - Low quality evidence from 1 RCT (n=44) shows a clinically important difference in the incidence of shivering between the groups, with a lower incidence of shivering in the group who received warmed IV fluids (pre-warmed fluids at 30-34°C) compared to the control group.
  - Very low quality evidence from 1 RCT (n=40) shows no clinically important difference in the incidence of shivering between groups who received warmed IV fluids (maintained fluid warming at 36.5°C) compared to control group.

Estimated blood loss

- Low quality evidence from 4 RCTs (n=249) shows no clinically important difference in the volume of blood loss between the group who received warmed IV fluids compared to the control group.

Subgroup analysis:

  - Low quality evidence from 1 RCT (n=149) shows no clinically important difference in estimated blood loss between the group who received warmed IV fluids (maintained fluid warming 37-42°C) compared to the control group.
  - Moderate quality evidence from 1 RCT (n=60) shows no clinically important difference in estimated blood loss between the group who received warmed IV fluids (pre-warmed fluids at 37-42°C) compared to the control group
  - Very low quality evidence from 1 RCT (n=40) shows no clinically important difference in estimated blood loss between the group who received warmed IV fluids (maintained fluid warming at 36.5°C) compared to control group
- Very low quality evidence from 1 RCT (n=67) shows no clinically important difference in the need for blood products between the group who received warmed IV fluids compared to the control group.

Important outcomes

Maternal (core) temperature change

- Low quality evidence from 2 RCTs (n=70) shows a clinically important difference in maternal temperature with less of a fall (change) in core temperature in the group who received warmed IV fluids compared to the control group.

Maternal temperature at different time points

- **Intra-operative**: Very low quality evidence from 3 RCTs (n=246) shows a clinically important difference in intra-operative maternal temperature between groups, with a higher core temperature in the group who received warmed IV fluids compared to the control group.
- **Post-op, baseline, and 30 minutes later**: Very low and low quality evidence from 2 RCTs (n=97) shows a clinically important difference in maternal temperature at these time points with a higher core temperature in the group who received warmed IV fluids compared to the control group.
- **Post-op, 45 minutes or later**: Very low quality evidence from 3 RCTs (n=246) shows a clinically important difference in maternal temperature at these time points with a higher core temperature in the group who received warmed IV fluids compared to the control group.
- **Post-op, discharge/postpartum:** Very low quality evidence from 2 RCTs (n=216) shows a clinically important difference in maternal temperature at these time points with a higher core temperature in the group who received warmed IV fluids compared to the control group.

Thermal comfort

- Very low quality evidence from 1 RCT (n=30) shows no clinically important difference in thermal comfort between the group who received warmed IV fluids compared to the control group.
- High quality evidence from 1 RCT (n=75) shows a clinically important difference in thermal comfort with a lower incidence of scoring low (<4) on thermal comfort in the group who received warmed IV fluids compared to the control group.
- Low quality evidence from 1 RCT (n=75) shows no clinically important difference in thermal comfort (incidence of scoring high (>6) on thermal comfort) between the group who received warmed IV fluids compared to the control group.

Wound infection

- No evidence was available for this outcome.

Comparison 2. Forced air warming versus control

Critical outcomes

Incidence of hypothermia

- Very low quality evidence from 3 RCTs (n=157) shows no clinically important difference in the incidence of hypothermia between the group who received forced air warming compared to the control group, overall or for either subgroup (background of no additional warming or background of maintained warmed IV fluids).

Incidence of shivering

- Low quality evidence from 6 RCTs (n=242) shows a clinically important difference in the incidence of shivering, with a lower incidence in the forced air warming group compared to the control group.

Estimated blood loss

- Low quality evidence from 3 RCTs (N=147) shows no clinically important difference in estimated blood loss between the group who received forced air warming compared to the control group, overall or for either subgroup (background of no additional warming or background of maintained warmed IV fluids).

Important outcomes

Maternal temperature change

- **Peri-operative change**: Very low quality evidence from 1 RCT (n=30) shows no clinically important difference in rate of change of temperature between the group who received forced air warming compared to the control group.
- **Intra-operative change**: Very low quality evidence from 3 RCTs (n=142) shows no clinically important difference in rate of change of temperature between the group who received forced air warming compared to the control group.

Maternal temperature at different time points

- **Intra-operative, within 30 minutes**: Very low quality evidence from 2 RCTs (n=127) shows no clinically important difference in maternal temperature at this time point between the group who received forced air warming compared to the control group.
- **Intra-operative, immediately post-delivery**: Very low quality evidence from 1 RCT (n=40) shows no clinically important difference in maternal temperature at this time point between the group who received forced air warming compared to the control group.
- **Intra-operative, end of surgery**: Very low quality evidence from 4 RCTs (n=219) shows a clinically important difference in maternal temperature at this time point between the groups, with a higher core temperature in the group who received forced air warming group compared to the control group.
- **Post-op, recovery room, within 15 minutes**: Very low quality evidence from 1 RCT (n=87) shows a clinically important difference in maternal temperature at this time point between the groups, with a higher core temperature in the group who received forced air warming group compared to the control group.

Thermal comfort

- **Pre-operative**: Very low quality evidence from 2 RCTs (n=70) shows a clinically important difference in thermal comfort between groups, with a higher level of thermal comfort in the group who received forced air warming compared to the control group.
- **Intra-operative, immediately post-delivery**: Very low quality evidence from 1 RCT (n=40) shows a clinically important difference in thermal comfort between groups, with a higher level of thermal comfort in the group who received forced air warming compared to the control group.
- **Intra-operative, end of surgery**: Low quality evidence from 1 RCT (n=40) shows a clinically important difference in thermal comfort between groups, with a higher level of thermal comfort in the group who received forced air warming compared to the control group.
- **Post-operative**: Low quality evidence from 3 RCTs (N=110) shows no clinically important difference in thermal comfort between the group who received forced air warming compared to the control group, overall or for either subgroup (post-op discharge or peri-operative)

Wound infection

- Very low quality evidence from 1 RCT (n=87) shows no clinically important difference in wound infection between the group who received forced air warming compared to the control group.

Comparison 3. Forced air warming + warmed IV fluid versus control

Critical outcomes

Incidence of hypothermia

- Moderate quality evidence from 1 RCT (n=44) shows a clinically important difference in incidence of hypothermia between the groups, with a lower incidence of hypothermia in the in the group who received forced air warming and warmed IV fluid compared to the control group.

Incidence of shivering

- **Intra-operative**: Moderate quality evidence from 1 RCT (n=44) shows no clinically important difference in shivering between group who received forced air warming and warmed IV fluid compared to the control group.
- **Post-operative**: Low quality evidence from 1 RCT (n=44) shows no clinically important difference in shivering between group who received forced air warming and warmed IV fluid compared to the control group.

Estimated blood loss

- Low quality evidence from 1 RCT (n=44) shows no clinically important difference in estimated blood loss between group who received forced air warming and warmed IV fluid compared to the control group, based on the wide inter-quartile range (IQR) in both groups.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- **Intra-operative/recovery room, baseline**: Moderate quality evidence from 1 RCT (n=44) shows a clinically important difference in maternal temperature at these time points between groups, with a higher core temperature in the group who received forced air warming and warmed IV fluid compared to the control group.

Thermal comfort

- **Post-op/recovery room, discharge**: Low quality evidence from 1 RCT (n=44) shows no clinically important difference in thermal comfort between group who received forced air warming and warmed IV fluid compared to the control group, based on the wide IQR in both groups

Wound infection

- No evidence was available for this outcome.

Comparison 4. Warmed mattress/under-body pad versus control

Critical outcomes

Incidence of hypothermia

- Very low quality evidence from 3 RCTs (n=357) shows no clinically important difference in the incidence of hypothermia between the group who received a warmed mattress/under-body pad compared to the control group.

Subgroup analysis:

- **Undefined time point:** Low quality evidence from 2 RCTs (n=204) shows a clinically important difference in the incidence of hypothermia between groups, with a lower incidence of hypothermia in the group who received a warmed mattress/under-body pad compared to the control group.
- **Postpartum:** Very low quality evidence from 1 RCT (n=153) shows no clinically important difference in the incidence of hypothermia between the group who received a warmed mattress/under-body pad compared to the control group.

Incidence of shivering

- Very low quality evidence from 1 RCT (n=116) shows no clinically important difference in the incidence of shivering between the group who received a warmed mattress/under-body pad compared to the control group.

Estimated blood loss

- Low quality evidence from 1 RCT (n=241) shows no clinically important difference in estimated blood loss between the group who received a warmed mattress/under-body pad compared to the control group.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome

Maternal temperature at different time points

- **Intra-operative**: Very low quality evidence from 3 RCTs (n=357) shows a clinically important difference in maternal temperature between groups, with a higher core temperature in the group who received a warmed mattress/under-body pad compared to the control group.

  Subgroup analysis:
  - **First 30 minutes:** Moderate quality evidence from 2 RCTs (n=204) shows no clinically important difference in maternal temperature between the group who received a warmed mattress/under-body pad compared to the control group.
  - **Anytime in operating room**: Very low quality evidence from 1 RCT (n=153) shows a clinically important difference in maternal temperature between the groups, with a higher core temperature in the group who received a warmed mattress/under-body pad compared to the control group.
- **Intra-op, recovery room, baseline**: very low quality evidence from 2 RCTs (n=204) shows no clinically important difference in maternal temperature between the group who received a warmed mattress/under-body pad compared to the control group.
- **Post-op, recovery room:** Very low quality evidence from 2 RCTs (n=241) shows no clinically important difference in maternal temperature between the group who received a warmed mattress/under-body pad compared to the control group.
- **Post-op, postpartum:** Low quality evidence from 1 RCT (n=153) shows a clinically important difference in maternal temperature between the groups, with a higher core temperature in the group who received a warmed mattress/under-body pad compared to the control group.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- Very low quality evidence from 1 RCT (n=88) shows no clinically important difference in wound infections between the group who received a warmed mattress/under-body pad compared to the control group.

Active warming measures versus other active warming

Comparison 5. Forced air warming versus warmed IV fluids

Critical outcomes

Incidence of hypothermia

- No evidence was available for this outcome.

Incidence of shivering

- Very low quality evidence from 1 RCT (n=30) shows no clinically important difference in the incidence of shivering between the group who received forced air warming compared to the group who received warmed IV fluids.

Estimated blood loss

- Very low quality evidence from 1 RCT (n=30) shows no clinically important difference in estimated blood loss between the group who received forced air warming compared to the group who received warmed IV fluids.

Important outcomes

Maternal temperature change

- **Intra-operative, 45 minutes post-intervention:** Very low quality evidence from 1 RCT (n=30) shows no clinically important difference in rate of change of temperature between the group who received forced air warming compared to the group who received warmed IV fluids.

Maternal temperature at different time points

- No evidence was available for this outcome.

Thermal comfort

- Very low quality evidence from 1 RCT (n=30) shows no clinically important difference in thermal comfort between the group who received forced air warming compared to the group who received warmed IV fluids.

Wound infection

- No evidence was available for this outcome.

Comparison 6. Forced air warming versus mattress warming

Critical outcomes

Incidence of hypothermia

- Very low quality evidence from 1 RCT (n=87) shows no clinically important difference in the incidence of hypothermia between the group who received forced air warming compared to the group who received mattress warming.

Incidence of shivering

- No evidence was available for this outcome.

Estimated blood loss

- Low quality evidence from 1 RCT (n=87) shows no clinically important difference in estimated blood loss between the group who received forced air warming compared to the group who received mattress warming.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- **Pre-operative, 15 minutes post-anaesthetic**: Low quality evidence from 1 RCT (n=87) shows no clinically important difference in maternal temperature between the group who received forced air warming compared to the group who received mattress warming.
- **Intra-operative, recovery room, baseline**: Low quality evidence from 1 RCT (n=87) shows no clinically important difference in maternal temperature between the group who received forced air warming compared to the group who received mattress warming.
- **Post-operative, recovery room, after 15 minutes:** Very low quality evidence from 1 RCT (n=87) shows a clinically important difference in maternal temperature between groups, with a higher core temperature in the group who received forced air warming compared to the group who received mattress warming.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- Very low quality evidence from 1 RCT (n=87) shows no clinically important difference in wound infections between the group who received forced air warming compared to the group who received mattress warming.

Comparison 7. Warmed mattress/under body pad versus other warming (not control/ usual care)

Critical outcomes

Incidence of hypothermia

- Very low quality evidence from 1 RCT and 1 cluster RCT (n=412) shows a clinically important difference in incidence of hypothermia between groups, with a lower incidence of hypothermia in the warmed mattress group compared to other warming group.

Subgroup analysis:

  - Very low quality evidence from 1 cluster RCT (n=262) shows a clinically important difference in the incidence of hypothermia between the groups, with a lower incidence of hypothermia in the warmed mattress group compared to other warming group, for the subgroup where the other warming group used warmed IV fluids, tinfoil hats, and warmed blankets.
  - Very low quality evidence from 1 RCT (n=150) shows no clinically important difference in the incidence of hypothermia between the groups, for the subgroup where the other warming group used warmed IV fluids only.

Incidence of shivering

- No evidence was available for this outcome.

Estimated blood loss

- Very low quality evidence from 1 RCT (n=150) shows no clinically important difference in estimated blood loss between the warmed mattress group compared to other warming group.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- **Intra-operative**: Very low quality evidence from 1 RCT and 1 cluster RCT (n=412) shows no clinically important difference in maternal temperature between the warmed mattress group compared to other warming group.

  Subgroup analysis:

  - Very low quality evidence from 1 cluster RCT (n=262) shows a clinically important difference in maternal temperature between the groups, with a higher core temperature in the warmed mattress group compared to other warming, for the subgroup where the other warming group used warmed IV fluids, tinfoil hats, and warmed blankets.
  - Low quality evidence from 1 RCT (n=150) shows no clinically important difference in maternal temperature between the warmed mattress group compared to other warming group, for the subgroup where the other warming group used warmed IV fluids only.
- **Post-operative, recovery room**: very low quality evidence from 1 RCT and 1 cluster RCT (n=634) shows no clinically important difference in maternal temperature between the warmed mattress group compared to other warming group, overall or in either subgroup.
- **Post-operative, postpartum**: Low quality evidence from 1 RCT (n=150) shows no clinically important difference in maternal temperature between the warmed mattress group compared to other warming group.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- Very low quality evidence from 1 cluster RCT (n=484) shows no clinically important difference in wound infection between the warmed mattress group compared to other warming group.

Thermal insulation measures

Comparison 8. Higher versus lower ambient temperature

Critical outcomes

Incidence of hypothermia

- Very low quality evidence from 1 cluster RCT (n=791) shows no clinically important difference in the incidence of hypothermia between the higher ambient temperature group compared to the lower ambient temperature group.

Incidence of shivering

- No evidence was available for this outcome.

Estimated blood loss

- No evidence was available for this outcome.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- No evidence was available for this outcome.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- Very low quality evidence from 1 cluster RCT (n=791) shows no clinically important difference in wound infection between the higher ambient temperature group compared to the lower ambient temperature group.

Pharmacological therapy

Comparison 9. 5-HT3 antagonist versus control

Critical outcomes

Incidence of hypothermia

- No evidence was available for this outcome.

Incidence of shivering

- Very low quality evidence from 1 RCT (n=116) shows no clinically important difference in the incidence of shivering between the group receiving a 5-HT3 antagonist and the control group.
- Very low quality evidence from 1 RCT (n=116) shows no clinically important difference in the incidence of shivering reaching a maximum value of 2-4 between the group receiving a 5-HT3 antagonist and the control group.

Estimated blood loss

- No evidence was available for this outcome.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- No evidence was available for this outcome.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- No evidence was available for this outcome.

Comparison 10. Opioid-like analgesic (pethidine) versus other opioid (morphine)

Critical outcomes

Incidence of hypothermia

- No evidence was available for this outcome.

Incidence of shivering

- Very low quality evidence from 1 RCT (n=119) shows a clinically important difference in the incidence of shivering between the groups, with a lower incidence of shivering in the pethidine group compared to the morphine group.

Subgroup analysis:

  - Very low quality evidence from 1 RCT (n=59) shows no clinically important difference in the incidence of shivering between pethidine group compared to the morphine group, for the subgroup who received 10mg pethidine compared to 0.1mg morphine
  - Very low quality evidence from 1 RCT (n=60) shows no clinically important in the incidence of shivering between pethidine group compared to the morphine group, for the subgroup who received 10mg pethidine compared to 0.2mg morphine

Estimated blood loss

- No evidence was available for this outcome.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- No evidence was available for this outcome.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- No evidence was available for this outcome.

Comparison 11a. Opioid-like analgesic versus control <u>for prevention</u>

Critical outcomes

Incidence of hypothermia

- No evidence was available for this outcome.

Incidence of shivering

- Low quality evidence from 3 RCTs (n=313) shows a clinically important difference in the incidence of shivering between groups, with a lower incidence of shivering in the opioid-like analgesic group compared to the control group.

Subgroup analysis:

  - Low quality evidence from 1 RCT (n=94) shows a clinically important difference in the incidence of shivering between groups, with a lower incidence of shivering in the opioid-like analgesic group compared to the control group, for the sub-group receiving 25mg pethidine.

- Very low quality evidence from 1 RCT (n=60) shows no clinically important difference in the incidence of shivering in the opioid-like analgesic group compared to the control group, for the sub-group receiving 10mg pethidine.
- Low quality evidence from 1 RCT (n=40) shows a clinically important difference in the incidence of shivering between groups, with a lower incidence of shivering in the opioid-like analgesic group compared to the control group, for the sub-group receiving 0.2mg/kg meperidine.
- Very low quality evidence from 1 RCT (n=59) shows no clinically important difference in the incidence of shivering in the opioid-like analgesic group compared to the control group, for the sub-group receiving 0.1mg morphine.
- Very low quality evidence from 1 RCT (N=60 shows no clinically important difference in the incidence of shivering in the opioid-like analgesic group compared to the control group, for the sub-group receiving 0.2mg morphine.

Estimated blood loss

- No evidence was available for this outcome.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- No evidence was available for this outcome.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- No evidence was available for this outcome.

Comparison 11b. Opioid-like analgesic (meperidine) versus control <u>for management</u>

Critical outcomes

Incidence of hypothermia

- No evidence was available for this outcome.

Incidence of shivering

- **At 2, 5, 15, 30, and 60 minutes post infusion**: Low quality evidence from 1 RCT (n=40) shows a clinically important difference in the incidence of shivering at these time points between groups, with a lower incidence of shivering in the meperidine group compared to the control group.

Estimated blood loss

- No evidence was available for this outcome.

Important outcomes

Rate of change of temperature (maternal temperature change)

- No evidence was available for this outcome.

Maternal temperature at different time points

- **At 2 and 5 minutes post infusion:** Very low quality evidence from 1 RCT (n=40) shows no clinically important difference in maternal temperature at these time points between the meperidine group and the control group.
- **At 15, 30, and 60 minutes post infusion**: Low quality evidence from 1 RCT (n=40) shows a clinically important difference in maternal temperature at these time points between groups, with a higher core temperature in the control group compared to meperidine group.

Thermal comfort

- No evidence was available for this outcome.

Wound infection

- No evidence was available for this outcome.

Economic evidence statements

No economic evidence was identified which was applicable to this review question.

The committee's discussion of the evidence

Interpreting the evidence

The outcomes that matter most

The incidence of hypothermia and shivering were considered to be the critical outcomes for this review as these were the symptoms of interest. Hypothermia may adversely affect clotting and so estimated blood loss was also considered to be critical outcome.

Hypothermia may also impair wound healing and so wound infection was an important outcome. Maternal temperature and rate of change of temperature were considered important as they would indicate if the prevention or management of hypothermia had been successful. Finally, as hypothermia and shivering are reported by women as impairing their experience of childbirth, thermal comfort was selected as an important outcome.

The quality of the evidence

The quality of evidence for this review was assessed using GRADE.

For active warming measures, the evidence was very low to moderate quality with only one outcome (from a small single study) in one comparison deemed high quality (thermal comfort score<4, n=75, comparison 1). The evidence for thermal insulation measures and pharmacological therapy was assessed as very low to low quality for all outcomes of interest.

Quality was largely downgraded for imprecision (wide confidence intervals), and unclear or high risk of bias across multiple domains (blinding of participants/personnel, and outcomes).

Benefits and harms

The committee discussed the potential causes of shivering and hypothermia during a caesarean birth, which may in part be due to the effects of the epidural or spinal anaesthesia. As the majority (up to 99% of elective and 97% of emergency caesarean births) are performed under regional anaesthesia, some complications such as shivering and thermal discomfort are evident in both the intra-operative and post-operative period. The committee noted that the incidence of hypothermia and shivering had decreased since the introduction of drapes which collected the amniotic fluid and so reduced the quantity of wet drapes that were in contact with the woman's skin.

The committee noted that there were already existing NICE guidelines on Hypothermia: prevention and management in adults having surgery (NICE CG65, 2008), and that this guideline provides guidance on the importance of avoiding peri-operative hypothermia to reduce the risk of postoperative complications, such as increased perioperative blood loss, longer post-anaesthetic recovery, postoperative shivering, thermal discomfort, morbid cardiac events including arrhythmia, altered drug metabolism, increased risk of wound infection, reduced patient satisfaction with the surgical experience, and longer stay in hospital. The committee discussed the differences between caesarean birth and general surgery populations, and noted that the risk of some of these adverse effects was reduced in women undergoing caesarean birth as they were usually younger, fitter and healthier than the general surgical population. In particular, the committee noted that the incidence of wound infection was low after caesarean birth, and so it may be difficult to see a difference in wound infection rates due to interventions for shivering and hypothermia.

The committee then discussed the evidence regarding the efficacy of different approaches to prevent hypothermia and reduce the risk of complications in women having a caesarean birth.

The evidence showed that none of the interventions reduced estimated blood loss. However, the committee agreed that if major obstetric haemorrhage occurs, maternal hypothermia can be a factor in impairing the function of coagulation proteins. It is therefore useful to maintain core temperature in women undergoing caesarean birth (particularly those at increased risk of post-partum haemorrhage) to minimise the risk of coagulopathy.

Similarly, none of the warming methods reduced the incidence of wound infection. However, the committee noted that the incidence of wound infection in the studies was very low (1/791 in Duryea 2016 and 5/484 in Grant 2015) so the trials were unlikely to have been powered to detect a difference.

The committee noted that each method of active warming showed benefit compared to usual care (control) in the incidence of shivering and hypothermia, or in maternal temperature or thermal comfort. The comparisons of different active warming measures with each other showed that there were few significant differences between groups. Active warming measures showed benefit with regards to thermal comfort when they were applied intra-operatively, with fewer differences postoperatively when the active warming had been removed.

The committee noted that current NICE guideline for general surgical procedures recommend forced air warming measures when the procedure is longer than 30 minutes. The committee agreed that all caesarean births fulfil this criterion, and discussed that if they made recommendations consistent with general surgical guidelines, this would mean that all women undergoing caesarean birth would receive forced air warming. However, the committee again noted the physiological differences between women having a caesarean birth and the general surgical population – pregnant women retain heat more effectively, likely due to their comparatively young age and better health (for example, fewer comorbidities). Thus using additional warming before the woman experiences a drop in core temperature or initiation of shivering may not be necessary, and even though the majority of the evidence was for the prevention of hypothermia and shivering, not for management, the committee agreed that they would expect forced air warming methods to work well for management and so recommended its use for women who develop shivering or hypothermia. The committee agreed that a temperature of less than 36^{o}C was an appropriate threshold used to define a patient who was hypothermic and at which there was an increased risk of adverse effects due to a reduced body temperature. This was also the threshold used in the NICE guideline for general surgical procedures and so the committee set this as the temperature threshold at which forced air warming should be commenced.

The use of warmed IV fluids alone or when in combination with another active warming measure (for example, forced air warming), was beneficial when compared to standard

care/unwarmed fluids. Again, the committee noted that the current NICE guideline for general surgical procedures recommends warmed intravenous fluids and blood products if the volume is greater than 500 ml. The committee discussed the fact that women may receive small volume infusions (for example, antibiotics or analgesics) and these would not need warming, but agreed that all larger volumes could have a cooling effect if administered unwarmed. The committee noted that the studies included in the review used a variety of different methods to warm IV fluids – some used a warming cabinet, some used an in-line warmer, and 1 study used a combination of both. The committee therefore chose to not specify exactly which method should be used to warm IV fluids, and noted that this was the same as the recommendation in the NICE guideline for general surgical procedures which does not state the method to be used. The committee also noted that the studies warmed fluids to a variety of temperatures, but agreed that fluids should normally be warmed and administered at body temperature of 37ºC. The committee discussed that there was no evidence from this review for the warming of irrigation fluids where used, but that this is considered best practice in all surgery, and is recommended in the NICE guideline for general surgical procedures. The committee therefore agreed to adopt the recommendation from this guideline for the prevention of shivering and hypothermia in women having a caesarean birth. The temperature range of 38ºC to 40ºC was also adopted from this guideline and the committee agreed that this was in accordance with their clinical experience, as irrigation fluids were warmed in a cabinet, and then removed for administration, so would cool down to 37ºC by the time they were administered.

The committee discussed the availability of the various active warming measures assessed in the review and agreed that mattress warming/under-body pads were not widely used or available, would have to remain in the surgical suite, and had issues around cleaning and reusability. Forced air warming used disposable 'blankets' into which hot air could be blown, and could be utilised at multiple stages of the procedure, travelling with the woman into recovery and onto the ward if appropriate. The committee therefore recommended forced air warming and noted that this was in line with the recommendations in the current NICE guideline for general surgical procedures.

The evidence showed there was no benefit from the higher ambient temperature compared to the lower ambient temperature (thermal insulation) in the prevention of shivering and hypothermia, However, the committee agreed that the small (3°C) difference between 20°C and 23°C room temperature in the study was insufficient to make a difference to outcomes, and they routinely maintain temperatures above this during most surgical procedures already, and so did not make a recommendation.

The evidence for pharmacological interventions showed a benefit of opioids (pethidine/meperidine) to prevent and manage shivering, and this was the only comparison that looked specifically at the management of hypothermia and shivering as opposed to primary prevention. Intravenous pethidine (50 mg, immediately post-delivery) was used in women having a caesarean birth under epidural anaesthesia with lidocaine and adrenaline. This significantly reduced the incidence and severity of shivering without increasing the incidence of nausea or need for anti-emetics. The incidence of shivering in the control group was high (87%), which was attributed to the cold operating theatre and rapid infusion of cold solutions. The committee noted that there was a higher incidence of shivering but a lower incidence of hypothermia in the control group of women who were already shivering, but discussed that this may be due to the fact that the act of shivering raises core temperature, and so administering of the opioid reduced shivering but then led to a lower body temperature compared to the control group.

The committee considered the use of opioids as a second line treatment (following the implementation of active warming measures if this was ineffective). However, after further discussion they agreed that despite the evidence for opioids (pethidine) in both prevention and management of shivering and hypothermia, its use during a caesarean birth would negatively impact the woman's ability to breastfeed in the hours after birth, and consequently

they did not make a recommendation to use opioids. The committee also noted that although pethidine was the only intervention assessed for use in management once hypothermia and shivering occurs, this evidence was from one small study conducted in the 1980s.

The evidence for the 5-HT3 antagonist (ondansetron) showed no benefit in preventing shivering and the committee considered whether to make a recommendation highlighting the fact it should not be used for this purpose. However, the committee decided not to make a 'do not use' recommendation as ondansetron is used to prevent and treat nausea and vomiting, so having a recommendation that it should not be used could be confusing for healthcare professionals.

The committee agreed that one of the main benefits of measures to prevent and manage hypothermia and shivering, such as use of forced air warming, was that it made the woman more comfortable and improved their birth experience, and that this was important to take into account.

Cost effectiveness and resource use

The committee discussed the cost implications of hypothermia and shivering, and noted that current practice is to retain the woman in the recovery ward if she is still shivering or has a core temperature below 36°C (hypothermia), so effective prevention and management of hypothermia and shivering may allow women to return to the postnatal ward earlier which would reduce resource use.

The committee noted that the cost-benefit analysis in the NICE guideline for the general surgical population had found that the expenditure on devices that were proven to prevent hypothermia was cost effective due to the reduction in wound infections. However, as noted above the rate of wound infection after caesarean birth is low, and no reduction in wound infection had been seen in this population.

The committee discussed the cost of the forced air warming blankets which were approximately £15 to £25 each, and recognised that even if the blankets were only used in women who were shivering or hypothermic, and not as prevention, there may be some cost implications to the NHS, depending on local current practice. However, they also noted that the number of women who would require warming would be a relatively low proportion of those having a caesarean birth as the room temperature is kept warm and warmed IV and irrigations fluids are used.

The committee agreed that warming of IV fluids and blood during infusion and warming irrigation fluids in a warming cabinet prior to administration is already standard practice.

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Appendices

Appendix A – Review protocols

Review protocol for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

Table 3: Review protocol for hypothermia and shivering

Field (based on PRISMA-P)	Content
Actual review question	What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?
Type of review question	Intervention
Objective of the review	To identify the most effective methods to prevent hypothermia or shivering from occurring, and the most effective methods to manage hypothermia and shivering in women having a caesarean birth. Interventions will be considered for the pre-operative, intra-operative and post-operative periods. The focus of this review is on maternal outcomes, rather than neonatal outcomes. Background: Shivering increases oxygen consumption dramatically, therefore patients are put at risk of cardiac complications. However, this is more of a problem for the elderly, and people with pre-existing cardiac disease (not common in the obstetric population). Shivering also has practical consequences, as it makes it difficult to monitor blood pressure using non-invasive methods (e.g. oscillometric blood pressure monitors). Hypothermia is a concern as it affects blood clotting and wound healing. In the non-obstetric population, the majority of surgical procedures are carried out under general anaesthesia, which prevents intra-operative shivering and allows the patient to be fully covered to prevent heat loss. The opposite is true for

Field (based on PRISMA-P)	Content
	women having caesarean birth where almost all procedures are performed using a regional anaesthetic.
Eligibility criteria – **population**/disease/condition/issue/domain	For prevention of hypothermia/shivering: All women undergoing caesarean birth • include any of the different modes of anaesthesia (general anaesthesia/epidural anaesthesia/spinal anaesthesia) • include any type of caesarean birth (emergency or planned) For management of hypothermia/shivering Women undergoing caesarean birth who are identified as having hypothermia and/or shivering • include any of the different modes of anaesthesia (general anaesthesia/epidural anaesthesia/spinal anaesthesia) • include any type of caesarean birth (emergency or planned)
Eligibility criteria – **intervention**(s)/exposure(s)/prognostic factor(s)	• Active warming measures (a process that transfers heat to the patient) ○ forced air warming ○ electric blanket ○ radiant heater ○ warmed cotton blankets ○ fluid warming including - (IV) fluid warmers (including blood/blood products) - other methods of fluid warming ○ heating pad • Thermal insulation measures (for example, ○ leg wrapping ○ compression boots

Field (based on PRISMA-P)	Content
	○ room temperature ○ reflective (“space”) blankets • Pharmacological therapy ○ used to reduce heat redistribution (e.g. vasoconstrictors, such as phenylephrine, metaraminol, noradrenaline/norepinephrine) ○ Other post-delivery drugs - Pethidine
Eligibility criteria – **comparator(s)**/control or reference (gold) standard	• Each of the interventions outlined above • Placebo • No treatment/usual care ○ consider other interventions such as cotton sheets, cotton blankets or wool blankets as “usual care”
Outcomes and prioritisation	**Critical outcomes:** • Incidence of hypothermia • Shivering • Estimated blood loss **Important outcomes** • Rate of change of temperature/ Maternal temperature change (increase or decrease) • Maternal temperature at different time points • Thermal comfort • Wound infection As noted, this question covers three distinct time periods – pre-, peri- and post-operative. There are also three relevant time periods for reporting of outcomes • during the pre-operative period (the hour before the start of surgery)

Field (based on PRISMA-P)	Content
	○ includes outcomes reported at induction of anaesthesia (relevant for pre-warming interventions) • intra-operative period ○ e.g. 30 minutes into surgery, 60 minutes into surgery ○ includes outcomes reported at end of surgery/transfer to recovery room • post-operative period ○ includes up to 24 hours post-surgery ○ first 2 hours post-surgery are the most relevant ▪ If studies report outcomes at multiple time points, only those up to 2 hours post-op will be reported. ▪ If a study reports post-op outcomes at a time after 2 hours, but within the first 24 hours, then the nearest time point to 2 hours will be reported.
Eligibility criteria – **study design**	Only published full text papers • Systematic reviews/meta-analyses of RCTs • RCTs
Other inclusion **exclusion criteria**	Exclude conference abstracts Exclude studies from developing countries Exclude studies where participants are women with sepsis
Proposed stratified, sensitivity/**sub-group analysis**, or meta-regression	**Subgroup analyses (in case of heterogeneity):** • Different modes of anaesthesia for caesarean birth (general anaesthesia/epidural anaesthesia/spinal anaesthesia/combined spinal epidural) • Women with significant blood loss (i.e. major obstetric haemorrhage) • Women with raised BMI

Field (based on PRISMA-P)	Content
Selection process – duplicate screening/selection/analysis	Duplicate screening/selection/analysis will not be undertaken for this review as this question was not prioritised for it. Included and excluded studies will be cross checked with the committee and with published systematic reviews when available.
Data management (software)	If pairwise meta-analyses are undertaken, they will be performed using Cochrane Review Manager (RevMan5). 'GRADE' will be used to assess the quality of evidence for each outcome. STAR will be used for bibliographies/citations and study sifting. Microsoft Word will be used for data extraction and quality assessment/critical appraisal
Information sources – databases and dates	Sources to be searched: Medline, Medline In-Process, CCTR, CDSR, and Embase. Limits (e.g. date, study design): Study design limited to Systematic Reviews and RCTs. Apply standard animal/non-English language filters. No date limit. Supplementary search techniques: No supplementary search techniques will be used.
Identify if an update	No – this is a new review question to be added to the guideline.
Author contacts	Developer: National Guideline Alliance NGA-enquiries@RCOG.ORG.UK
Highlight if amendment to previous protocol	For details please see section 4.5 of Developing NICE guidelines: the manual
Search strategy – for one database	For details please see appendix B

Field (based on PRISMA-P)	Content
Data collection process – forms/duplicate	A standardised evidence table format will be used, and published as appendix D (clinical evidence tables) or H (economic evidence tables)
Data items – define all variables to be collected	For details please see evidence tables in appendix D (clinical evidence tables) or H (economic evidence tables)
Methods for assessing bias at outcome/study level	Appraisal of methodological quality: The methodological quality of each study will be assessed using an appropriate checklist: • ROBIS for systematic reviews • Cochrane risk of bias tool for randomised studies For details please see section 6.2 of Developing NICE guidelines: the manual The risk of bias across all available evidence will evaluated for each outcome using an adaptation of the 'Grading of Recommendations Assessment, Development and Evaluation (GRADE) toolbox' developed by the international GRADE working group http://www.gradeworkinggroup.org/
Criteria for quantitative synthesis	For details please see section 6.4 of Developing NICE guidelines: the manual
Methods for quantitative analysis – combining studies and exploring (in)consistency	Synthesis of data: Meta-analysis will be conducted where appropriate using Review Manager. Minimum important differences **Maternal temperature at different times**. In line with the NICE guideline on the prevention and management of hypothermia in adults having surgery, a difference of 0.5°C compared to the control group temperature is considered to be clinically significant for a control group temperature above 36°C and a difference

Field (based on PRISMA-P)	Content
	of 0.20°C is considered to be clinically significant for control group temperatures below 36°C. For other outcomes, default values will be used of: 0.8 and 1.25 for dichotomous outcomes; 0.5 times SD for continuous outcomes, unless more appropriate values are identified by the guideline committee or in the literature.
Meta-bias assessment – publication bias, selective reporting bias	For details please see section 6.2 of Developing NICE guidelines: the manual.
Confidence in cumulative evidence	For details please see sections 6.4 and 9.1 of Developing NICE guidelines: the manual
Rationale/context – what is known	For details please see the introduction to the evidence review
Describe contributions of authors and guarantor	A multidisciplinary committee developed the guideline. The committee was convened by the NGA and chaired by Sarah Fishburn in line with section 3 of Developing NICE guidelines: the manual. Staff from the NGA undertook systematic literature searches, appraised the evidence, conducted meta-analysis and cost-effectiveness analysis where appropriate, and drafted the guideline in collaboration with the committee. For details please see the methods chapter of the full guideline.
Sources of funding/support	The NGA is funded by NICE and hosted by the Royal College of Obstetricians and Gynaecologists
Name of sponsor	The NGA is funded by NICE and hosted by the Royal College of Obstetricians and Gynaecologists
Roles of sponsor	NICE funds the NGA to develop guidelines for the NHS in England.
PROSPERO registration number	Not registered to PROSPERO

CDSR: Cochrane Database of Systematic Reviews; CENTRAL: Cochrane Central Register of Controlled Trials; DARE: Database of Abstracts of Reviews of Effects; GRADE: Grading of Recommendations Assessment, Development and Evaluation; HTA: Health Technology Assessment; NGA: National Guideline Alliance; NHS: National health service; NICE: National Institute for Health and Care Excellence; RCT: randomised controlled trial; RoB: risk of bias; SD: standard deviation

Appendix B – Literature search strategies

Literature search strategies for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

Review question search strategies

Databases: Medline; Medline EPub Ahead of Print; and Medline In-Process & Other Non-Indexed Citations

Date last searched: 22/11/2019

#	Searches
1	exp CESAREAN SECTION/
2	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
3	or/1-2
4	HYPOTHERMIA/
5	hypothermia?.ti,ab.
6	SHIVERING/
7	shiver$.ti,ab.
8	or/4-7
9	3 and 8
10	limit 9 to english language
11	LETTER/
12	EDITORIAL/
13	NEWS/
14	exp HISTORICAL ARTICLE/
15	ANECDOTES AS TOPIC/
16	COMMENT/
17	CASE REPORT/
18	(letter or comment*).ti.
19	or/11-18
20	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
21	19 not 20
22	ANIMALS/ not HUMANS/
23	exp ANIMALS, LABORATORY/
24	exp ANIMAL EXPERIMENTATION/
25	exp MODELS, ANIMAL/
26	exp RODENTIA/
27	(rat or rats or mouse or mice).ti.
28	or/21-27
29	10 not 28

Databases: Embase; and Embase Classic

Date last searched: 22/11/2019

#	Searches
1	exp CESAREAN SECTION/
2	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
3	or/1-2
4	HYPOTHERMIA/
5	hypothermia?.ti,ab.
6	SHIVERING/
7	shiver$.ti,ab.
8	or/4-7
9	3 and 8
10	limit 9 to english language
11	letter.pt. or LETTER/
12	note.pt.
13	editorial.pt.
14	CASE REPORT/ or CASE STUDY/
15	(letter or comment*).ti.
16	or/11-15

#	Searches
17	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
18	16 not 17
19	ANIMAL/ not HUMAN/
20	NONHUMAN/
21	exp ANIMAL EXPERIMENT/
22	exp EXPERIMENTAL ANIMAL/
23	ANIMAL MODEL/
24	exp RODENT/
25	(rat or rats or mouse or mice).ti.
26	or/18-25
27	10 not 26

Databases: Cochrane Central Register of Controlled Trials; and Cochrane Database of Systematic Reviews

Date last searched: 22/11/2019

#	Searches
#1	MeSH descriptor: [CESAREAN SECTION] explode all trees
#2	(cesarean* or caesarean* or "c section*" or csection* or (deliver* near/3 abdom*)):ti,ab
#3	#1 or #2
#4	MeSH descriptor: [HYPOTHERMIA] this term only
#5	hypothermia*:ti,ab
#6	MeSH descriptor: [SHIVERING] this term only
#7	shiver*:ti,ab
#8	#4 or #5 or #6 or #7
#9	#3 and #8

Health economics search strategies

Databases: Medline; Medline EPub Ahead of Print; and Medline In-Process & Other Non-Indexed Citations

Date last searched: 22/11/2019

#	Searches
1	ECONOMICS/
2	VALUE OF LIFE/
3	exp "COSTS AND COST ANALYSIS"/
4	exp ECONOMICS, HOSPITAL/
5	exp ECONOMICS, MEDICAL/
6	exp RESOURCE ALLOCATION/
7	ECONOMICS, NURSING/
8	ECONOMICS, PHARMACEUTICAL/
9	exp "FEES AND CHARGES"/
10	exp BUDGETS/
11	budget*.ti,ab.
12	cost*.ti,ab.
13	(economic* or pharmaco?economic*).ti,ab.
14	(price* or pricing*).ti,ab.
15	(financ* or fee or fees or expenditure* or saving*).ti,ab.
16	(value adj2 (money or monetary)).ti,ab.
17	resourc* allocat*.ti,ab.
18	(fund or funds or funding* or funded).ti,ab.
19	(ration or rations or rationing* or rationed).ti,ab.
20	ec.fs.
21	or/1-20
22	exp CESAREAN SECTION/
23	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
24	or/22-23
25	HYPOTHERMIA/
26	hypothermia?.ti,ab.
27	SHIVERING/
28	shiver$.ti,ab.
29	or/25-28

#	Searches
30	24 and 29
31	limit 30 to english language
32	LETTER/
33	EDITORIAL/
34	NEWS/
35	exp HISTORICAL ARTICLE/
36	ANECDOTES AS TOPIC/
37	COMMENT/
38	CASE REPORT/
39	(letter or comment*).ti.
40	or/32-39
41	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
42	40 not 41
43	ANIMALS/ not HUMANS/
44	exp ANIMALS, LABORATORY/
45	exp ANIMAL EXPERIMENTATION/
46	exp MODELS, ANIMAL/
47	exp RODENTIA/
48	(rat or rats or mouse or mice).ti.
49	or/42-48
50	31 not 49
51	21 and 50

Databases: Embase; and Embase Classic

Date last searched: 22/11/2019

#	Searches
1	HEALTH ECONOMICS/
2	exp ECONOMIC EVALUATION/
3	exp HEALTH CARE COST/
4	exp FEE/
5	BUDGET/
6	FUNDING/
7	RESOURCE ALLOCATION/
8	budget*.ti,ab.
9	cost*.ti,ab.
10	(economic* or pharmaco?economic*).ti,ab.
11	(price* or pricing*).ti,ab.
12	(financ* or fee or fees or expenditure* or saving*).ti,ab.
13	(value adj2 (money or monetary)).ti,ab.
14	resourc* allocat*.ti,ab.
15	(fund or funds or funding* or funded).ti,ab.
16	(ration or rations or rationing* or rationed).ti,ab.
17	or/1-16
18	exp CESAREAN SECTION/
19	(c?esar#an$ or c section$ or csection$ or (deliver$ adj3 abdom$)).ti,ab.
20	or/18-19
21	HYPOTHERMIA/
22	hypothermia?.ti,ab.
23	SHIVERING/
24	shiver$.ti,ab.
25	or/21-24
26	20 and 25
27	limit 26 to english language
28	letter.pt. or LETTER/
29	note.pt.
30	editorial.pt.
31	CASE REPORT/ or CASE STUDY/
32	(letter or comment*).ti.
33	or/28-32
34	RANDOMIZED CONTROLLED TRIAL/ or random*.ti,ab.
35	33 not 34
36	ANIMAL/ not HUMAN/
37	NONHUMAN/
38	exp ANIMAL EXPERIMENT/
39	exp EXPERIMENTAL ANIMAL/
40	ANIMAL MODEL/

#	Searches
41	exp RODENT/
42	(rat or rats or mouse or mice).ti.
43	or/35-42
44	27 not 43
45	17 and 44

Database: Cochrane Central Register of Controlled Trials

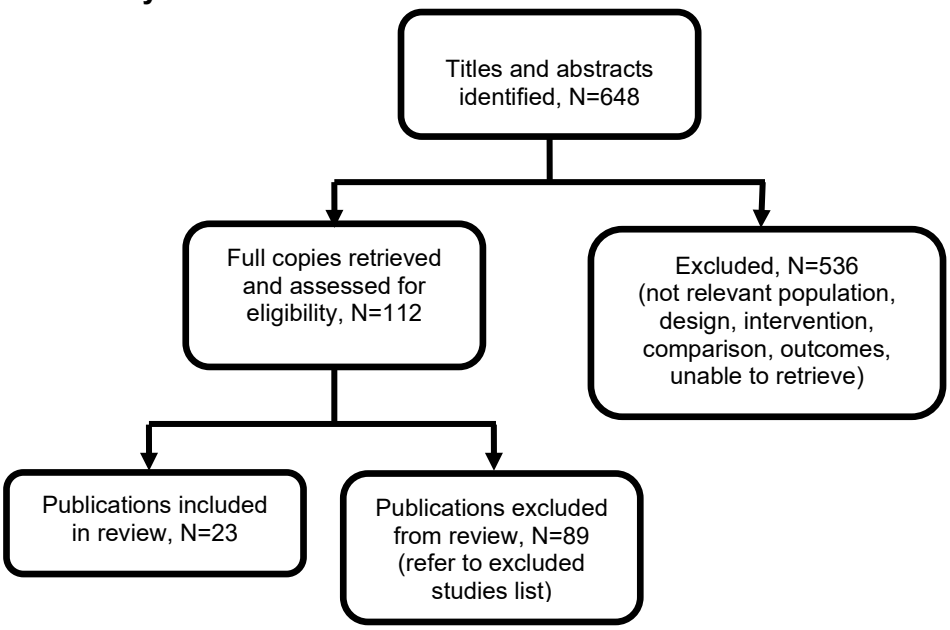
Date last searched: 22/11/2019

#	Searches
#1	MeSH descriptor: [ECONOMICS] this term only
#2	MeSH descriptor: [VALUE OF LIFE] this term only
#3	MeSH descriptor: [COSTS AND COST ANALYSIS] explode all trees
#4	MeSH descriptor: [ECONOMICS, HOSPITAL] explode all trees
#5	MeSH descriptor: [ECONOMICS, MEDICAL] explode all trees
#6	MeSH descriptor: [RESOURCE ALLOCATION] explode all trees
#7	MeSH descriptor: [ECONOMICS, NURSING] this term only
#8	MeSH descriptor: [ECONOMICS, PHARMACEUTICAL] this term only
#9	MeSH descriptor: [FEES AND CHARGES] explode all trees
#10	MeSH descriptor: [BUDGETS] explode all trees
#11	budget*:ti,ab
#12	cost*:ti,ab
#13	(economic* or pharmaco?economic*):ti,ab
#14	(price* or pricing*):ti,ab
#15	(financ* or fee or fees or expenditure* or saving*):ti,ab
#16	(value near/2 (money or monetary)):ti,ab
#17	resourc* allocat*:ti,ab
#18	(fund or funds or funding* or funded):ti,ab
#19	(ration or rations or rationing* or rationed) .ti,ab.
#20	#1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19
#21	MeSH descriptor: [CESAREAN SECTION] explode all trees
#22	(cesarean* or caesarean* or "c section*" or csection* or (deliver* near/3 abdom*)):ti,ab
#23	#21 or #22
#24	MeSH descriptor: [HYPOTHERMIA] this term only
#25	hypothermia*:ti,ab
#26	MeSH descriptor: [SHIVERING] this term only
#27	shiver*:ti,ab
#28	#24 or #25 or #26 or #27
#29	#23 and #28
#30	#20 and #29

Appendix C – Clinical evidence study selection

Clinical study selection for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

Figure 1: Study selection flow chart



Appendix D – Clinical evidence tables

Clinical evidence tables for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

Table 4: Clinical evidence tables for hypothermia and shivering

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr>
<td>Full citation

Browning, R. M., Fellingham, W. H., O'Loughlin, E. J., Brown, N. A., Paech, M. J., Prophylactic ondansetron does not prevent shivering or decrease shivering severity during cesarean delivery under combined spinal epidural anesthesia: a randomized trial, Regional Anesthesia & Pain Medicine, 38, 39-43, 2013

Ref Id

659510</td>
<td>Sample size

n=118: control n=60; intervention (ondansetron) n=58 recruited, n=56 analysed (2 excluded from analysis, reason given)

Characteristics

mean age (years): 31 (placebo); 32 (intervention)
previous c-section: 71%; 77%
previous shivering:57%; 74%

Inclusion criteria

American Society of Anesthesiologists class 1 or 2 women older than 18 years who were scheduled for elective cesarean delivery and who had elected for CSE anesthesia were recruited from Kaleeya and Rockingham General Hospitals in Western Australia

Exclusion criteria

preoperative use of ondansetron, tramadol, meperidine, or clonidine and if there was a contraindication to CSE technique, intolerance or allergy to ondansetron, shivering present before study drug administration, failure to</td>
<td>Interventions

Intervention: intravenous ondansetron 8 mg in 4 mL saline
Control: saline placebo 4 mL</td>
<td>Details

The study drug was prepared in a masked 5-mL syringe by an anesthesiologist not involved in the care of the patient or data collection.
The contents of the syringe were administered intravenously before anesthesia.
The spinal anesthetic technique was standardized, established at a low lumbar interspace using a CSE technique with a 16-gauge Tuohy needle and 27-gauge pencil-point spinal needle and loss of resistance to saline to identify the epidural space.
Hyperbaric bupivacaine 0.5% 2.2 to 2.5 mL, plus fentanyl 15 Kg, was administered intrathecally.</td>
<td>Results

<u>Shivering</u>:
any shivering: placebo 47% n=28/60; intervention 41% n=23/56
reached max shivering score at any point (score 2-4): placebo 33% n=20/60; intervention 32% n=18/56

<u>Maternal temperature at different time points</u>:
<table>
<tr><td>Max shivering score (2-4) achieved at which time point</td><td>intervention N=56</td><td>placebo N=60</td></tr>
<tr><td>before CSE</td><td>13% N=7</td><td>7% N=4</td></tr>
<tr><td>after CSE, pre-surgery</td><td>14% N=8</td><td>15% N=9</td></tr>
<tr><td>during surgery</td><td>20% N=11</td><td>12% N=7</td></tr>
</table>
</td>
<td>Limitations

RoB
Selection bias (Random sequence generation) LOW RISK
Selection Bias (Allocation concealment) LOW RISK
Performance bias (Blinding of participants and personnel) LOW RISK
Detection bias (Blinding of outcomes) HIGH RISK
Attrition bias (incomplete outcome data) LOW RISK
Reporting bias (selective reporting) UNCLEAR
Other biases NONE IDENTIFIED</td>
</tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Country/ies where the study was carried out Australia **Study type** RCT **Aim of the study** PREVENTION OF SHIVERING (PRE-ANAESTHESIA) evaluate the anti-shivering efficacy of ondansetron, which reduces the incidence and severity of shivering in non-obstetric patients **Study dates** not reported **Source of funding** Fremantle Hospital	identify the subarachnoid space, conversion to general anesthesia, or the administration of intrathecal or epidural morphine.		All patients received room-temperature intravenous crystalloid 1000 to 1500 mL, and exposed skin was covered with a blanket during preparation for and after establishing CSE anesthesia.	in post-anaesthesia ward | 17% N=10 | 18% N=11	**Other information**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Medical Research Foundation					
Full citation Butwick, A. J., Lipman, S. S., Carvalho, B., Intraoperative forced air-warming during cesarean delivery under spinal anesthesia does not prevent maternal hypothermia, Anesthesia & Analgesia, 105, 1413-9, table of contents, 2007 **Ref Id** 386827 **Country/ies where the study was carried out** USA **Study type** Randomised controlled trial.	**Sample size** N=30 • n=15 assigned to forced air-warming unit • n=15 assigned to control **Characteristics** Forced air-warming n=15 / Control n=15 / – Age, years, mean ± SD: 36 ± 2 / 32 ± 6 / p=0.02 Weight, kg, mean ± SD: 78 ± 11 / 81 ± 15 / NS Height, cm, mean ± SD: 162 ± 7 / 162 ± 5 / NS SD, standard deviation; NS, not significant; kg, kilogram; cm, centimetre **Inclusion criteria** Aged between 18 and 40 years Singleton pregnancy Gestation >37 weeks Scheduled caesarean birth	**Interventions** Forced air-warmer group: A forced air-warming unit with lower body warming cover was applied (Bair Hugger®) using a Model 501 warming unit set at 43°C. The forced air-warmer was applied after the induction of anaesthesia, and removed at the end of surgery. Control group: The identical cover was applied with the forced air-warming unit switched off.	**Details** Randomisation method was by computer-generated random number sequence. Group assignments were contained in sequentially numbered opaque envelopes. Blinding of participants was not reported (likely to be impossible due to sensation of heat from the warming unit). Study investigators were blinded to the intervention (they left the room, and a different anaesthetist applied the cover). **Anaesthesia:** Premedication of metoclopramide and ranitidine as administered. Participants received 500mL IV colloid at room temperature as an initial infusion. Spinal anaesthesia was performed with hyperbaric bupivacaine 12mg, fentanyl 10mcg and morphine 200mcg. **Standard care:** A warmed cotton blanket was placed over the	**Results** **Critical outcomes:** Incidence of hypothermia ≤35.5°C (time period - until discharge from recovery room) Forced air-warming group: 8/15 Control group: 10/15 Shivering score ≥ 1 (until discharge from recovery room) Forced air-warming group: 4/15 Control group: 7/15 Estimated blood loss Forced air-warming group: 674 ± 183 mL Control group: 640 ± 123 mL **Important outcomes** Maternal temperature at different time points: maximal core temperature change (until discharge from recovery room) Forced air-warming group: -1.3 ± 0.4 °C Control group: -1.3 ± 0.3 °C Thermal comfort (until discharge from recovery room) Forced air-warming group: 51 ± 7 mm Control group: 49 ± 6 mm	**Limitations** For ethical reasons, participants in the control group were administered forced air-warming if they became hypothermic, therefore 10/15 participants in the control group received the intervention. **Other information** Risk of Bias assessed using the Cochrane ROB tool **Random sequence generation** Computer generated list (LOW risk) **Allocation concealment** Group allocation was maintained in sequentially numbered opaque envelopes (LOW risk) **Blinding of participants:**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Aim of the study PREVENTION To assess whether intra-operative lower body forced air-warming prevents hypothermia in women undergoing elective CS with spinal anaesthesia. **Study dates** Not reported (publication date 2007). **Source of funding** Internal funding from the Department of Anesthesia, Stanford University Medical Center, and grants from the National Institutes of Health. No industry funding.	**Exclusion criteria** Severe uncontrolled medical conditions (including diabetes mellitus, pregnancy-induced hypertension, coagulation disorder and significant cardiovascular disease) Body mass index >40kg/m^2		forced air-warming cover of participants in both groups. A second warmed cotton blanket was placed over the upper body, with arms positioned on arm rests. The operating room ambient temperature was maintained near 23°C. **Outcome measurement:** Core temperature was recorded using an oral digital thermometer, placed under the tongue for at least 60 seconds. Hypothermia was defined as ≤35.5°C Shivering was graded using the following scale: 0 = no shivering; 1 = one or more of piloerection, peripheral vasoconstriction, peripheral cyanosis without other cause, but without visible muscle activity; 2 = visible muscle activity confined to one muscle group; 3 = visible muscle activity in more than one muscle group; and 4 = gross muscular activity involving the whole body. Thermal comfort was assessed using a verbal numerical scale of 0mm = worst imaginable cold,		No information was provided (UNCLEAR risk) **Blinding of personnel:** A separate anaesthetist was assigned to administer the intervention. However, unblinding was necessary if the participant became hypothermic during the study period (n=10 out of 15) (UNCLEAR risk) **Blinding of outcome assessment:** Study investigators were initially blinded to group allocation, but this may have been inadvertently revealed during surgery if there was a need to manage hypothermia. Some outcomes were rated by the participant (thermal comfort) and it is unclear whether she could have been adequately blinded to the intervention (UNCLEAR risk). **Incomplete outcome data:** Outcomes are reported for all

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td></td><td></td><td></td><td>50mm = thermoneutral and 100mm = insufferably hot.</td><td></td><td>participants (LOW risk)
Selective reporting
No published trial protocol is reported. (UNCLEAR risk)
Other bias
Baseline imbalance in maternal age - unclear whether this impacts on results. (UNCLEAR)</td></tr>
<tr><td>Full citation

Casey, W. F., Smith, C. E., Katz, J. M., O'Loughlin, K., Weeks, S. K., Intravenous meperidine for control of shivering during caesarean section under epidural anaesthesia, Canadian Journal of Anaesthesia, 35, 128-33, 1988

Ref Id

386856</td><td>Sample size

n=46 studied (23 per group); n=40 treated for shivering (20 per group)

Characteristics

age: meperidine: 29.2 (1.1) years, saline: 27.9 (1.4) years
height: meperidine: 158.7(1.3)cm, saline: 157.7 (1.0)cm,
mean weight: saline group 69.2 + 2.3 kg; meperidine group 78.6(2.6) kg, p < 0.05)
primigravidas (16 meperidine, 12 saline)

Inclusion criteria

Forty-six patients (ASA physical status I) undergoing Caesarean section with epidural anaesthesia</td><td>Interventions

Intervention: intravenous meperidine 50 mg
control:IV 0.9 per cent saline
After delivery of the infant, patients received a single dose of intravenous meperidine 50 mg or 0.9 per cent saline in a randomized double-blind fashion. If not shivering at the time of delivery, the patient did not receive intravenous treatment, and no further measurements were recorded. Shivering was</td><td>Details

The epidural catheter was inserted at the L2-3 or L3-4 interspace at the time of Caesarean section (12 patients), unless previously placed for analgesia during labour (34 patients). After fluid loading with 1-2 L of 0.9 per cent saline, carbonated two per cent lidocaine with 1:200,000 epinephrine was given in 4 m] increments via the epidural catheter to achieve an adequate block. Arterial pressure, electrocardiograph, oxygen saturation,, respiratory rate and tympanic membrane temperature were monitored continuously.</td><td>Results

Number of women shivering
<table><tr><td>Shivering (N)</td><td>intervention</td><td>control</td></tr><tr><td>At delivery</td><td>n=20/23</td><td>n=20/23</td></tr><tr><td>Total treated</td><td>n=20</td><td>n=20</td></tr><tr><td>2 mins post infusion</td><td>8/20</td><td>19/20</td></tr><tr><td>5 mins post</td><td>5/20</td><td>17/20</td></tr><tr><td>15 mins post</td><td>3/20</td><td>17/20</td></tr><tr><td>30 mins post</td><td>6/20</td><td>18/20</td></tr><tr><td>60 mins post</td><td>5/20</td><td>14/20</td></tr></table>Core temperature (°C)</td><td>Limitations

RoB
Selection bias (Random sequence generation) UNCLEAR
Selection Bias (Allocation concealment) UNCLEAR
Performance bias (Blinding of participants and personnel) UNCLEAR
Detection bias (Blinding of outcomes) UNCLEAR
Attrition bias (incomplete outcome data) UNCLEAR
Reporting bias (selective reporting)</td></tr>
</table>

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr>
<td>Country/ies where the study was carried out

Canada

Study type

RCT

Aim of the study

MANAGEMENT OF SHIVERING POST-DELIVERY evaluate the efficacy and safety of intravenous meperidine in controlling shivering during epidural anaesthesia for Caesarean section

Study dates

Not reported

Source of funding

Not reported</td>
<td>Exclusion criteria

Patients with known sensitivity to meperidine, or with any obstetrical or anaesthetic condition that might dictate against the use of regional anaesthesia</td>
<td>classified as 0 = none, 1 = mild, but not distressing to the patient, 2 = moderate and distressing, 3 = severe, distressing, and interfering with monitoring</td>
<td>Oxygen, 6 L/min, was administered via a plastic face mask.
All patients received an infusion of synlocinon (20 units/L) following clamping of the umbilical cord, and a single dose of epidural fentanyl (50 mcg diluted in 10 ml 0.9% saline) 30 minutes after delivery.</td>
<td>
<table>
<tr><th>Core temp. mean (SEM)</th><th>intervention N=20</th><th>control N=20</th></tr>
<tr><td>At delivery</td><td>36.0 (0.2)</td><td>36.2 (0.3)</td></tr>
<tr><td>2 mins post infusion</td><td>36.0 (0.2)</td><td>36.2 (0.2)</td></tr>
<tr><td>5 mins post</td><td>36.0 (0.2)</td><td>36.1 (0.3)</td></tr>
<tr><td>15 mins post</td><td>35.9 (0.2)</td><td>36.2 (0.2)</td></tr>
<tr><td>30 mins post</td><td>35.7 (0.2)</td><td>36.2 (0.2)</td></tr>
<tr><td>60 mins post</td><td>35.8 (0.2)</td><td>36.2 (0.3)</td></tr>
</table>
</td>
<td>UNCLEAR
Other biases NONE IDENTIFIED

Other information</td>
</tr>
</table>

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr>
<td>Full citation

Chakladar, A., Dixon, M. J., Crook, D., Harper, C. M., The effects of a resistive warming mattress during caesarean section: a randomised, controlled trial, International Journal of Obstetric Anesthesia, 23, 309-16, 2014

Ref Id

659514

Country/ies where the study was carried out

UK

Study type

Randomised controlled trial.

Aim of the study

PREVENTION</td>
<td>Sample size

N=119

• n=59 mattress warming
• n=60 control

(n=3 excluded from analyses as surgery was postponed)

Characteristics
<table><tr><td></td><td>Mattress warmed group n=58</td><td>Control group n=60</td><td></td></tr><tr><td>Age, years, mean ± SD</td><td>33.6 ± 5.8</td><td>34.3 ± 5.9</td><td>NS</td></tr><tr><td>Body mass index (kg/m^2) ± SD</td><td>24.8 ± 4.4</td><td>25.7 ± 5.9</td><td>NS</td></tr><tr><td>Fluid warming administered</td><td>51</td><td>55</td><td>NS</td></tr></table>
Inclusion criteria

Any women undergoing elective CS

Exclusion criteria

Unable to fully understand the trial
<16 years of age</td>
<td>Interventions

Warmed mattress group: participants were placed on a full body reusable pressure relieving under-body resistive warming mattress (Inditherm plc) covered with a cotton sheet. The mattress was set to 40°C before the participant entered the operating theatre.
Control group: participants were placed on an identical mattress, with the mattress turned off.</td>
<td>Details

Anaesthesia: was administered according to the individual anaesthetists choice. The practice of the institution was that warmed fluid would only be used if >500mL was anticipated as being required.
All participants wore standard open backed gowns, which were folded over the chest during surgery. These were changed immediately after surgery if wet or soiled. Otherwise the participant was transferred to the recovery room in the original gowns, and covered with a cotton sheet and blankets as required.
Power calculation: A 50% fall in incidence of hypothermia was estimated for the mattress. A sample size of 58 per group would give 80% power to detect this difference, with a type 1 error rate of 0.05.</td>
<td>Results

Critical outcomes:
<u>Incidence of hypothermia (defined as core temp <36.0°C on admission to recovery room)</u>
Warmed mattress group: 3/58
Control group: 11/58
<u>Shivering (defined as occurrence of shivering at any time)</u>
Warmed mattress group: 10/58
Control group: 8/58
<u>Estimated blood loss (median, range)</u>
Warmed mattress group: 0.5L [0.1-2.5L]
Control group: 0.6L [0.2-4.0L]
(need for blood transfusion also reported as 2/58 in warmed group, 3/58 in control group)
Important outcomes
Maternal temperature at different time points
<table><tr><td>Time</td><td>Warmed group</td><td>Control</td></tr><tr><td>pre-op</td><td>36.7 ± 0.3</td><td>36.6 ± 0.4</td></tr><tr><td>post-anaesthetic</td><td>36.8 ± 0.4</td><td>36.7 ± 0.4</td></tr><tr><td>knife-to-skin</td><td>36.5 ± 0.3</td><td>36.4 ± 0.4</td></tr><tr><td>dressing</td><td>36.5 ± 0.4</td><td>36.4 ± 0.4</td></tr></table></td>
<td>Limitations

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Web-based randomisation system (LOW risk)
Allocation concealment
Not reported (UNCLEAR risk)
Blinding of participants:
Participants were not informed of their group allocation (LOW risk)
Blinding of personnel:
The data analyst and the anaesthetist for the surgery were both blinded to group allocation (LOW risk)
Blinding of outcome assessment:
the investigator was not blinded to group allocation, although outcomes reported are largely objective (LOW risk)
Incomplete outcome data:
Outcomes are reported for all</td>
</tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
To identify whether an under body resistive warming mattress would reduce the incidence of inadvertent perioperative hypothermia in women undergoing elective CS **Study dates** February 2010 to July 2011 **Source of funding** No external funding was received. A resistive mattress was loaned to the hospital for the duration of the trial from Inditherm plc. The authors declare that the company had no input into the conduct of the trial.				recovery admission: 36.5 ± 0.5 / 36.3 ± 0.4 recovery admission + 30 mins: 36.6 ± 0.6 / 36.4 ± 0.4	participants (LOW risk) **Selective reporting** The trial protocol was prospectively registered. Some pre-specified secondary outcomes are not reported in this article (wound infection. time to breast feeding, length of hospital stay, health of baby), however it is unclear whether this affects the validity of the other, primary outcome measures. (UNCLE AR risk) **Other bias** None identified (LOW risk) **Other information** 57 women in each group had a spinal anaesthetic. 1 woman in the control group had a general anaesthetic, and 1 woman in the warmed group had an epidural anaesthetic.

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr>
<td>Full citation

Chan, V. W., Morley-Forster, P. K., Vosu, H. A., Temperature changes and shivering after epidural anesthesia for cesarean section, Regional Anesthesia, 14, 48-52, 1989

Ref Id

386870

Country/ies where the study was carried out

Canada

Study type

Randomised controlled trial.

Aim of the study

PREVENTION
To determine whether reduction of heat loss</td>
<td>Sample size

N=40

• n=21 warmed group
• n=19 control group

Characteristics

<table><tr><th></th><th>Warmed group n=21</th><th>Control n=19</th></tr><tr><td>Age, years, mean ± SEM</td><td>31.5 ± 1.0</td><td>33.9 ± 1.2</td></tr><tr><td>Weight, kg, mean ± SEM</td><td>76.1 ± 2.9</td><td>76.5 ± 3.6</td></tr><tr><td>Room temperature, °C, mean ± SEM</td><td>22.8 ± 0.2</td><td>22.9 ± 0.3</td></tr></table>SEM standard error of the mean

Inclusion criteria

Undergoing elective CS under epidural anaesthesia
ASA 1

Exclusion criteria

History of phenothiazine use, thyroid dysfunction, fever, external or middle ear conditions.</td>
<td>Interventions

Warmed group: all IV fluids were administered through a warmer set to 36.5°C. Cleansing solutions were heated in a warming cupboard between 38 and 42°C. Participants were clothed with extra gowns, socks and blankets on their trip to the operating room, and kept covered as much as possible during siting of the epidural and the following 20 minutes.
Control group: received unwarmed fluids and were clothed in a single hospital gown on transfer to the operating room.</td>
<td>Details

Anaesthesia: sodium citrate pre-medication was given. Epidural anaesthesia was administered with carbonated lidocaine and 1:200,000 epinephrine to a sensory level of T4 to T6. Temperature recording was conducted from bladder, aural canal, left side of the chest, lateral aspect or upper right arm, ventral surface of right thigh and lateral aspect of left calf. Using standard formulae, mean skin temperature and mean body temperature were calculated (MST = 0.3[chest+arm]+0.2[thigh +calf]; MBT = [0.66x bladder]+[0.34 x MST]). Shivering was graded by an observer (who was unaware of the participants temperature) on a scale of 0 to 3, with 0 = none, 1 = mild, 2 = moderate and 3 = severe.</td>
<td>Results

Critical outcomes:
Shivering score ≥ 1 (until discharge from recovery room)
Warmed group: 11/21
Control group: 13/19
Estimated blood loss
Warmed group: 580 ± 43 mL (mean ± SEM)
Control group: 610 ± 47 mL
Important outcomes
Maternal temperature at different time points: core temperature (bladder) change (at arrival in recovery room)
Warmed group: -0.6 ± 0.01 °C (mean ± SEM)
Control group: -1.0 ± 0.02 °C</td>
<td>Limitations

Risk of Bias assessed using the Cochrane ROB tool
Random sequence generation
No information was provided (UNCLEAR risk)
Allocation concealment
Group allocation was by drawing a card (UNCLEAR risk)
Blinding of participants:
No information was provided, but it is probably that blinding could not have been conducted (HIGH risk)
Blinding of personnel:
No information was provided, but it is probable that blinding could not have been conducted (HIGH risk)
Blinding of outcome assessment:
No information was provided (UNCLEAR risk).</td>
</tr>
</table>

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>reduces the incidence of shivering during CS under epidural anaesthetic.

Study dates

Not reported (study published 1989)

Source of funding

Not reported.</td><td></td><td></td><td></td><td></td><td>Incomplete outcome data: Outcomes are reported for all participants (LOW risk)
Selective reporting No published trial protocol is reported. (UNCLEAR risk)
Other bias None detected (LOW risk).

Other information</td></tr>
<tr><td>Full citation

Chebbout, R., Newton, R. S., Walters, M., Wrench, I. J., Woolnough, M., Does the addition of active body warming to in-line intravenous fluid warming prevent maternal hypothermia during elective caesarean section? A randomised controlled trial,</td><td>Sample size

N=132
n=44 standard care (IV fluid warming group)
n=44 forced air-warming
n=44 conduction mattress warming
Characteristics<table><tr><td></td><td>IV fluid warming n=44</td><td>Forced air-warming n=43</td><td>Conduction mattress warming n=44</td></tr><tr><td>Age, years, mean ± SD</td><td>31.6 ± 5.8</td><td>32.0 ± 5.7</td><td>31.8 ± 5.4</td></tr></table></td><td>Interventions

The operating table surface was covered with a sponge mattress, an Inditherm® three-quarter conduction mattress, a blue paper sheet, a white cotton bed sheet, a small square absorption pad and Bair Hugger® underbody blanket. All participants received warmed IV fluid, delivered</td><td>Details

A standard spinal anaesthetic of 0.5% hyperbaric bupivacaine with diamorphine was given.
Maternal temperature was measured orally.
Thermal comfort was measured using a seven point Likert scale with the increments +3 (hot), +2 (warm), +1 (slightly warm), 0 (neutral, "just right"), -1 (slightly cool), -2 (cool) and -3 (cold) .
Power calculation showed that 80% power to detect a clinically meaningful temperature</td><td>Results

Critical outcomes:
<u>Incidence of hypothermia <36°C (time period - until admission to recovery room)</u>
Forced air-warming group: 0/43
Conduction mattress warming group: 0/44
Control group (IV fluid warming only): 0/44
<u>Estimated blood loss</u>
Forced air-warming group: 520 ± 190mL
Conduction mattress warming group: 540 ± 240mL
Control group (IV fluid warming only): 550 ± 200mL
Important outcomes
<u>Maternal temperature at different time points:</u></td><td>Limitations

Other information

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation Computer generated list (LOW risk)
Allocation concealment Sequentially numbered opaque envelopes (LOW risk)</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
International Journal of Obstetric Anesthesia, 27, 27, 2017 **Ref Id** 659519 **Country/ies where the study was carried out** UK **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To compare the efficacy of forced air-warming and conduction mattress warming when added to IV fluid warming for women undergoing CS under spinal anaesthesia.	<table><tr><td>BMI, kg/m², mean ± SD</td><td>25.4 ± 3.2</td><td>25.0 ± 3.1</td><td>24.9 ± 3.2</td></tr><tr><td>Operating room temperature</td><td>23.0 ± 0.9</td><td>23.1 ± 0.5</td><td>23.0 ± 0.7</td></tr></table>BMI body mass index, SD standard deviation **Inclusion criteria** Women undergoing elective CS under spinal anaesthesia, with a singleton, uncomplicated pregnancy. **Exclusion criteria** Age < 18 years, BMI ≤19 or ≥31 kg/m², multiple pregnancy, coexisting maternal disease, pregnancy-induced disease, coagulation abnormality, thyroid disease, expected complex procedure or grand multiparity.	through a fluid warmer set to 40°C Conduction mattress warming group: the conduction mattress was switched on, but the Bair hugger remained off during the surgery. Forced air-warming group: the conduction mattress was switched off, and the Bair hugger was switched on and set at high flow and medium heat (38 ± 1.5°C) Control group: neither the mattress nor the Bair hugger were switched on. Warmed IV fluids were administered.	difference of 0.3°C (with a type 1 error of 0.01) would be achieved with 44 participants per group.	*15 minutes after delivery of anaesthetic* Forced air-warming group: 36.7 ± 0.2°C Conduction mattress warming group: 36.7 ± 0.2°C Control group (IV fluid warming only): 36.7 ± 0.2°C *On admission to recovery room* Forced air-warming group: 36.6 ± 0.2°C Conduction mattress warming group: 36.6 ± 0.2°C Control group (IV fluid warming only): 36.6 ± 0.2°C *15 minutes after admission to recovery room* Forced air-warming group: 36.6 ± 0.2°C Conduction mattress warming group: 36.5 ± 0.2°C Control group (IV fluid warming only): 36.5 ± 0.2°C Other measurements taken pre-operatively, at delivery of anaesthetic, at delivery of anaesthetic +30 and +45 minutes, and 30 minutes after admission to recovery room. No significant difference at any of these times. <u>Thermal comfort</u> *30 minutes after delivery of anaesthetic (median [IQR])* Forced air-warming group: 1 [0-2] Conduction mattress warming group: 1 [0-2] Control group: 1 [0-2] *On admission to recovery room (median [IQR])* Forced air-warming group: 0 [0-2] Conduction mattress warming group: 0 [0-1]	**Blinding of participants:** No information was provided, although it is likely that participants could have identified which group they belonged to. (UNCLEAR risk) **Blinding of personnel:** No information was provided (UNCLEAR risk) **Blinding of outcome assessment:** No information was provided (UNCLEAR risk). **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** The trial protocol is published, and all pre-specified outcomes are reported. (LOW risk) **Other bias** Block randomisation in an unblinded trial - potential for investigators to guess treatment allocation (UNCLEAR risk)

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Study dates

October 2014 to January 2016.

Source of funding

Project grant of £3000 from the Obstetric Anaesthetists Association. No other funding was received.</td><td></td><td></td><td></td><td>Control group: 0 [0-1]

30 minutes after admission to recovery room (median [IQR])
Forced air-warming group: 0 [0-1]
Conduction mattress warming group: 0 [0-1]
Control group: 0 [0-1]
<u>Wound infection (duration of follow up not reported)</u>
Forced air-warming group: 1/43
Conduction mattress warming group: 2/44
Control group: 3/44</td><td></td></tr>
<tr><td>Full citation

Chung, S. H., Lee, B. S., Yang, H. J., Kweon, K. S., Kim, H. H., Song, J., Shin, D. W., Effect of preoperative warming during cesarean section under spinal anesthesia, Korean Journal of Anesthesiology, 62, 454-60, 2012

Ref Id

659524</td><td>Sample size

N=45
n=15 fluid warming
n=15 forced air-warming
n=15 standard care
Characteristics<table><tr><th></th><th>IV fluid group n=15</th><th>Forced air-warming group n=15</th><th>Control n=15</th></tr><tr><td>Age, years, mean ± SD</td><td>32.5 ± 3.4</td><td>31.8 ± 3.9</td><td>31.9 ± 4.6</td></tr><tr><td>Weight, kg, mean ± SD</td><td>68.0 ± 11.6</td><td>68.8 ± 10.4</td><td>67.0 ± 9.9</td></tr></table>SD, standard deviation</td><td>Interventions

Fluid warming group: a 10ml/kg IV fluid preload of Hartmann's solution, stored in a warming cabinet set at 40°C, was administered during the 15 minutes before the anaesthetic. A forced air-warming unit was applied but switched off. Forced air-warming group: an upper body forced air-warming unit (Bair Hugger®) was applied and set at 43°C. IV fluid preload was administered with</td><td>Details

Spinal anaesthesia was performed with 10mg hyperbaric bupivacaine. When systolic blood pressure dropped below 100mmHg (or by more than 20% of the resting BP) ephedrine was adminstered IV. Shivering was graded using the following scale: 0 = no shivering; 1 = one or more of piloerection, peripheral vasoconstriction, peripheral cyanosis without other cause, but without visible muscle activity; 2 = visible muscle activity confined to one muscle group; 3 = visible muscle activity in more than one muscle</td><td>Results

Critical outcomes:
<u>Shivering score ≥ 1</u>
Warmed IV fluid group: 2/15
Forced air-warming group: 3/15
Control group: 8/15
<u>Estimated blood loss</u>
Warmed IV fluid group: 507 ± 139mL
Forced air-warming group: 587 ± 141mL
Control group: 540 ± 112mL
Important outcomes
<u>Maternal temperature at different time points: core temperature change at 45 minutes</u>
Warmed IV fluid group: -0.5 ± 0.3°C
Forced air-warming group: -0.6 ± 0.4°C
Control group: -0.9 ± 0.4°C
<u>Thermal comfort (until discharge from recovery room)</u>
Warmed IV fluid group: 59.0 ± 12.1mm
Forced air-warming group: 59.3 ± 13.2mm
Control group: 69.0 ± 15.9mm</td><td>Limitations

Other information

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
No information is provided (UNCLEAR risk)
Allocation concealment
No information is provided (UNCLEAR risk)
Blinding of participants:
No information was provided (UNCLEAR risk)</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Country/ies where the study was carried out South Korea **Study type** Randomised controlled trial **Aim of the study** PREVENTION To assess whether forced air-warming or prewarmed fluids before spinal anaesthesia prevents maternal hypothermia and shivering during CS. **Study dates** Not reported (study published 2012) **Source of funding** Not reported	**Inclusion criteria** ASA grade I to II 38 to 42 weeks gestation Elective caesarean section **Exclusion criteria** Contraindication to spinal anaesthesia Gestational hypertension Placenta praevia Multiple pregnancy Weight <50 or >100kg Fever Recent medication (except vitamins/minerals) Conversion to general anaesthetic due to insufficient spinal anaesthesia	room temperature fluid. Control group: IV fluid preload was administered with room temperature fluid. A forced air-warming unit was applied but switched off.	group; and 4 = gross muscular activity involving the whole body. Thermal comfort was assessed using a verbal numerical scale of 0mm = insufferably hot, 50mm = thermoneutral and 100mm = worst imaginable cold.	(n.b. data have been converted for meta-analysis to ensure scale is equivalent in all studies)	**Blinding of personnel:** No information was provided (UNCLEAR risk) **Blinding of outcome assessment:** No information was provided (UNCLEAR risk) **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported. (UNCLEAR risk) **Other bias** Not identified (LOW risk)

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr>
<td>Full citation

Cobb, B., Cho, Y., Hilton, G., Ting, V., Carvalho, B., Active Warming Utilizing Combined IV Fluid and Forced-Air Warming Decreases Hypothermia and Improves Maternal Comfort During Cesarean Delivery: A Randomized Control Trial, Anesthesia & Analgesia, 122, 1490-7, 2016

Ref Id

608955

Country/ies where the study was carried out

USA

Study type

Randomised controlled trial.</td>
<td>Sample size

N=46

• n=23 warmed IV fluid and forced air-warming
• n=23 no warming

Characteristics

<table>
<tr><th></th><th>Active warming n=23</th><th>No warming n=23</th></tr>
<tr><td>Age, years, mean ± SD</td><td>32 ± 7</td><td>31 ± 6</td></tr>
<tr><td>BMI, kg/m², median (IQR)</td><td>33 (30-41)</td><td>33 (26-37)</td></tr>
<tr><td>Operating room temperature, °C, mean ± SD</td><td>24.0 ± 1.0</td><td>23.6 ± 0.9</td></tr>
</table>

Inclusion criteria

ASA status I-II
Age 18-40
Gestational age ≥37 weeks
Singleton pregnancy
Scheduled CS with spinal anaesthesia

Exclusion criteria

Emergency CS
Scheduled CS under epidural/GA</td>
<td>Interventions

Active warming group: participants received IV fluid coload warmed to 41ºC through a fluid warmer. An air-warming blanket was placed over the lower extremities and attached to a Bair Hugger® set to high (43°C)
Control group: participants received the IV fluid coload through a fluid warmer, but the unit was switched off. The air-warming blanket was placed over them, but again the unit was set to</td>
<td>Details

Spinal anaesthesia consisted of 10-12mg intrathecal hyperbaric bupivacaine with 10mcg fentanyl. A coload of 1000ml lactated Ringer's solution was administered commencing at the time of the intrathecal injection.
Core temperature was measured with a skin sensor on the right temporal region.
Numerical shivering scores were assessed by an investigator as 0=no shivering, 1=shivering localised to the core and neck, 2=shivering including the upper extremities and 3=total body shivering.
Thermal comfort scores were obtained from participants by asking them to rate thermal comfort on a verbal numerical scale (0=completely unsatisfied and 100=completely satisfied)
All participants received full body forced air-warming set to "high" in the recovery room, as per institutional practice.</td>
<td>Results

Critical outcomes:
<u>Incidence of perioperative hypothermia <36°C (throughout surgery, until 1 hour after admission to recovery)</u>
Warmed group: 14/22
Control group: 20/22
<u>Shivering score ≥ 1 intra-operatively</u>
Warmed group: 5/22
Control group: 10/22
<u>Shivering score ≥ 1 post-operatively</u>
Warmed group: 4/22
Control group: 4/22
<u>Estimated blood loss</u>
Warmed group: 950 [800-1000] mL
Control group: 975 [800-1000] mL (median [IQR])
Important outcomes
<u>Maternal temperature on arrival to recovery room</u>
Warmed group: 35.9 ± 0.5°C
Control group: 35.5 ± 0.5°C
<u>Thermal comfort (until discharge from recovery room)</u>
Forced air-warming group: 100 [95-100]
Control group: 90 [70-100]</td>
<td>Limitations

Other information

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Computer generated random numbers (LOW risk)
Allocation concealment
Sealed envelope method (LOW risk)
Blinding of participants:
Participants were blinded to the intervention (LOW risk)
Blinding of personnel:
Personnel were blinded to the intervention (LOW risk)
Blinding of outcome assessment:
Outcome assessors were blinded to the intervention (LOW risk).
Incomplete outcome data:
Outcomes are reported for all</td>
</tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Aim of the study PREVENTION To assess the use of combined warmed IV fluid and forced air-warming on women undergoing CS under spinal anaesthesia. **Study dates** November 2013 - April 2015 **Source of funding** None reported.					participants (LOW risk) **Selective reporting** A published trial protocol is reported. Protocol states that temperature will be recorded until up to 3 hours post spinal anaesthetic, and report only describes temperature readings until 1 hour post surgery. (UNCLEAR risk) **Other bias** None detected (LOW risk)
Full citation Duryea, E. L., Nelson, D. B., Wyckoff, M. H., Grant, E. N., Tao, W., Sadana, N., Chalak, L. F., McIntire, D. D., Leveno, K. J., The impact of ambient operating room temperature on	**Sample size** N=825 • n=419 randomised to OR temperature of 20°C • n=406 randomised to OR temperature of 23°C **Characteristics** | | Operating room | Operating room |	**Interventions** Operating room temperature was set at either 20°C or 23°C.	**Details** Treatment group was assigned on a rotating weekly basis according to a computer generated randomisation schedule. Operating room temperature was recorded and the accuracy was audited with an independently calibrated thermometer.	**Results** **Critical outcomes:** Incidence of hypothermia <36.5°C Intervention group (23°C): 269/390 Control group (20°C): 310/401 Incidence of moderate-severe hypothermia <36.0°C Intervention group (23°C): 104/390 Control group (20°C): 132/401 **Important outcomes** Wound infection Intervention group (23°C): 0/390 Control group (20°C): 1/401	**Limitations** **Other information** Risk of Bias assessed using the Cochrane ROB tool **Random sequence generation** Computer generated randomisation schedule (LOW risk)

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
neonatal and maternal hypothermia and associated morbidities: a randomized controlled trial, American Journal of Obstetrics & Gynecology, 214, 505.e1-7, 2016 **Ref Id** 608979 **Country/ies where the study was carried out** USA **Study type** Cluster RCT **Aim of the study** PREVENTION To assess the impact of an increase in operating room temperature on neonatal and maternal hypothermia.	<table><tr><td></td><td>temp 23°C n=390</td><td>temp 20°C n=401</td></tr><tr><td>Age, years, mean ± SD</td><td>30.0 ± 6.7</td><td>29.8 ± 6.0</td></tr><tr><td>BMI <25kg/m², n (%)</td><td>17 (4)</td><td>17 (4)</td></tr><tr><td>Preterm</td><td>65 (16%)</td><td>81 (20%)</td></tr></table> **Inclusion criteria** Women undergoing CS on the high-risk labour and delivery unit. **Exclusion criteria** None reported.				**Allocation concealment** "Cluster" randomisation with allocation on a weekly basis (HIGH risk) **Blinding of participants:** No blinding of participants (HIGH risk) **Blinding of personnel:** No blinding of personnel (HIGH risk) **Blinding of outcome assessment:** No blinding of outcome assessors (HIGH risk). **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported. (UNCLEAR risk) **Other bias** None identified (LOW risk)

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Study dates

Feb to July 2015.

Source of funding

None reported.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Full citation

Fallis, W. M., Hamelin, K., Symonds, J., Wang, X., Maternal and newborn outcomes related to maternal warming during cesarean delivery, JOGNN - Journal of Obstetric, Gynecologic, & Neonatal Nursing, 35, 324-31, 2006

Ref Id

387079

Country/ies where the</td><td>Sample size

N=62
n=32 forced air-warming group
n=30 standard care
Characteristics<table><tr><td></td><td>Forced air-warming group n=32</td><td>Standard care group n=30</td></tr><tr><td>Age, years, mean ± SD</td><td>30 ± 5</td><td>30 ± 5</td></tr><tr><td>Weight, kg, mean ± SD</td><td>87.7 ± 17.5</td><td>82.5 ± 12.3</td></tr></table></td><td>Interventions

Forced air-warming group: an upper body forced air-warming blanket was applied immediately following placement of the spinal anaesthetic. The warming unit was turned to "high" (43°C). It remained in place until the woman left the operating room.
Standard care: warmed cotton blankets were applied in the operating room as per usual routine on an as-needed basis.</td><td>Details

Shivering was recorded on a 4-point scale
0=no shivering
1=mild
2=moderate
3=severe

Thermal comfort was measured on a 0-10 scale, with the description "worst imaginable cold" for 0, "thermally neutral" for 5 and "insufferably hot" for 10.
No information was provided on the anaesthetic, other than that women underwent spinal anaesthesia, with the exception of one woman who underwent epidural anaesthesia.</td><td>Results

Critical outcomes:
<u>Shivering score ≥ 1</u>
Forced air-warming group: 10/32
Control group: 10/30
Important outcomes
<u>Maternal temperature at different time points: final oral temperature (on departure from operating room)</u>
Forced air-warming group: 36.1 ± 0.4°C
Control group: 35.9 ± 0.4°C
<u>Maternal temperature at different time points: change in oral temperature (from arrival to departure from operating room)</u>
Forced air-warming group: -0.7 ± 0.4°C
Control group: -0.8 ± 0.5°C
<u>Thermal comfort (until discharge from recovery room)</u>
Insufficient data to assess (graphical representation only). Reported as higher thermal comfort scores in the intervention arm at 30, 45 and 60 minutes.</td><td>Limitations

Other information

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Methods state "participants were assigned to the control or intervention group based on block randomisation". No further details are provided (UNCLEAR risk)
Allocation concealment
Group allocation was maintained in numbered opaque envelopes (LOW risk)</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
study was carried out Canada **Study type** RCT **Aim of the study** PREVENTION To compare forced air-warming with standard care, in the prevention of hypothermia and shivering. **Study dates** Nov 2003 to July 2004. **Source of funding** Grant from Health Sciences Centre Foundation. Equipment was donated by Associated Health Systems	<table><tr><td>Thermal comfort at baseline, mean ± SD</td><td>4.0 ± 1.6</td><td>4.1 ± 1.5</td></tr></table> kg kilogram; SD standard deviation **Inclusion criteria** Low-risk, pregnant women 18 years or older ≥37 weeks' gestation elective CS **Exclusion criteria** Taking any mediation (except prenatal vitamins) High-risk pregnancy				**Blinding of participants:** No information was provided (UNCLEAR risk) **Blinding of personnel:** No information was provided (UNCLEAR risk) **Blinding of outcome assessment:** No information was provided (UNCLEAR risk). **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported. (UNCLEAR risk) **Other bias** None identified (LOW risk)

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Inc and Alaris Medical.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Full citation

Grant, E. N., Craig, M. G., Tao, W., McIntire, D. D., Leveno, K. J., Active Warming during Cesarean Delivery: Should We SCIP It?, American Journal of Perinatology, 32, 933-8, 2015

Ref Id

659538

Country/ies where the study was carried out

USA

Study type

Cluster RCT

Aim of the study

PREVENTION</td><td>Sample size

N=484

• n=243 warming mattress
• n=241 standard care

Characteristics

<table><tr><th></th><th>Warming mattress n=243</th><th>Control n=241</th></tr><tr><td>Age, years ≤ 15, n (%)</td><td>1 (0)</td><td>0 (0)</td></tr><tr><td>Age, years ≥ 35, n (%)</td><td>43 (18)</td><td>53 (22)</td></tr><tr><td>BMI, kg/m², ≥ 35, n (%)</td><td>86 (35)</td><td>79 (33)</td></tr><tr><td>Neuraxial anaesthesia, n (%)</td><td>235 (97)</td><td>232 (96)</td></tr></table>
Inclusion criteria

All women presenting for CS between 7am on Monday and 3pm on Friday during the study period, within the designated operating rooms (2 out of a possible 7 rooms).</td><td>Interventions

Warming group: A PerfecTemp warming mattress was used, and set to 37°C.
Standard care: participants received a heat retaining "tinfoil" cap, warmed blankets and warmed IV and irrigation fluids.</td><td>Details

Cluster randomisation was used to assign the treatment group on different weeks.</td><td>Results

Critical outcomes:
<u>Incidence of hypothermia <36°C</u>
Mattress warmed group: 88/131
Control group: 105/131
(only reported for women in whom a bladder temperature sensor was in place)
Important outcomes
<u>Maternal temperature at different time points (end of surgery, measured with bladder catheter)</u>
Mattress warmed group: 35.9 ± 0.5 °C (n=131)
Control group: 35.7 ± 0.5 °C (n=131)
<u>Maternal temperature at different time points (arrival in recovery room, measured orally)</u>
Mattress warmed group: 36.3 ± 0.6 °C (n=243)
Control group: 36.3 ± 0.6 °C (n=241)
<u>Wound infection</u>
Mattress warmed group: 4/243
Control group: 1/241</td><td>Limitations

Other information

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Computer generated list (LOW risk)
Allocation concealment
Allocation was on a weekly basis (HIGH risk)
Blinding of participants:
Trial described as "open" (HIGH risk)
Blinding of personnel:
Trial described as "open" (HIGH risk)
Blinding of outcome assessment:
Trial described as "open" (HIGH risk)
Incomplete outcome data:
Outcomes are not reported for some participants - only women with a</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
To assess whether use of a warming mattress decreases the incidence of hypothermia in women undergoing CS. **Study dates** January to June 2012 **Source of funding** Center for Translational Medicine, National Institute of Health/National Center for Advancing Translational Sciences.	**Exclusion criteria** No exclusions.				bladder temperature sensor are included for the outcomes hypothermia and temperature at the end of surgery. Bladder temperature sensors were only used if women did not already have a urinary catheter on arrival at the operating room. It is unclear whether all women were included in the follow up for wound infection. (HIGH risk) **Selective reporting** No published trial protocol is reported. (UNCLEAR risk) **Other bias.** None identified (LOW risk)
Full citation Hong, J. Y., Lee, I. H., Comparison of the effects of intrathecal morphine and pethidine on shivering after Caesarean	**Sample size** N=120 • n=30 bupivacaine alone (B) • n=30 bupivicaine + 0.1mg morphine (BM0.1) • n=30 bupivacaine + 0.2mg morphine (BM0.2)	**Interventions** Combined spinal-epidural anaesthesia was administered with the following medications: B group: 8-10mg of 0.5% bupivacaine	**Details** Before anaesthesia, participants were given IV lactated Ringer's solution 15ml/kg at room temperature. The operating room was maintained at 23-25°C. Shivering was rated by an independent	**Results** **Critical outcomes:** Incidence of shivering (definition not stated, presumed to equate to shivering score ≥ 1) B group: 7/30 BM0.1 group: 5/29 BM0.2 group: 4/30 BP group: 1/30 **Important outcomes**	**Limitations** **Other information** Risk of Bias assessed using the Cochrane ROB tool

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
delivery under combined-spinal epidural anaesthesia, Anaesthesia, 60, 1168-72, 2005 **Ref Id** 659542 **Country/ies where the study was carried out** South Korea **Study type** RCT **Aim of the study** PREVENTION To compare the anti-shivering effect of morphine and pethidine when added to spinal anaesthesia. **Study dates** Not reported.	• n=30 bupivacaine + 10mg pethidine (BP) **Characteristics** B n=30 / BM0.1 n=30 / BM0.2 n=30 / BP n=30 Age, years, mean ± SD: 31.3 ± 4.5 / 30.5 ± 3.2 / 29.7 ± 1.8 / 30.8 ± 4.3 Weight, kg, mean ± SD: 64.8 ± 4.0 / 68.1 ± 6.1 / 66.9 ± 4.7 / 65.2 ± 7.1 kg kilogram; SD standard deviation **Inclusion criteria** Elective CS under combined spinal-epidural ASA physical status I or II **Exclusion criteria** Contra-indication to regional anaesthesia Allergy to study medication Severe obesity Pre-eclampsia Placenta praevia Diabetes	BM0.1: 8-10mg of 0.5% bupivacaine plus 0.1mg morphine BM0.2: 8-10mg of 0.5% bupivacaine plus 0.2mg morphine BP: 8-10mg of 0.5% bupivacaine plus 10mg pethidine	assessor according to the following scale: 0=no shivering 1=piloerection or peripheral vasoconstriction but no visible shivering 2=muscular activity in only one muscle group 3=muscular activity in more than one muscle group 4=shivering involving the whole body	<u>Maternal temperature at different time points:</u> Insufficient information - data represented graphically only.	**Random sequence generation** No information was provided (UNCLEAR risk) **Allocation concealment** Sealed envelope method (LOW risk) **Blinding of participants:** No information was provided (UNCLEAR risk) **Blinding of personnel:** No information was provided (UNCLEAR risk) **Blinding of outcome assessment:** No information was provided (UNCLEAR risk) **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported. (UNCLEAR risk) **Other bias** None identified (LOW risk)

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Source of funding

Not reported</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Full citation

Horn, E. P., Bein, B., Steinfath, M., Ramaker, K., Buchloh, B., Hocker, J., The incidence and prevention of hypothermia in newborn bonding after cesarean delivery: a randomized controlled trial, Anesthesia & Analgesia, 118, 997-1002, 2014

Ref Id

387354

Country/ies where the study was carried out

Germany

Study type

Randomised controlled trial.</td><td>Sample size

N=40

• n=19 assigned to active forced-air warming
• n=21 assigned to control

Characteristics

<table><tr><td></td><td>Active forced air-warming n=19</td></tr><tr><td>Age, years, mean ± SD</td><td>31 ± 5</td></tr><tr><td>Weight, kg, mean ± SD</td><td>90 ± 16</td></tr><tr><td>Height, cm, mean ± SD</td><td>166 ± 7</td></tr><tr><td>Operating room temperature, °C, mean ± SD</td><td>22.9 ± 0.7</td></tr></table>SD, standard deviation; kg, kilogram; cm, centimetre

Inclusion criteria

Women aged above 18 years old</td><td>Interventions

Active forced air-warming group: a forced air-cover (Level 1 Snuggle Warm® Upper Body Blanket) was positioned over the upper body of the participant. A Level 1 Equator® warmer was set to "high level" (44°C) during the warming period. Control group: participants were covered with a cotton blanket taken from a 40°C heating cabinet.</td><td>Details

Randomisation was performed through coin-toss by a nurse independent to the trial. It was unclear whether participants and investigators were blinded to treatment allocation.
Anaesthesia:
Participants received 30mL sodium citrate oral premedication 20 minutes preoperatively. Spinal anaesthesia was performed with 1.4 to 1.6 mL of hyperbaric bupivacaine and 5µg of sufentanil. No IV opioids were administered.
Outcome measurement:
Core temperature was recorded using a sublingual temperature probe (Temp-Plus II, Model 2080, Alaris™). Hypothermia was defined as < 36°C. Shivering was graded using the following scale: 0=no shivering; 1=intermittent, low intensity shivering; 2=moderate shivering;</td><td>Results

Critical outcomes:
<u>Incidence of hypothermia < 36°C after 20-minute bonding</u>
Intervention group: 1/19
Control group: 10/21
<u>Shivering score ≥ 1 after 20-minute bonding</u>
Intervention group: 0/19
Control group: 5/21
Important outcomes
<u>Maternal core temperature at start of surgery</u>
Intervention group: 36.4 ± 0.5 °C
Control group: 36.7 ± 0.5 °C
<u>Maternal core temperature at start of bonding</u>
Intervention group: 36.4 ± 0.4 °C
Control group: 36.5 ± 0.5 °C
<u>Maternal core temperature after 20-minute bonding</u>
Intervention group: 36.4 ± 0.4 °C
Control group: 36.0 ± 0.5 °C
<u>Thermal comfort at start of surgery</u>
Intervention group: 0 ± 9 mm
Control group: -4 ± 8 mm
<u>Thermal comfort at start of bonding</u>
Intervention group: 2 ± 12 mm
Control group: -6 ± 9 mm
<u>Thermal comfort after 20-minute bonding</u>
Intervention group: 7 ± 10 mm
Control group: -9 ± 10 mm</td><td>Limitations

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Coin toss (HIGH risk)
Allocation concealment
No information provided (UNCLEAR risk)
Blinding of participants:
No information was provided (UNCLEAR risk)
Blinding of personnel:
No information was provided (UNCLEAR risk)
Blinding of outcome assessment:
No information was provided (UNCLEAR risk)
Incomplete outcome data:
Outcomes are provided for all</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Aim of the study PREVENTION To assess whether active forced-air warming prevents hypothermia in women undergoing planned caesarean section under spinal anaesthesia. **Study dates** February to April 2013. **Source of funding** Department of Anesthesiology and Intensive Care Medicine.	**Exclusion criteria** Classified as American ASA physical status > III CS planned under general anaesthesia Week of gestation <36 and >42 Placenta previa or abruption Meconium stained amniotic fluid Chorioamnionitis Any abnormalities in cardiotocography		and 3=continuous, intense shivering. Thermal comfort was assessed using a 100-mm visual analog scale of -50 mm=worst imaginable cold; 0mm=thermally neutral; and +50mm=insufferably hot.		participants (LOW risk) **Selective reporting** Published trial protocol registered and main outcomes reported (LOW risk) **Other bias** None identified (LOW risk) **Other information**
Full citation Horn, E. P., Schroeder, F., Gottschalk, A., Sessler, D. I., Hiltmeyer, N.,	**Sample size** N=30 • n=15 assigned to forced-air heating	**Interventions** Forced-air cover group: the cover (Bair Hugger; Augustine Medical) was positioned	**Details** Randomisation method was by computer-generated random number sequence. Group assignments	**Results** **Critical outcomes:** Shivering score ≥ 1 Intervention group: 2/15 Control group: 9/15 **Important outcomes**	**Limitations** Risk of Bias assessed using the Cochrane ROB tool **Random sequence generation**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Standl, T., Schulte am Esch, J., Active warming during cesarean delivery, Anesthesia & Analgesia, 94, 409-14, table of contents, 2002 **Ref Id** 387355 **Country/ies where the study was carried out** USA **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To assess whether forced-air cover prevents hypothermia in women undergoing elective caesarean section with	• n=15 assigned to control **Characteristics** [table] SD, standard deviation; kg, kilogram; cm, centimetre. **Inclusion criteria** Aged above 18 **Exclusion criteria** Diagnosis of preeclampsia or eclampsia History or clinical evidence of a clothing disorder Those taking medications other than perinatal vitamins	over the upper body 15 minutes before insertion of the epidural catheter; a Model 501 warmer was set to "high". Control group: participants were covered with a single cotton blanket.	were contained in sequentially numbered opaque envelopes. Blinding of participants was not reported (likely to be impossible due to sensation of heat from the warming unit). Blinding of study investigators or outcome assessors was not reported. **Anaesthesia:** Participants received 150 mg of oral ranitidine 2h before surgery. All fluids were warmed to 37°C. Epidural anaesthesia was performed with doses of 4mL ropivacaine without epinephrine. Participants were not given opioids. **Outcome measurement:** Core temperature was recorded using a Mon-a-Therm thermocouples in the tympanic membrane. Shivering was graded using the following scale: 0=no shivering; 1=intermittent; 2 moderate shivering; and 3=continuous intense shivering. Thermal comfort was assessed using a visual analogue scale of 0mm= worst imaginable cold; 50 mm= thermally	<u>Maternal temperature at the end of surgery</u> Intervention group: 37.1 ± 0.4 °C Control group: 36.0 ± 0.5 °C <u>Thermal comfort after 15 minutes of treatment</u> Intervention group: 63 ± 11 mm Control group: 52 ± 9 mm	Computer-generated random number sequence (LOW risk) **Allocation concealment** Sequentially numbered opaque envelopes (LOW risk) **Blinding of participants:** No information was provided (UNCLEAR risk) **Blinding of personnel:** No information was provided (UNCLEAR risk) **Blinding of outcome assessment:** No information was provided (UNCLEAR risk) **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported (UNCLEAR risk) **Other bias** None identified (LOW risk)

	Forced air-warming n=15	Control n=15
Age, years, mean ± SD	33 ± 4	31 ± 5
Weight, kg, mean ± SD	79 ± 9	81 ± 14
Height, cm, mean ± SD	165 ± 9	169 ± 6

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
epidural anaesthesia. **Study dates** Not reported (publication date 2002). **Source of funding** Augustine Medical, the Joseph Drown Foundation, and the Commonwealth of Kentucky Research Challenge Trust Fund. Mallinckrodt donated the thermocouples used.			neutral; 100 mm= insufferably hot.		**Other information**
Full citation Jorgensen, H. S., Bach, L. F., Helbo-Hansen, H. S., Nielsen, P. Aa, Warm or cold saline for volume preload before spinal anaesthesia for caesarean section?,	**Sample size** N=120 • n= 60 assigned to warm saline • n= 60 assigned to control n=7 withdrawn from study due to selection criteria/ protocol violation or because of failed spinal anaesthesia)	**Interventions** Warm saline group: participants received warm 0.9% saline for i.v. volume preload (20 mL/kg before the 15 minutes preceding spinal injection) and maintenance (10 mL/kg before the	**Details** Randomisation method was by computer-generated random number sequence. Group assignments were contained in envelopes. Blinding of participants was not reported (likely to be impossible due to the sensation of heat).	**Results** **Critical outcomes:** Shivering score ≥ 1 Intervention group: 8/57 Control group: 14/56	**Limitations** Risk of Bias assessed using the Cochrane ROB tool **Random sequence generation** Computer generated list (LOW risk) **Allocation concealment**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
International Journal of Obstetric Anesthesia, 9, 20-25, 2000 **Ref Id** 931672 **Country/ies where the study was carried out** Denmark **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To assess whether warm saline prevents shivering in women undergoing elective CS with spinal anaesthesia. **Study dates**	**Characteristics** | | Warm saline n=57* | Control n=56* | |---|---|---| | Age, years, mean ± SD | 30.4 ± 4.7 | 29.9 ± 4.4 | | Weight, kg, mean ± SD | 79.1 ± 10.7 | 79.5 ± 13 | | Height, cm, mean ± SD | 167 ± 6 | 167 ± 6 | SD, standard deviation; kg, kilogram; cm, centimetre *Based on the N included after n=7 were withdrawn (see sample size section) **Inclusion criteria** Term pregnancy **Exclusion criteria** Pre-eclampsia Arterial hypertension Multiple pregnancy	20 following spinal injection). Control group: participants received cold 0.9% saline.	Blinding of study investigators was not reported. **Anaesthesia:** Participants received 2.7 mL of bupivacaine 0.5% with 8.0% dextrose (Marcaine spinal heavy 0.5%, ASTRA, Sweden) and IV bolus dose of ephedrine. Intrathecal opioids were not administered. **Outcome measurement:** Shivering was evaluated using 4-point verbal rating scale (absent, slight, moderate, severe).		Group allocation was maintained in sequentially numbered envelopes (LOW risk) **Blinding of participants:** No information was provided (UNCLEAR risk) **Blinding of personnel:** No information was provided (UNCLEAR risk) **Blinding of outcome assessment:** No information was provided (UNCLEAR risk) **Incomplete outcome data:** Drop-outs accounted for <20% and reasons were provided (LOW risk) **Selective reporting** No published trial protocol is reported (UNCLEAR risk) **Other bias** None identified (LOW risk) **Other information**

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Not reported (publication date 2000).

Source of funding

Odense University Hospital.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Full citation

Munday, J., Osborne, S., Yates, P., Sturgess, D., Jones, L., Gosden, E., Preoperative Warming Versus no Preoperative Warming for Maintenance of Normothermia in Women Receiving Intrathecal Morphine for Cesarean Delivery: A Single-Blinded, Randomized Controlled Trial, Anesthesia and Analgesia, 126, 183-189, 2018

Ref Id</td><td>Sample size

N=50
n=25 assigned to prewarming
n=25 assigned to control
Characteristics
<table><tr><th></th><th>Prewarming n=25</th><th>Control n=25</th><th>P-value</th></tr><tr><td>Age, years, median (range)</td><td>31 (23-41)</td><td>36 (19-40)</td><td>NS</td></tr><tr><td>BMI, kg/m^2, median (range)</td><td>22.9 (16.2-38.2)</td><td>23.8 (17.6-40.3)</td><td>NS</td></tr><tr><td>OR temperature, °C, median (range)</td><td>21.4 (20.20-23)</td><td>21.5 (20.6-22.6)</td><td>NS</td></tr></table></td><td>Interventions

Prewarming: Participants received 20 minutes of forced air warming (Cocoon™) set to 43°C.
Control: participants received no active preoperative warming during the admission and preoperative period.</td><td>Details

Randomisation schedule was computer–generated with fixed-size blocks. Group assignments were contained in sequentially numbered opaque envelopes. Participants were not blinded to group allocation. Outcome assessors were blinded to group allocation.
Anaesthesia:
Participants received spinal anaesthesia (or combined spinal and epidural). No opioids were provided via the epidural catheter. Participants received 2.2 to 2.4 hyperbaric 0.5% bupivacaine, intrathecal morphine 100 mcg, and intrathecal fentanyl 15 to 20 mcg.
Standard care:</td><td>Results

Critical outcomes:
<u>Shivering score ≥ 1</u>
Intervention group: 3/25
Control group: 8/25
Important outcomes
<u>Maternal temperature change form baseline to end of procedure:</u>
Intervention group: 0.5 ± 0.32 °C
Control group: 0.7 ± 0.57 °C
<u>Thermal comfort</u>
Intervention group: 5.4 mm (95% CI 5.1 to 5.7)
Control group: 5.2 mm (95% CI 4.9 to 5.5)</td><td>Limitations

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Randomisation schedule was computer–generated, utilising fixed-size blocks (LOW risk)
Allocation concealment
Group assignments were contained in sequentially numbered opaque envelopes (LOW risk)
Blinding of participants:
Participants were aware of treatment allocation (HIGH risk)
Blinding of personnel:</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
911034 **Country/ies where the study was carried out** Australia **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To assess whether preoperative warming reduces the incidence of hypothermia in women undergoing elective CS receiving intrathecal morphine. **Study dates** February 2015 to February 2016.	NS, not significant; kg, kilogram; m^2, square metre; cm, centimetre **Inclusion criteria** Singleton term pregnancy **Exclusion criteria** Known allergy to morphine Known impaired thermoregulation or thyroid disorders Vascular disease Poor cutaneous perfusion ASA score >II Previous history of preeclampsia/ eclampsia Planned ICU admission Tympanic membrane/ aural canal that was not visible on otoscopy Baseline temperature ≥37°C		All participants received IV fluid warmed to 38.5°C (via Biegler™ fluid warmer) and were covered with a cotton blanket and surgical drapes. **Outcome measurement:** Maternal temperature was measured with a calibrated Genius™ aural canal thermometer and a Mon-a-Therm™ indwelling urinary catheterization at baseline, pre-spinal, post-spinal, every 15 minutes and at the end of the procedure, on arrival to PACU, and every 15 minutes until ready for discharge from PACU. Thermal comfort was measured using a 100mm Visual Analogue Scale (VAS). Shivering was assessed via a three-point scale.		Personnel were aware of treatment allocation (HIGH risk) **Blinding of outcome assessment:** Outcome assessors were blinded to treatment allocation (LOW risk) **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** Published trial reported all main outcomes (LOW risk) **Other bias** None identified (LOW risk) **Other information**

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Source of funding

PNAQ, Mater Nursing Research Centre, Queensland University of Technology, individual funding (Dr David Sturgess).</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Full citation

Paris, L. G., Seitz, M., McElroy, K. G., Regan, M., A randomized controlled trial to improve outcomes utilizing various warming techniques during cesarean birth, JOGNN - Journal of Obstetric, Gynecologic, & Neonatal Nursing, 43, 719-28, 2014

Ref Id

609109

Country/ies where the</td><td>Sample size

N=226

• n=73 assigned to warmed IV fluids
• n=77 assigned to warmed under body pad
• n=76 assigned to usual care

Characteristics

<table><tr><th></th><th>Warmed IV fluids n=73</th><th>Warmed under body pad n=73</th><th>Control n=76</th></tr><tr><td>Age, years, mean ± SD</td><td>31.93 ± 5.35</td><td>32.44 ± 5.29</td><td>30.87 ± 4.37</td></tr><tr><td>BMI kg/m², mean ± SD</td><td>32.43 ± 6.34</td><td>32.18 ± 6.31</td><td>32.73 ± 6.60</td></tr></table></td><td>Interventions

Warmed IV fluids group: participants received IV fluids warmed to 41ºC. Warmed under body pad group: participants received IV fluids at room temperature and were placed over a standard hospital sheet over a foam warming pad (PerfectTemp Warming Pad, Medline Institutes) set at 40.3ºC. Control group: participants received IV fluids at room temperature and received standard hospital linens or mattresses.</td><td>Details

Randomisation was performed with the Research Randomizer website and random allocation sequence was generated. Group assignments were contained in sealed envelope. Participants, outcome assessors or study investigators were not blinded to treatment allocation.
Anaesthesia:
Not reported
Standard of care:
Maternal comfort measures were applied as per standard of care or as follows: lower extremities were covered with a warm blanket and applied across the participant's chest. Those participants who were</td><td>Results

Critical outcomes:
<u>Incidence of hypothermia <36.0ºC (postpartum)</u>
Warmed IV fluids group: 14/73
Warmed under body pad: 10/77
Control group: 12/76
<u>Estimated blood loss</u>
Warmed IV fluids group: 826 ± 156.09 mL
Warmed under body pad: 788.89 ± 239.60 mL
Control group: 783.80 ± 199.78 mL
Important outcomes
<u>Maternal temperature at different time points:</u>

<table><tr><th>Time points</th><th>Warmed IV fluids n=73</th><th>Warmed under body pad n=77</th><th>Control n=76</th></tr><tr><td>Operating room,</td><td>36.5 ± 0.30</td><td>36.47 ± 0.23</td><td>36.35 ±0.35</td></tr></table></td><td>Limitations

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Randomisation was performed with the Research Randomizer website (LOW risk)
Allocation concealment
Group assignments were contained in sealed envelope (LOW risk)
Blinding of participants:
Not blinded (HIGH risk)
Blinding of personnel:
Not blinded (HIGH risk)</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
study was carried out USA **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To evaluated whether different warming techniques prevent hypothermia in women undergoing caesarean section. **Study dates** April 2011 to February 2012. **Source of funding** Medline industries donated the Warming Pad and	**Inclusion criteria** Planned singleton caesarean birth. **Exclusion criteria** Those who did not received postoperative Duramorph or planned postpartum tubal ligation during CS		cold/shivered also received rescue blankets. If complaints of shivering continued after 15 minutes, participants were covered with a forced warm air blanket set to medium. **Outcome measurement:** Maternal temperature was recorded from the temperature sensing Foley catheters. Hypothermia was defined as <36.0ºC. The estimated blood loss was extracted from the chart.	°C, mean ± SD PACU, °C, mean ± SD: 36.13 ± 0.37; 36.24 ± 0.37; 35.91 ± 0.45 Post partum, °C, mean ± SD: 36.48 ± 0.49; 36.53 ±0.46; 35.55 ± 0.60	**Blinding of outcome assessment:** Not blinded (HIGH risk) **Incomplete outcome data:** Outcomes were reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported (UNCLEAR risk) **Other bias** None identified (LOW risk) **Other information**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
temperature sensing Foley catheters.					
Full citation Roy, J. D., Girard, M., Drolet, P., Intrathecal meperidine decreases shivering during cesarean delivery under spinal anesthesia, Anesthesia & Analgesia, 98, 230-4, table of contents, 2004 **Ref Id** 388164 **Country/ies where the study was carried out** Canada **Study type** RCT **Aim of the study** PREVENTION	**Sample size** n=40; 20 per group **Characteristics** Age mean(SD): intervention 31 (5)years; control 32 (6) years Gestational age: intervention 39 (1); control 38 (2) weeks Surgery time: intervention 59 (18)mins; control 53 (15)mins **Inclusion criteria** parturients (ASA physical status I or II) scheduled for nonemergent cesarean delivery under spinal anesthesia were enrolled **Exclusion criteria** Parturients with contraindications to regional anesthesia, allergy to the study medication, a height <152 cm, or severe preeclampsia	**Interventions** Intervention: hyperbaric bupivacaine (0.75%; 10.5 mg), morphine 0.15 mg, PLUS meperidine (0.2 mg/kg) Control - hyperbaric bupivacaine (0.75%; 10.5 mg), morphine 0.15 mg, PLUS saline (0.2 mg/kg)	**Details** Patients were randomly divided into two groups by random drawing of sealed envelopes. Medication was prepared by an anesthesiologist not involved in the study. All therapeutic interventions were standardized. Before the spinal anesthesia was performed, patients were placed under standard monitoring and received IV lactated Ringer's solution 15 mL/kg During anesthesia, oxygen was given, and patients were covered with drapes but not actively warmed. All fluids were warmed to 37°C. Spinal anesthesia was performed in the sitting position at the L3-4 interspace with a midline approach by using a 27-gauge Whitacre needle. After spinal injection, parturients were placed supine with left uterine displacement.	**Results** incidence of shivering: meperidine n=9/20; saline n=17/20; P<0.02	**Limitations** RoB Selection bias (Random sequence generation) LOW RISK Selection Bias (Allocation concealment) LOW RISK Performance bias (Blinding of participants and personnel) LOW RISK Detection bias (Blinding of outcomes) HIGH RISK Attrition bias (incomplete outcome data) LOW RISK Reporting bias (selective reporting) UNCLEAR Other biases NONE IDENTIFIED **Other information**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
determine whether meperidine (0.2 mg/kg), added to a bupivacaine and morphine spinal mixture, decreases the incidence and intensity of shivering during spinal anesthesia for cesarean delivery. **Study dates** Not reported **Source of funding** Not reported					
Full citation Sutherland, J., Seaton, H., Lowry, C., The influence of epidural pethidine on shivering during lower segment caesarean section under epidural anaesthesia,	**Sample size** N=94 • n=47 assigned to pethidine • n=47 assigned to control **Characteristics** Not reported	**Interventions** Pethidine group: participants received 5 ml of pethidine 25 mg preservative-free in saline in addition to the anaesthesia. Control group: participants received 5 ml of saline solution in	**Details** Randomisation or allocation method was not reported. Outcome assessors were blinded to treatment allocation. **Anaesthesia:** Premedication was not provided. Epidural anaesthesia was established with bupivacaine 0.5% with adrenaline 1:200000	**Results** **Critical outcomes:** Shivering score ≥ 1 Intervention group: 5/47 Control group: 17/47	**Limitations** In order to establish epidural anaesthesia, n=7 received lignocaine 2% with adrenaline in combination with bupivacaine 0.5% with adrenaline. Of these participants, n=4 received additional saline and n=3 pethidine.

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Anaesthesia & Intensive Care, 19, 228-32, 1991 **Ref Id** 659592 **Country/ies where the study was carried out** Australia **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To assess whether pethidine prevents shivering in women undergoing CS with epidural anaesthesia. **Study dates** Not reported (publication date 1991).	**Inclusion criteria** Not reported **Exclusion criteria** Known pethidine hypersensitivity Opioid addiction Renal disease Gestational hypertension	addition to the anaesthesia.	with or withour lignocaine 2% to total 20-25 ml. No opioids or sedative agents were used. **Outcome measurement:** Evaluation of shivering took place after delivery, over a period of 10 minutes, at the time of mother-child bonding. Patient follow-up determined the patients' assessment of shivering (severe or not severe).		**Other information** Risk of Bias assessed using the Cochrane ROB tool **Random sequence generation** No information was provided (UNCLEAR risk) **Allocation concealment** No information was provided (UNCLEAR risk) **Blinding of participants:** No information was provided (UNCLEAR risk) **Blinding of personnel:** No information was provided (UNCLEAR risk) **Blinding of outcome assessment:** Outcome assessors were blinded to treatment allocation (LOW risk) **Incomplete outcome data:** Results were reported for all participant (LOW risk) **Selective reporting**

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Source of funding

Not reported.</td><td></td><td></td><td></td><td></td><td>No published trial protocol is provided (UNCLEAR risk)
Other bias
None identified (LOW risk)</td></tr>
<tr><td>Full citation

Woolnough,M., Allam,J., Hemingway,C., Cox,M., Yentis,S.M., Intra-operative fluid warming in elective caesarean section: a blinded randomised controlled trial, International Journal of Obstetric Anesthesia, 18, 346-351, 2009

Ref Id

61155

Country/ies where the study was carried out

UK

Study type</td><td>Sample size

N=75
n=25 assigned to room temperature
n=25 assigned to cabinet
n=25 assigned to Hotline®
Characteristics<table><tr><th></th><th>Room temperature n=25</th><th>Cabinet n=25</th><th>Hotline® n=25</th></tr><tr><td>Age, years, mean ± SD</td><td>34.8 ± 5.0</td><td>35.8 ± 3.8</td><td>34.3 ± 4.7</td></tr><tr><td>BMI, kg/m^2, mean ± SD</td><td>26.8 ± 6.9</td><td>25.1 ± 5.4</td><td>25.1 ± 3.5</td></tr><tr><td>Ambient temperature °C,</td><td>24.2 ± 0.9</td><td>23.9 ± 1.4</td><td>24.2± 0.8</td></tr></table></td><td>Interventions

Room temperature: participants received all intravenous fluids at room temperature with the Hotline® fluid warmer switched off.
Cabinet: participants received all intravenous fluids stored in a warming cabinet (QED Scientific, Derbyshire, UK) set at 45ºC and administered without further warming during infusion.
Hotline®: participants received all intravenous fluids warmed during administration via Hotline® fluid warmer pre-set at 42°C.</td><td>Details

Randomisation method was by computer generated random numbers. Group assignments were contained sealed envelopes. Participants and investigators were blinded to treatment allocation.
Anaesthesia:
Participants received a 10-mL/kg fluid preload of Hartmann's solution, infused over 15 minutes before CSE anaesthesia.
Outcome measurement:
A separate investigator recorded the temperature and humidity and, at the same time points, the maternal thermal comfort and shivering. For measuring thermal comfort, the following numerical scale was used: 0= the worst imaginable cold, 5= comfortable [thermally</td><td>Results

Critical outcomes:
<u>Shivering score ≥ 1</u>
Room temperature: 11/25
Cabinet: 9/25
Hotline® : 7/25
Important outcomes
<u>Thermal comfort <4</u>
Room temperature: 8/25
Cabinet: 3/25
Hotline® : 1/25
<u>Thermal comfort >6</u>
Room temperature: 8/25
Cabinet: 10/25
Hotline® : 10/25</td><td>Limitations

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Computer generated list (LOW risk)
Allocation concealment
Group allocation was maintained in sequentially numbered envelopes (LOW risk)
Blinding of participants:
Participants were blinded to group allocation (LOW risk)
Blinding of personnel:
Personnel was blinded to group allocation (LOW risk)
Blinding of outcome assessment:
Outcome assessors were blinded to</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Randomised controlled trial. **Aim of the study** PREVENTION To assess whether the effect of warming intravenous fluids in women undergoing elective CS under combined spinal-epidural anaesthesia reduced the incidence of shivering. **Study dates** No reported (publication date 2009). **Source of funding** Not reported (Hotline® sets were provided by Smiths Medical International).	<table><tr><td>mean ± SD</td><td></td><td></td><td></td></tr></table> SD, standard deviation; kg, kilogram; m^2, square metre. **Inclusion criteria** Term uncomplicated singleton pregnancies. **Exclusion criteria** Preeclampsia/ eclampsia Pyrexia Drug therapy other than antacids and vitamins/ minerals Increased risk of intra-operative haemorrhage		neutral], 10 = insufferably hot. Pain was scored from 0 (no pain) to 10 (worst imaginable pain). The investigator also assessed the degree of shivering as 0= no shivering, 1= mild, intermittent shivering, 2= intense, continuous shivering.		group allocation (LOW risk) **Incomplete outcome data:** Outcomes were reported for all participants (LOW risk) **Selective reporting** No published trial protocol was reported (LOW risk) **Other bias** None identified (LOW risk) **Other information**

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Full citation Workhoven, M. N., Intravenous fluid temperature, shivering, and the parturient, Anesthesia & Analgesia, 65, 496-8, 1986 **Ref Id** 388608 **Country/ies where the study was carried out** USA **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To assess whether warmed IV fluids prevents shivering in women undergoing elective CS with	**Sample size** N= 44 • n=22 assigned to warmed IV fluids • n=22 assigned to room temperature IV fluids **Characteristics** [table_1] Kg, kilogram; cm, centimetre *SD was not reported **Inclusion criteria** Term pregnant women ASA class I or II **Exclusion criteria** Not reported	**Interventions** Warmed IV fluid group: fluids were heated in a warming cabinet and administered immediately. Fluid temperatures were between 30.0°C and 33.9°C. Room temperature IV fluid group: fluids were at room temperature betwe en 20.0°C and 22.2°C.	**Details** Participants were assigned to each group on an alternating basis. Group assignment method was not reported. Whether participants, outcome assessors and personnel were blinded was not reported. **Anaesthesia:** Participants received 1L of lactated Ringer's or Normosol-R solution over 10-15 minutes. 1 L of 2.5 or 5% dextrose was given at a rate according to blood pressure. Epidural anaesthesia was performed with 17 to 22 mL of lidocaine 2%. Small doses of fentanyl, thiopental, or both were given Iv before and after birth. **Standard care:** Participants were covered with warm blankets. **Outcome measurement:** Definitions were not provided.	**Results** **Critical outcomes:** Shivering score ≥ 1 Intervention group: 3/22 Control group:14/22 **Important outcomes** Maternal temperature at preoperative: Intervention group: 36.6°C (SD was not reported) Control group: 36.6°C (SD was not reported) Maternal temperature at postoperative: Intervention group: 36.1°C (SD was not reported) Control group: 36.3°C (SD was not reported)	**Limitations** Risk of Bias assessed using the Cochrane ROB tool **Random sequence generation** Participants were assigned to each group on an alternating basis (HIGH risk) **Allocation concealment** Group assignment method was not reported (HIGH risk) **Blinding of participants:** Not reported (UNCLEAR risk) **Blinding of personnel:** Not reported (UNCLEAR risk) **Blinding of outcome assessment:** Not reported (UNCLEAR risk) **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported (UNCLEAR risk) **Other bias**

[table_1]

	Warmed IV fluids n=22
Age, years, mean*	27.8
Weight, kg, mean*	73.3
Height, cm, mean*	162.5

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>epidural anaesthesia.

Study dates

Not reported (publication date 1986).

Source of funding

Not reported.</td><td></td><td></td><td></td><td></td><td>None identified (LOW risk)

Other information</td></tr>
<tr><td>Full citation

Yokoyama,K., Suzuki,M., Shimada,Y., Matsushima,T., Bito,H., Sakamoto,A., Effect of administration of pre-warmed intravenous fluids on the frequency of hypothermia following spinal anesthesia for Cesarean delivery, Journal of Clinical Anesthesia, 21, 242-248, 2009

Ref Id</td><td>Sample size

N=30
n=15 assigned to warmed fluid group
n=15 assigned to control
Characteristics<table><tr><th></th><th>Warmed fluid n=15</th><th>Control n=15</th><th>P-value</th></tr><tr><td>Age, years, mean ± SD</td><td>32 ± 6</td><td>34 ± 4</td><td>NS</td></tr><tr><td>Weight, kg, mean ± SD</td><td>62 ± 7</td><td>59 ± 9</td><td>NS</td></tr><tr><td>Height, cm, mean ± SD</td><td>156 ± 6</td><td>153 ± 6.5</td><td>NS</td></tr></table></td><td>Interventions

Warmed fluid group: the colloid was kept in a warmer for 3 days. The temperature was maintained at 41°C. It was taken out just before infusion and it was infused through IV warmer coil kept in a water-bath warmer.
Control: the colloid was kept in the operating room at 25°C.</td><td>Details

Randomisation method was by computer-generated schedule. Group assignments were not reported. Study was double-blind.
Anaesthesia:
Premedication was not administered. Participants received 1000 mL of hydroxy ethyl starch (HES) warm or at room temperature, according to randomisation schedule. Spinal anaesthesia was performed with hyperbaric bupivacaine 12.5mg. No local anaesthetics were administered through the epidural catheter.
Standard care:</td><td>Results

Critical outcomes:
<u>Estimated blood loss and amniotic fluid</u>
Intervention group: 946 ± 398 mL
Control group: 1122 ± 424 mL
Important outcomes
<u>Maternal temperature at different time points</u><table><tr><th>Time points</th><th>Warmed fluid n=15</th><th>Control n=15</th></tr><tr><td>Delivery, °C, mean ± SD</td><td>36.7 ± 0.3</td><td>36.2 ± 0.3</td></tr><tr><td>15 minutes*,°C, mean ± SD</td><td>36.6 ± 0.3</td><td>35.8 ± 0.3</td></tr><tr><td>30 minutes*, °C, mean ± SD</td><td>36.5 ± 0.3</td><td>35.6 ± 0.3</td></tr></table></td><td>Limitations

<u>Risk of Bias assessed using the Cochrane ROB tool</u>
Random sequence generation
Randomisation method was by computer-generated schedule (LOW risk)
Allocation concealment
Group assignments were not reported (UNCLEAR risk)
Blinding of participants:
Participants were blinded to treatment allocation (LOW risk)
Blinding of personnel:
Personnel were blinded to treatment</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
119984 **Country/ies where the study was carried out** Japan **Study type** Randomised controlled trial. **Aim of the study** PREVENTION To assess whether pre-warmed intravenous fluids prevents hypothermia in women undergoing elective caesarean delivery under spinal anaesthesia. **Study dates** Not reported (publication date 2009).	SD, standard deviation; NS, not significant; kg, kilogram; cm, centimetre **Inclusion criteria** Not reported **Exclusion criteria** Not reported		No active warming device was used. A reflective blanket was used to cover patient's shoulders, upper extremities, and lower extremities. The operating room temperature was maintained at approximately 25°C. **Outcome measurement:** Measurement of core temperature was performed before colloid administration, epidural administration, birth and 15, 30m and 45 minutes after birth. The temperature was recorded by personnel not aware of treatment allocation. Method was not reported. Total blood loss was the sum of the quantity of suctioned blood and the quantity of blood absorbed by the gauze. The total amount included amniotic fluid.	45 minutes*,°C, mean ± SD | 36.4 ± 0.2 | 35.5 ± 0.3 *Minutes after delivery	allocation (LOW risk) **Blinding of outcome assessment:** Outcome assessors were blinded to treatment allocation (LOW risk) **Incomplete outcome data:** Outcomes are reported for all participants (LOW risk) **Selective reporting** No published trial protocol is reported (LOW risk) **Other bias** None identified (LOW risk) **Other information**

<table>
<tr><th>Study details</th><th>Participants</th><th>Interventions</th><th>Methods</th><th>Outcomes and Results</th><th>Comments</th></tr>
<tr><td>Source of funding

Not reported.</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Full citation

Smith, Charles E, Fisgus, John R, Kan, Margaret, Lengen, Sarah K, Myles, Clifford, Jacobs, Dennis, Choi, Emil, Bolden, Norman, Pinchak, Alfred C, Hagen, Joan F, Original Studies-Efficacy of IV Fluid Warming in Patients Undergoing Cesarean Section With Regional Anesthesia-Does warming IV fluids result in higher core temperatures and less intraoperative, American Journal of Anesthesiology, 27, 84-88, 2000

Ref Id</td><td>Sample size

N=67
intervention (Warmed fluids) n=35; control (room temperature fluids) n=32

Characteristics
<table><tr><td></td><td>hotline n=35</td><td>control n=32</td></tr><tr><td>age: mean(SEM)</td><td>27(1) years</td><td>29 (1) years</td></tr><tr><td>ASA 1</td><td>2/35 (6%)</td><td>0</td></tr><tr><td>ASA 2</td><td>30/35 (86%)</td><td>26/32 (81%)</td></tr><tr><td>ASA 3</td><td>3/35 (8%)</td><td>6/32 (19%)</td></tr></table>
Inclusion criteria

women age>/= 18 years scheduled for c-section with regional anaesthesia

Exclusion criteria

• otitis,
• emergency surgery,
• indwelling epidural catheter for labour pain relief,</td><td>Interventions

Intervention: IV warmed fluids (42 °C) "Hotline"; all intraoperative fluids delivered to patient IV site via warmer using an 8cm extension. At end of surgery, fluid-warming tubing was disconnected, patient was transported to the recovery room with an identical fluid administration as control patients.
Control: IV room-temperature fluids (20-22 °C)</td><td>Details

Choice of anaesthetic technique was not dictated by protocol. Regional anaesthesia was either lumbar spinal or epidural anaesthesia, with the goal of obtaining t4-t6 level.
Oxygen administered via nasal cannula at 2L/min. Patients covered in a similar fashion with standard operating room blankets and surgical drapes. Operating temperature was set at 21 °C. No other warming device used. Radiant heat directed over the patient's trunk was used to treat mild postoperative shivering and/or core temp <35.5 °C. IV meperidine was given for moderate-to-severe shivering that caused patient discomfort or interfered with monitoring</td><td>Results

Incidence of hypothermia
<table><tr><td>core temp=tympanic</td><td>hotline</td><td>control</td></tr><tr><td>intra-operative <36 C</td><td>N=16/35 (46%)</td><td>N=24/32 (75%)</td></tr><tr><td>intra-operative <35.5 C</td><td>N=8/35 (22%)</td><td>N=10/32 (31%)</td></tr></table>Shivering (post-op period): intervention (hotline) N=11/35 (31%); control (room temp) N=10/32 (31%)
Estimated blood loss: no infusion of blood or any blood products required in either group (N=0)
Maternal temperature at different time points (mean[SEM])
<table><tr><td>core temp=tympanic</td><td>hotline</td><td>control</td></tr><tr><td>intra-operative baseline</td><td>36.9 [0.1]</td><td>36.8 [0.1]</td></tr><tr><td>intra-operative lowest</td><td>36.0 [0.1]</td><td>35.5 [0.1]</td></tr></table></td><td>Limitations

RoB
Selection bias (Random sequence generation) UNCLEAR
Selection Bias (Allocation concealment) UNCLEAR
Performance bias (Blinding of participants and personnel) UNCLEAR
Detection bias (Blinding of outcomes) LOW RISK OF BIAS
Attrition bias (incomplete outcome data) UNCLEAR
Reporting bias (selective reporting) UNCLEAR
Other biases NONE IDENTIFIED

Other information</td></tr>
</table>

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
1163170 **Country/ies where the study was carried out** USA **Study type** RCT **Aim of the study** PREVENTION test the hypothesis that use of warmed IV fluids compared with room temperature fluids, results in higher core temperature and a lower incidence of hyperthermia (<36 °C) in women undergoing c-section with regional anaesthesia **Study dates** Not reported	• pre-op temperature of >/- 38 °C, or <35.5 °C			<table><tr><td>intra-operative final</td><td>36.1 [0.1]</td><td>35.6 [0.1]</td></tr><tr><td>post-op baseline</td><td>36.0 [0.1]</td><td>35.6 [0.1]</td></tr><tr><td>post-op 30 mins</td><td>36.1 [0.1]</td><td>35.6 [0.1]</td></tr><tr><td>post-op 60 mins</td><td>36.2 [0.1]</td><td>35.8 [0.1]</td></tr><tr><td>post-op, discharge</td><td>36.5 [0.1]</td><td>36.1 [0.1]</td></tr></table> *"post-op" is timed from arrival in recovery room* In revMan, SD has been used instead of SEM; SD=SEM*sqrt(n); Hotline sqrt(n)=sqrt(35)=5.92; Control sqrt(32)=5.66	

Study details	Participants	Interventions	Methods	Outcomes and Results	Comments
Source of funding Not reported					

Appendix E – Forest plots

Forest plots for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

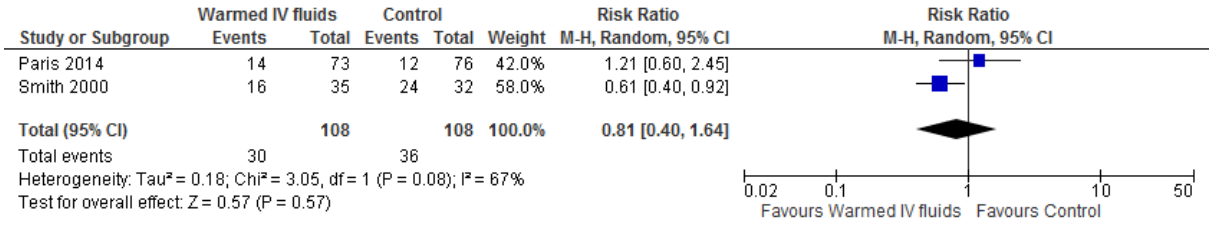
This section includes forest plots only for outcomes that are meta-analysed. Outcomes from single studies are not presented here, but the quality assessment for these outcomes is provided in the GRADE profiles in appendix F.

Active warming measures versus control

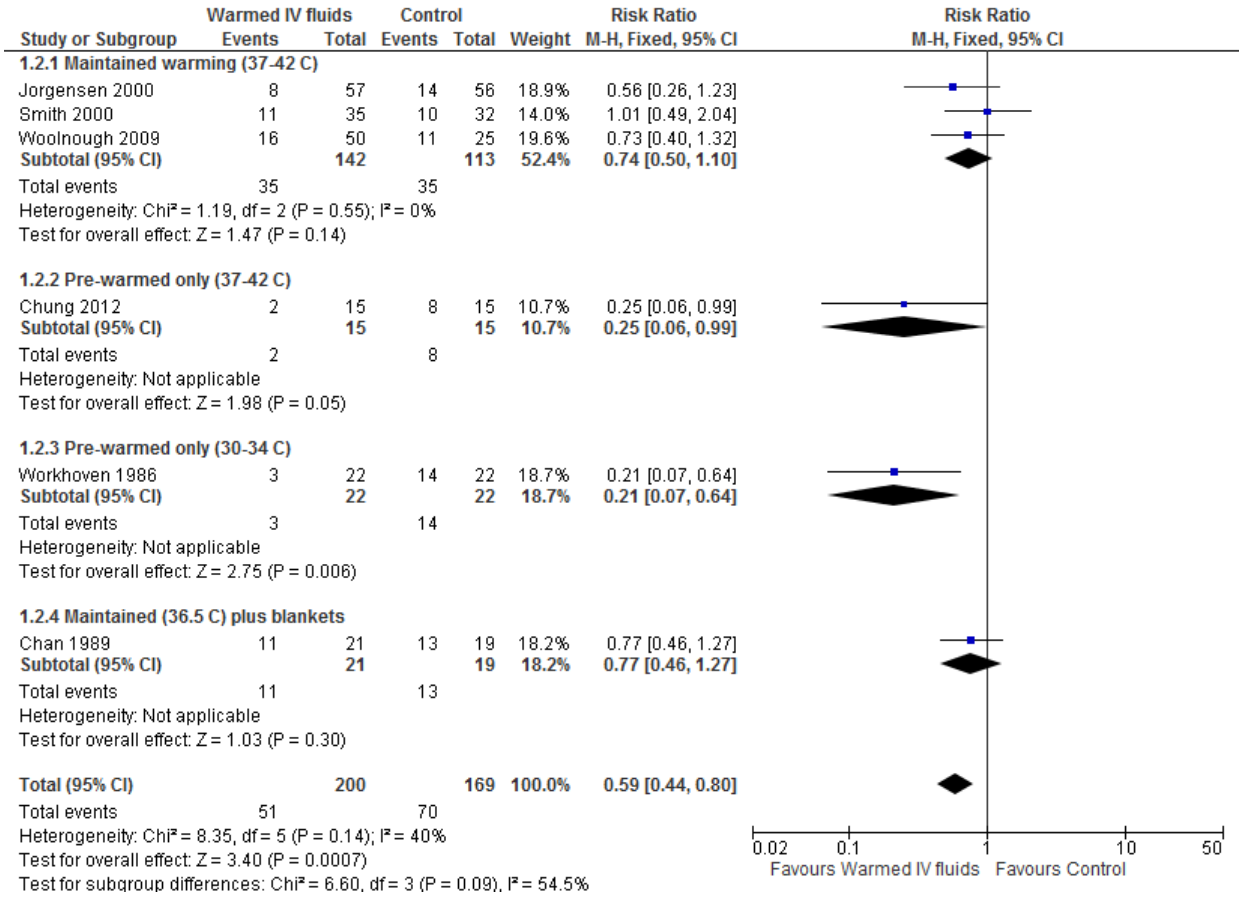
Comparison 1. Warmed IV fluids versus control

Critical outcomes

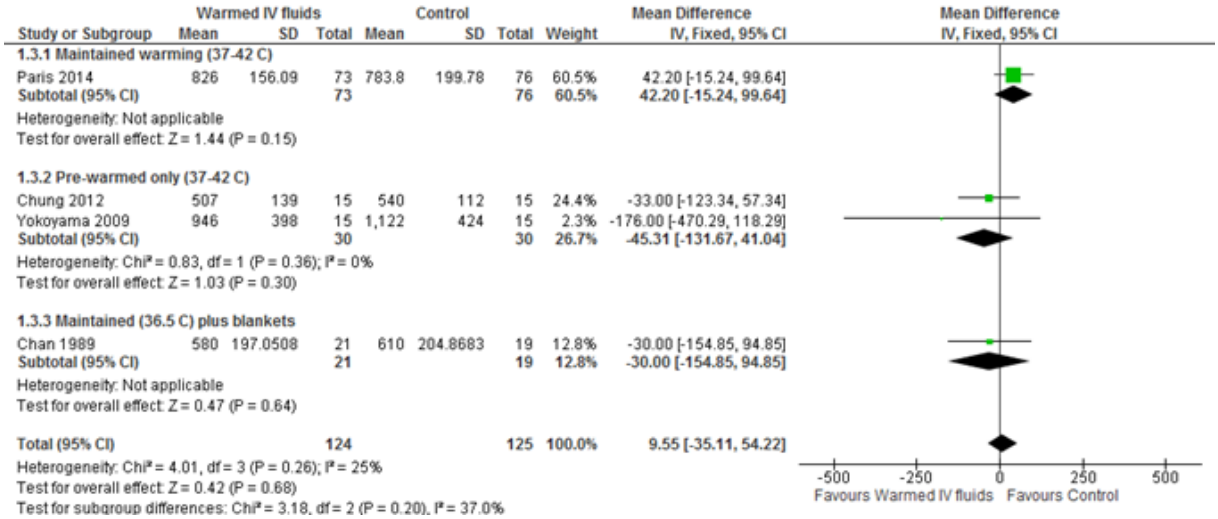
1.1 Incidence of hypothermia



1.2 Incidence of shivering

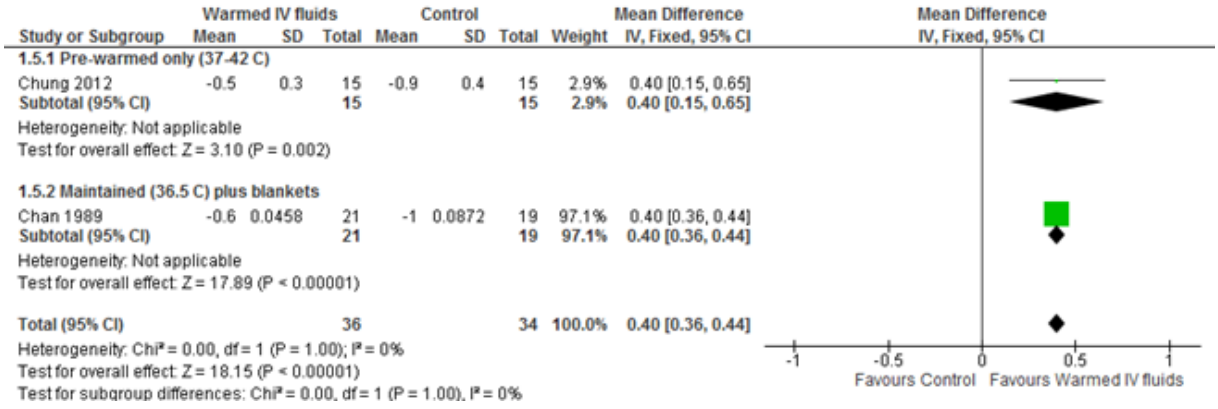


1.3 Estimated blood loss

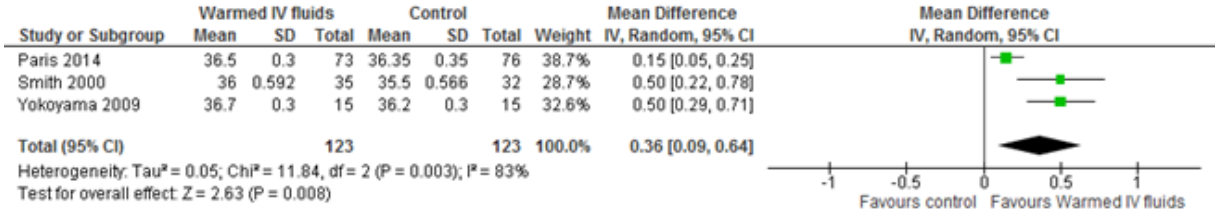


Important outomes

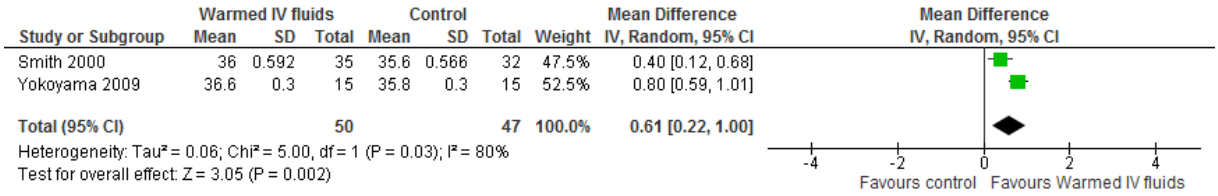
1.5 Maternal (core) temperature change



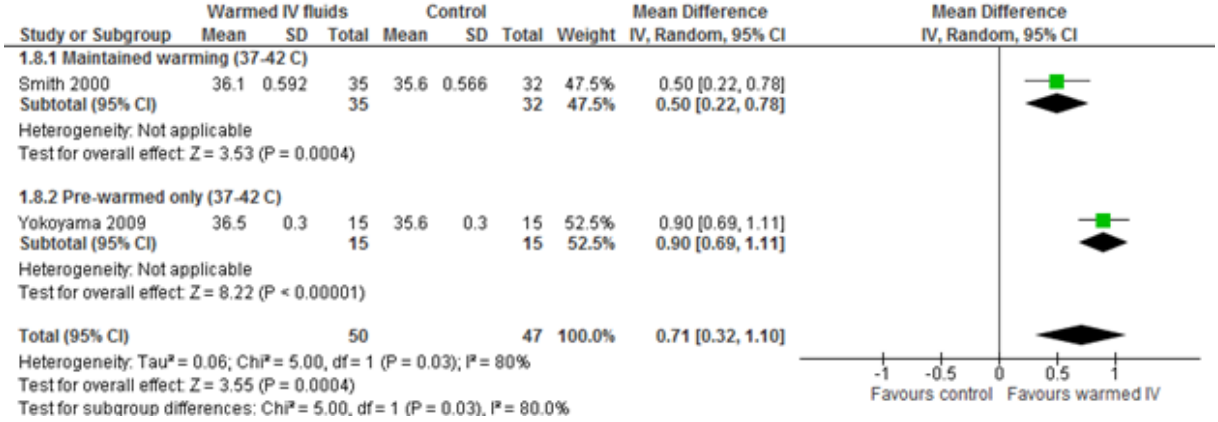
1.6 Maternal temp (intra-op)



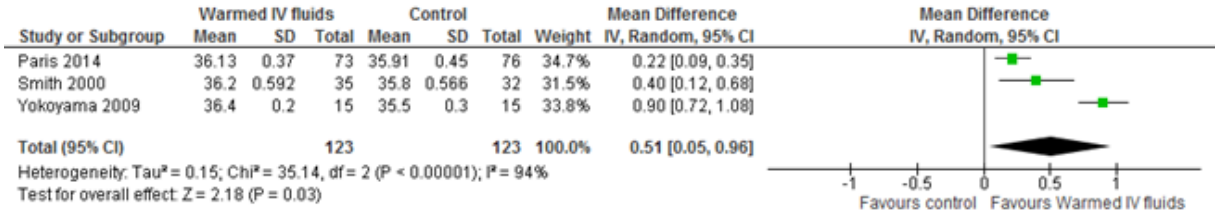
1.7 Maternal temp (post-op, baseline)



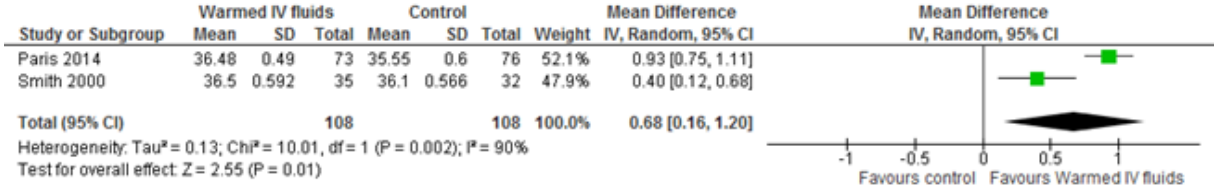
1.8 Maternal temp (post-op, 30 mins)



1.9 Maternal temp (post-op, recovery room, 45+ mins)



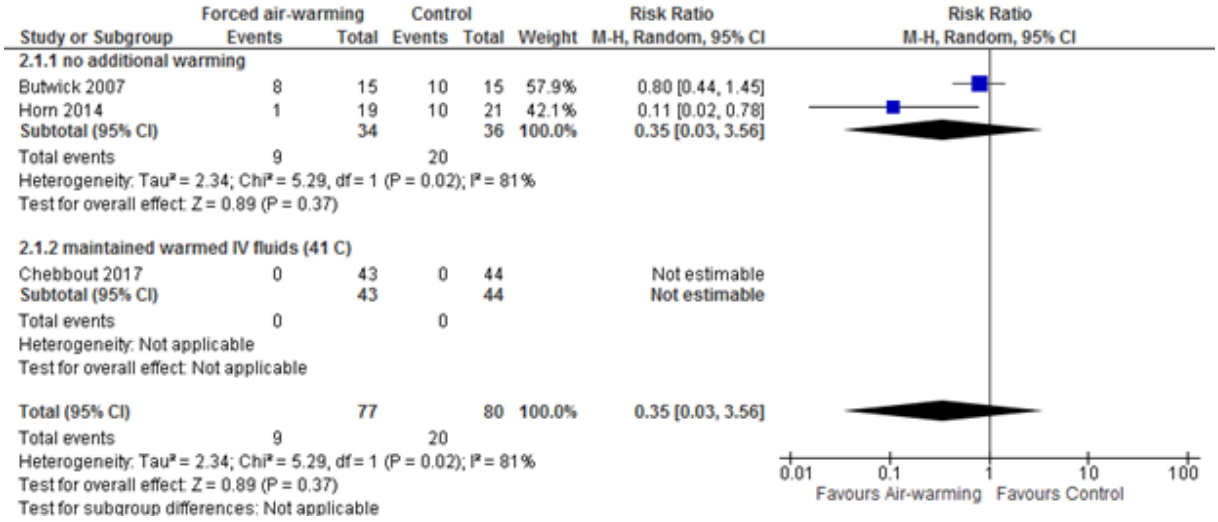
1.10 Maternal temp (post-op, discharge/postpartum)



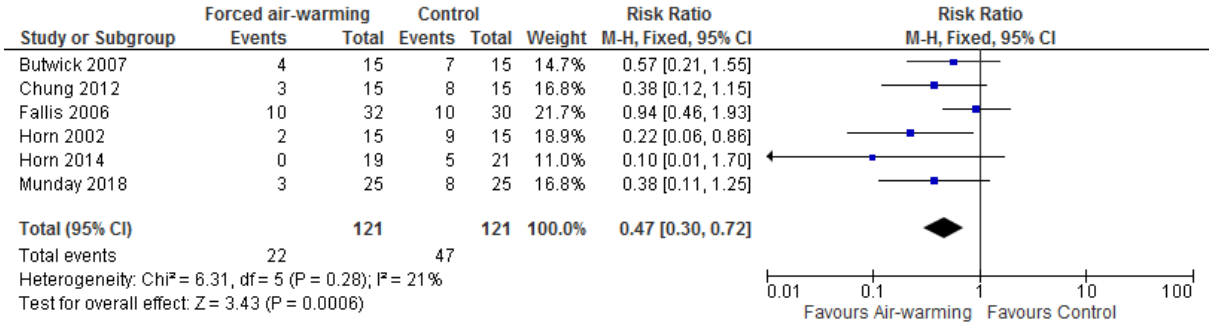
Comparison 2. Forced air warming versus control

Critical outcomes

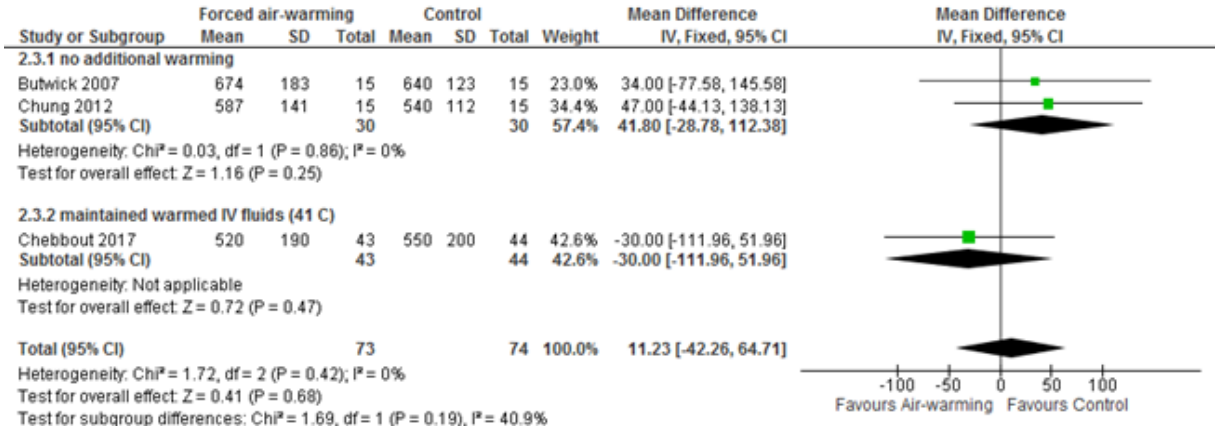
2.1 Incidence of hypothermia



2.2 Incidence of shivering

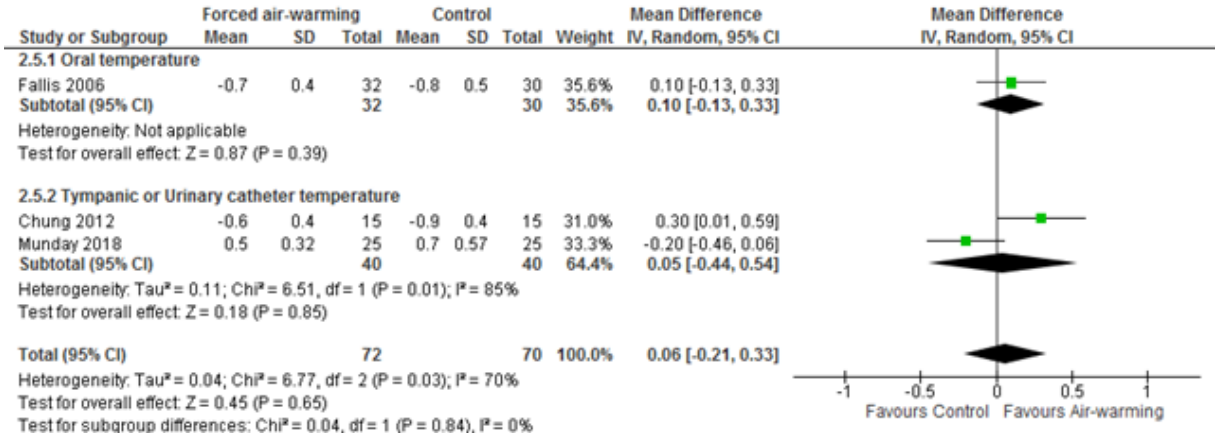


2.3 Estimated blood loss

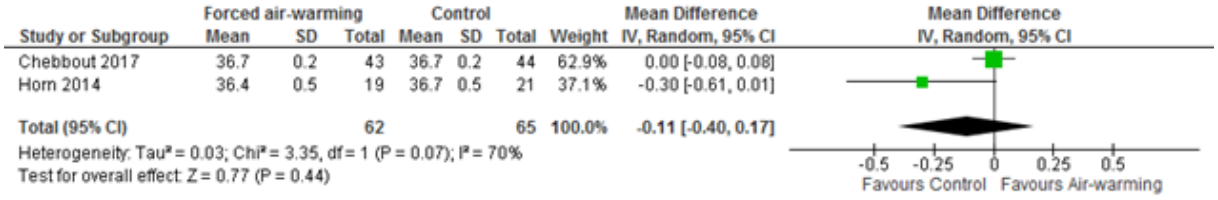


Important outcomes

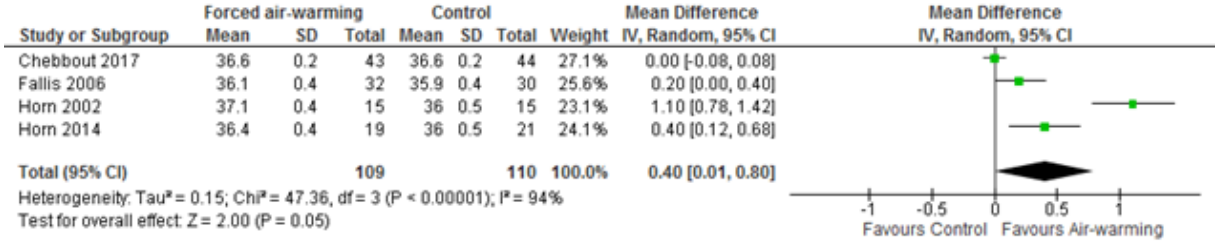
2.5 Maternal temp change (intra-op change)



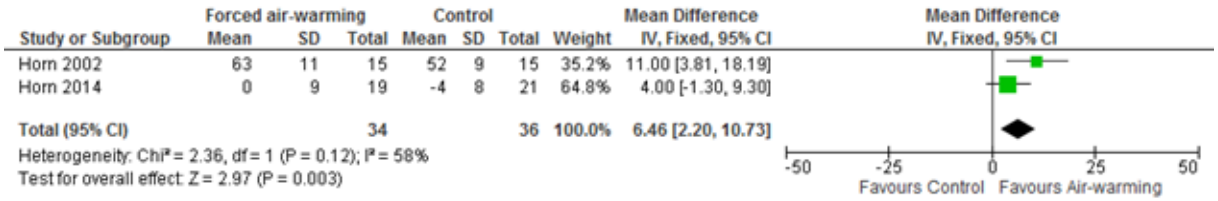
2.6 Maternal temp (intra-op, within 30mins)



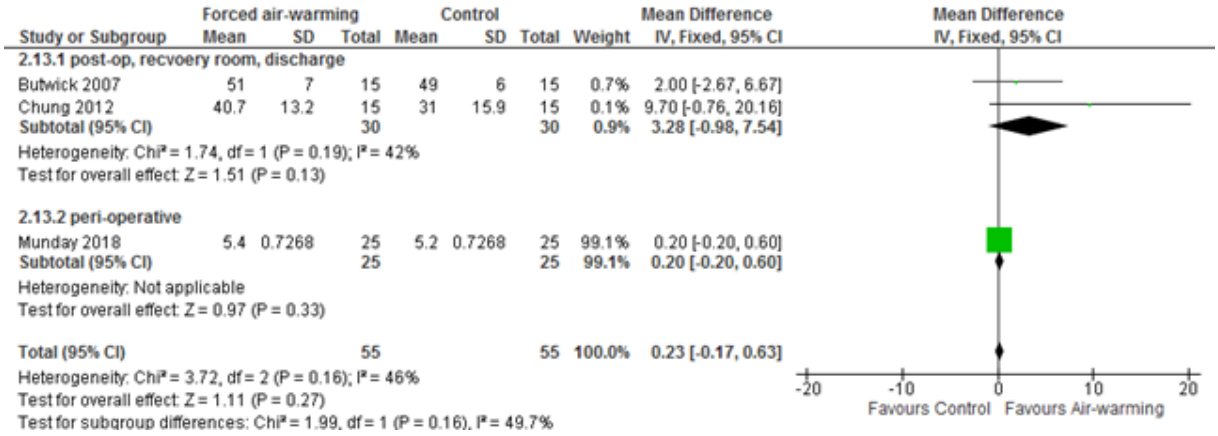
2.8 Maternal temp (intra-op, end of surgery)



2.10 Thermal comfort (pre-op)



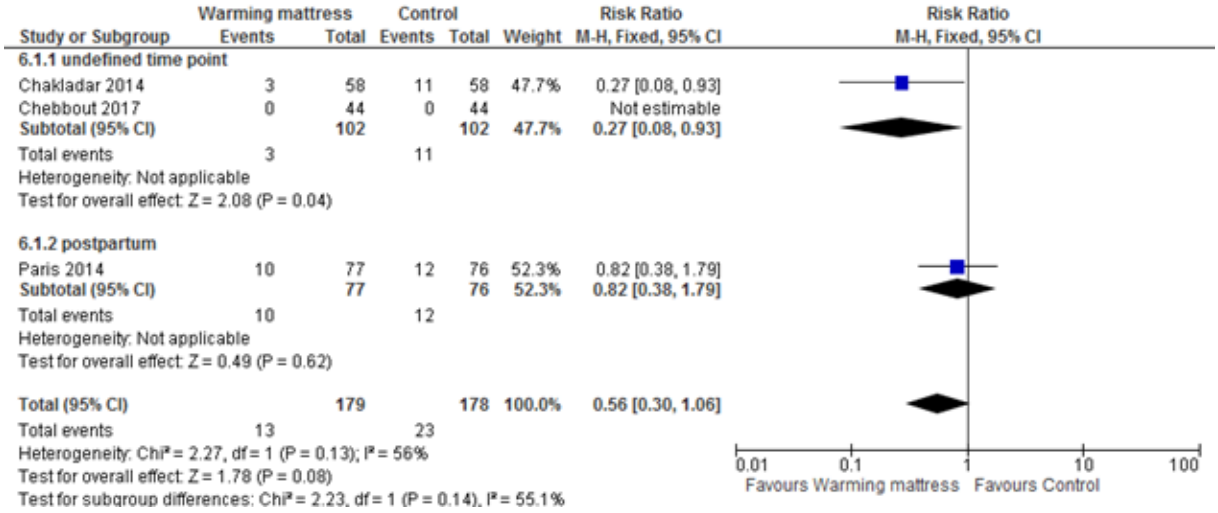
2.13 Thermal comfort (post-op)



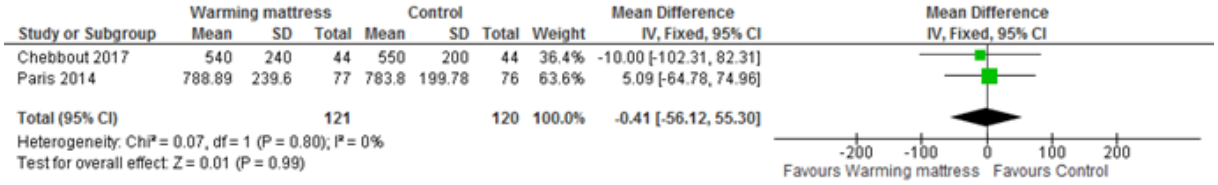
Comparison 4. Warmed mattress/under-body pad versus control

Critical outcomes

4.1 Incidence of hypothermia

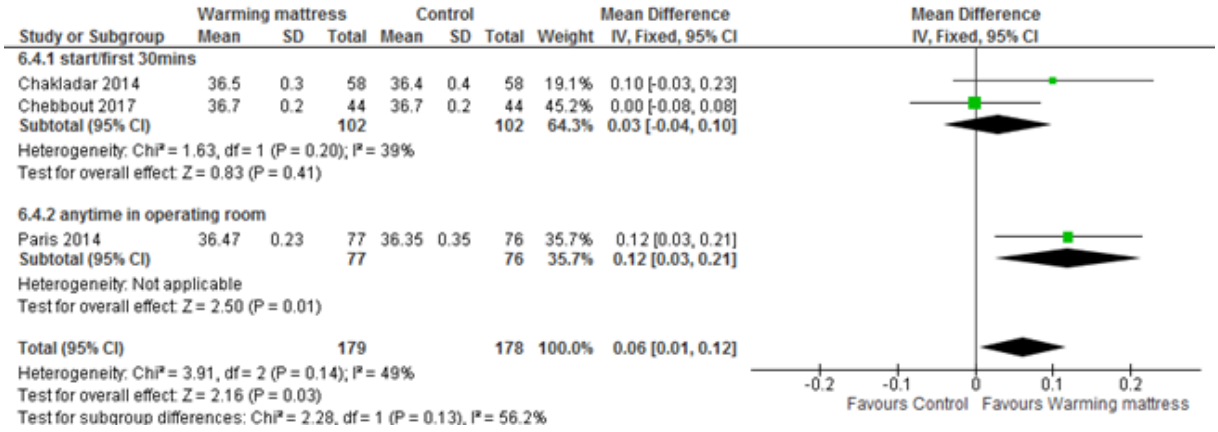


4.3 Estimated blood loss

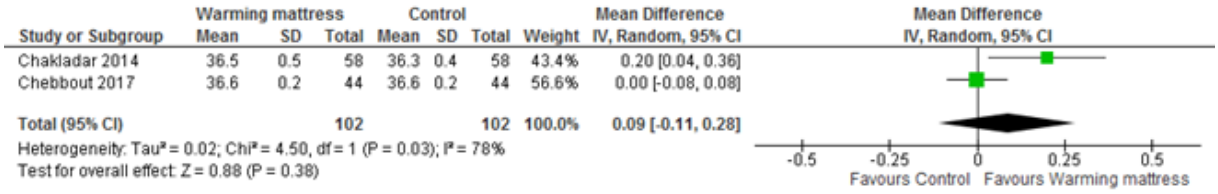


Important outcomes

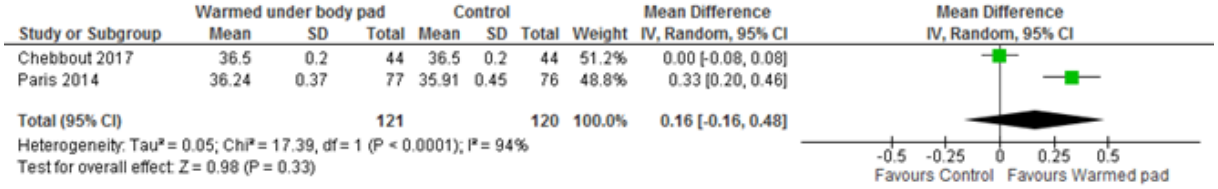
4.4 Maternal temp (intra-op)



4.5 Maternal temp (recovery room, baseline)



4.6 Maternal temp (post-op, recovery room)

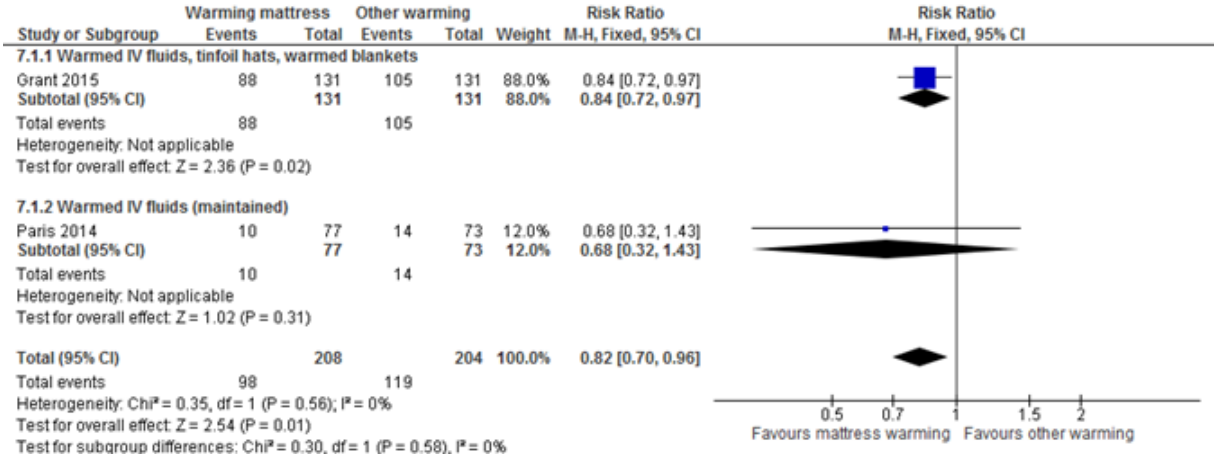


Active warming measures versus other active warming

Comparison 7. Warmed mattress/under-body pad vs other warming

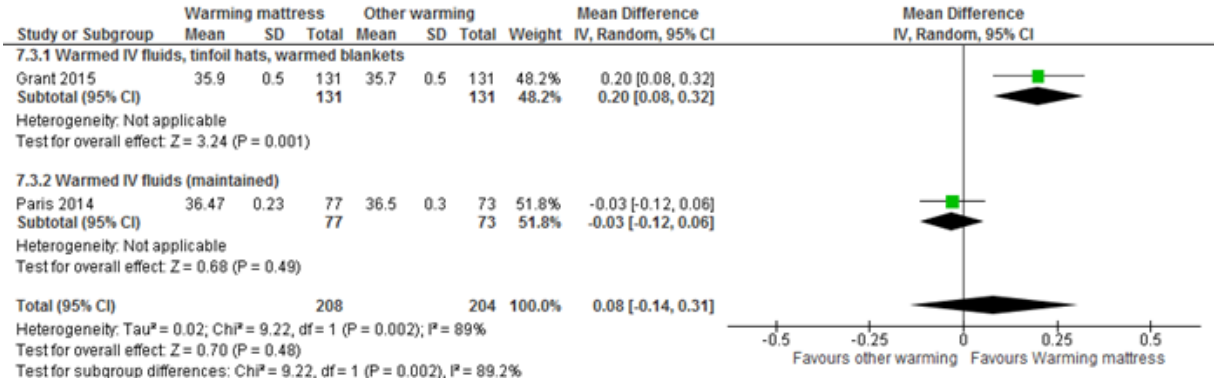
Critical outcomes

7.1 Incidence of hypothermia

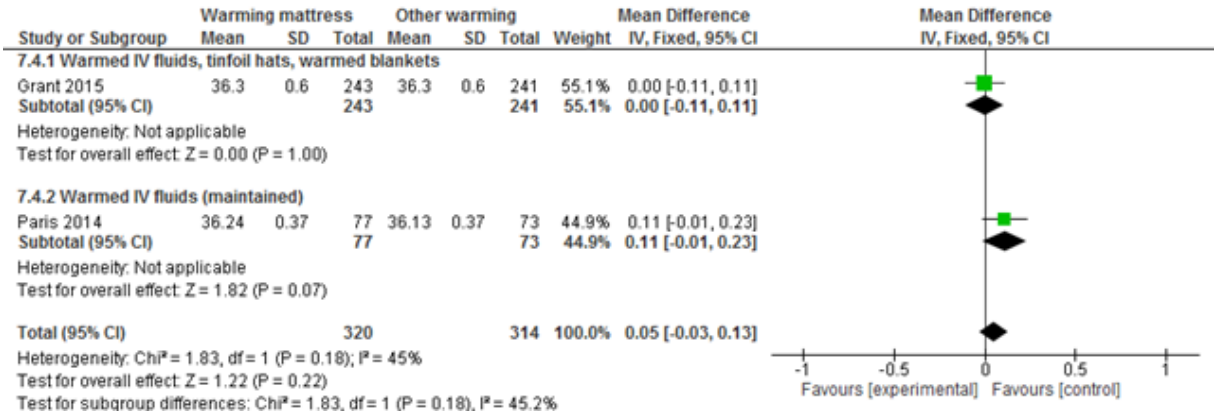


Important outcomes

7.3 Maternal temp (intra-op)



7.4 Maternal temp (post op, recovery room)

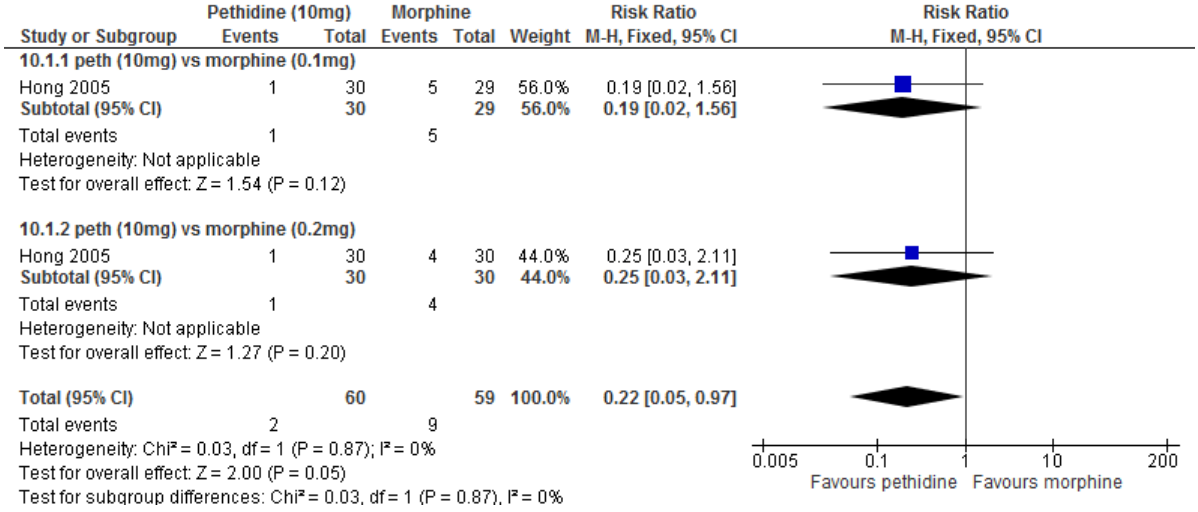


Pharmacological therapy

Comparison 10. Opioid-like analgesic (pethidine) vs other opioid (morphine)

Critical outcomes

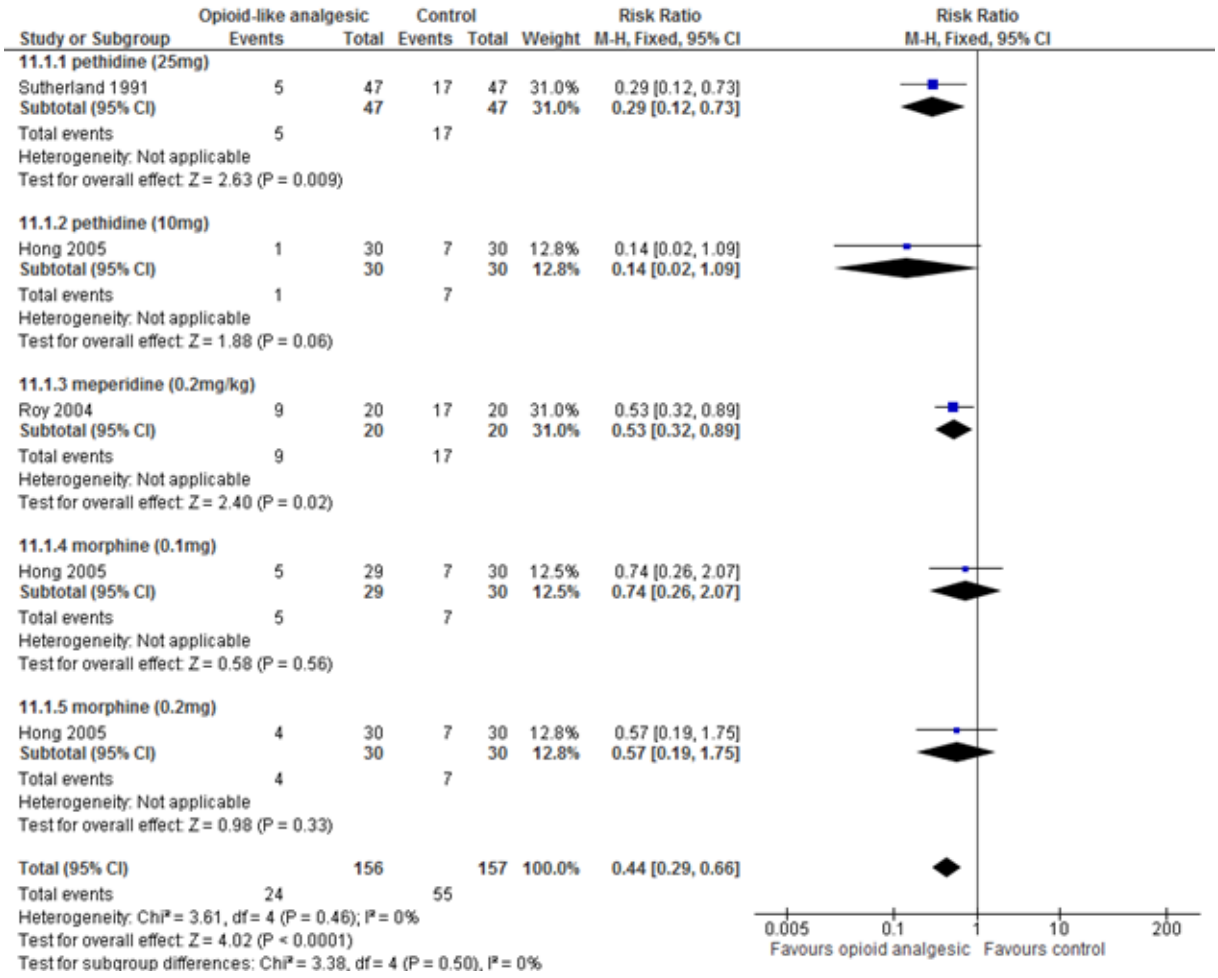
10.1 Incidence of shivering



Comparison 11a. Opioid-like analgesic vs control for prevention

Critical outcomes

11a.1 Incidence of shivering



Appendix F – GRADE tables

GRADE tables for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

Active warming measures versus control

Comparison 1: Warmed IV fluids versus control

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed IV fluids	Control	Relative (95% CI)	Absolute		
Incidence of hypothermia (<36 C) - Maintained warming (37-42 C)												
2 (Paris 2014; Smith 2000)	randomised trials	very serious[1]	serious[2]	no serious indirectness	very serious[3]	none	30/108 (27.8%)	36/108 (33.3%)	RR 0.81 (0.4 to 1.64)	63 fewer per 1000 (from 200 fewer to 213 more)	VERY LOW	CRITICAL
Incidence of shivering												
6 (Chan 1989; Chung 2012; Jorgensen 2000; Smith 2000; Woolnough 2009; Workhoven 1986)	randomised trials	very serious[4]	no serious inconsistency	no serious indirectness	no serious imprecision	none	51/200 (25.5%)	70/169 (41.4%)	RR 0.59 (0.44 to 0.8)	170 fewer per 1000 (from 83 fewer to 232 fewer)	LOW	CRITICAL
SUBGROUP: Incidence of shivering - Maintained warming (37-42 C)												
3 (Jorgensen 2000; Smith 2000; Woolnough 2009)	randomised trials	very serious[4]	no serious inconsistency	no serious indirectness	serious[5]	none	35/142 (24.6%)	35/113 (31%)	RR 0.74 (0.5 to 1.1)	81 fewer per 1000 (from 155 fewer to 31 more)	VERY LOW	CRITICAL
SUBGROUP: Incidence of shivering - Pre-warmed only (37-42 C)												
1 (Chung 2012)	randomised trials	very serious[6]	no serious inconsistency	no serious indirectness	serious[5]	none	2/15 (13.3%)	8/15 (53.3%)	RR 0.25 (0.06 to 0.99)	400 fewer per 1000 (from 5 fewer to 501 fewer)	VERY LOW	CRITICAL
SUBGROUP: Incidence of shivering - Pre-warmed only (30-34 C)												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed IV fluids	Control	Relative (95% CI)	Absolute		
1 (Workhoven 1986)	randomised trials	very serious[6, 7]	no serious inconsistency	no serious indirectness	no serious imprecision	none	3/22 (13.6%)	14/22 (63.6%)	RR 0.21 (0.07 to 0.64)	503 fewer per 1000 (from 229 fewer to 592 fewer)	LOW	CRITICAL
SUBGROUP: Incidence of shivering - Maintained (36.5 C) plus blankets												
1 (Chan 1989)	randomised trials	very serious[6]	no serious inconsistency	no serious indirectness	very serious[3]	none	11/21 (52.4%)	13/19 (68.4%)	RR 0.77 (0.46 to 1.27)	157 fewer per 1000 (from 369 fewer to 185 more)	VERY LOW	CRITICAL
Estimated blood loss (Better indicated by lower values)												
4 (Chan 1989; Chung 2012; Paris 2014; Yokoyama 2009)	randomised trials	very serious[4]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	124	125	-	MD 9.55 higher (35.11 lower to 54.22 higher)	LOW	CRITICAL
SUBGROUP: Estimated blood loss - Maintained warming (37-42 C) (Better indicated by lower values)												
1 (Paris 2014)	randomised trials	very serious[7]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	73	76	-	MD 42.2 higher (15.24 lower to 99.64 higher)	LOW	CRITICAL
SUBGROUP: Estimated blood loss - Pre-warmed only (37-42 C) (Better indicated by lower values)												
2 (Chung 2012; Yokoyama 2009)	randomised trials	serious[9]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	30	30	-	MD 45.31 lower (131.67 lower to 41.04 higher)	MODERATE	CRITICAL
SUBGROUP: Estimated blood loss - Maintained (36.5 C) plus blankets (Better indicated by lower values)												
1 (Chan 1989)	randomised trials	very serious[6]	no serious inconsistency	no serious indirectness	serious [8,10]	none	21	19	-	MD 30 lower (154.85 lower to 94.85 higher)	VERY LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed IV fluids	Control	Relative (95% CI)	Absolute		
Estimated blood loss (need for blood products)												
1 (Smith 2000)	randomised trials	very serious[6]	no serious inconsistency	no serious indirectness	very serious[11]	none	0/35 (0%)	0/32 (0%)	See comment[12]	0 more per 1000 (from 60 fewer to 60 more)[16]	VERY LOW	CRITICAL
Maternal (core) temperature change (Better indicated by higher values)												
2 (Chan 1989; Chung 2012)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	36	34	-	MD 0.4 higher (0.36 to 0.44 higher)	LOW	IMPORTANT
Maternal temp (intraoperative) (Better indicated by higher values)												
3 (Paris 2014; Smith 2000; Yokoyama 2009)	randomised trials	very serious[5]	very serious[14]	no serious indirectness	serious[8,15]	none	123	123	-	MD 0.36 higher (0.09 to 0.64 higher)	VERY LOW	IMPORTANT
Maternal temp (post-op, baseline) (Better indicated by higher values)												
2 (Smith 2000; Yokoyama 2009)	randomised trials	no serious risk of bias	very serious[16]	no serious indirectness	no serious imprecision[8]	none	50	47	-	MD 0.61 higher (0.22 to 1 higher)	LOW	IMPORTANT
Maternal temp (post-op, 30mins) (Better indicated by higher values)												
2 (Smith 2000; Yokoyama 2009)	randomised trials	serious[9]	very serious[16]	no serious indirectness	no serious imprecision[8]	none	50	47	-	MD 0.71 higher (0.32 to 1.1 higher)	VERY LOW	IMPORTANT
Maternal temp (post-op, recovery room, 45mins+) (Better indicated by higher values)												
3 (Paris 2014; Smith 2000; Yokoyama 2009)	randomised trials	very serious[4]	very serious[17]	no serious indirectness	serious[8,18]	none	123	123	-	MD 0.51 higher (0.05 to 0.96 higher)	VERY LOW	IMPORTANT
Maternal temp (post-op, discharge/postpartum) (Better indicated by higher values)												
2 (Paris 2014; Smith 2000)	randomised trials	very serious[1]	very serious[19]	no serious indirectness	serious[8,20]	none	108	108	-	MD 0.68 higher (0.16 to 1.2 higher)	VERY LOW	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed IV fluids	Control	Relative (95% CI)	Absolute		
Thermal comfort (Better indicated by higher values)												
1 (Chung 2012)	randomised trials	very serious[6]	no serious inconsistency	no serious indirectness	serious[8,21]	none	15	15	-	MD 10 higher (0.11 lower to 20.11 higher)	VERY LOW	IMPORTANT
Thermal comfort <4												
1 (Woolnough 2009)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	no serious imprecision	none	4/50 (8%)	8/25 (32%)	RR 0.25 (0.08 to 0.75)	240 fewer per 1000 (from 80 fewer to 294 fewer)	HIGH	IMPORTANT
Thermal comfort >6												
1 (Woolnough 2009)	randomised trials	no serious risk of bias	no serious inconsistency	no serious indirectness	very serious[3]	none	20/50 (40%)	8/25 (32%)	RR 1.25 (0.64 to 2.43)	80 more per 1000 (from 115 fewer to 458 more)	LOW	IMPORTANT

[1] *High ROB in 2+ domains or unclear ROB in 4+ domains in each study*
[2] *i2=67% (using random effects model)*
[3] *95%CI crosses two MID boundaries (0.8 to 1.25)*
[4] *High and unclear ROB in majority of studies*
[5] *95%CI crosses one MID boundary (0.8 to 1.25)*
[6] *Unclear ROB in 4+ domains*
[7] *High ROB in 2+ domains*
[8] *MID = +/-0.5*SD in control group*
[9] *Unclear ROB in 4+ domains in one study, low ROB in one study*
[10] *95%CI crosses one MID boundary (+/-102)*
[11] *OIS<300: No relative measure CI for assessment, sample size <300*
[12] *risk difference calculated as zero cases in each group*
[13] *absolute effect calculated from risk difference*
[14] *i2=83% (using random effects model)*
[15] *95%CI crosses one MID boundary (+/-0.20)*
[16] *i2=80% (using random effects model)*
[17] *i2=94% (using random effects model)*
[18] *95%CI crosses one MID boundary (+/-0.22)*
[19] *i2=90% (using random effects model)*

[20] *95%CI crosses one MID boundary (+/-0.29)*
[21] *95%CI crosses one MID boundary (+/-8)*

Comparison 2: Forced air warming versus control

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Forced air warming	Control	Relative (95% CI)	Absolute		
Incidence of hypothermia												
3 (Butwick 2007; Chebbout 2017; Horn 2014)	randomised trials	very serious [1]	very serious[2]	no serious indirectness	very serious[3]	none	9/77 (11.7%)	20/80 (25%)	RR 0.35 (0.03 to 3.56)	162 fewer per 1000 (from 243 fewer to 640 more)	VERY LOW	CRITICAL
SUBGROUP: Incidence of hypothermia – both groups had no additional warming (other than intervention)												
2 (Butwick 2007; Horn 2014)	randomised trials	very serious [1]	very serious[2]	no serious indirectness	very serious[3]	none	9/34 (26.5%)	20/36 (55.6%)	RR 0.35 (0.03 to 3.56)	361 fewer per 1000 (from 539 fewer to 1000 more)	VERY LOW	CRITICAL
SUBGROUP: Incidence of hypothermia – both control and intervention groups also had maintained warmed IV fluids (41 C)												
1 (Chebbout 2017)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	very serious[4]	none	0/43 (0%)	0/44 (0%)	Not estimable[5]	0 more per 1000 (from 40 fewer to 40 more)[6]	VERY LOW	CRITICAL
Incidence of shivering												
6 (Butwick 2007; Chung 2012; Fallis 2006; Horn 2002; Horn 2014; Munday 2018)	randomised trials	very serious [7]	no serious inconsistency	no serious indirectness	no serious imprecision	none	22/121 (18.2%)	47/121 (38.8%)	RR 0.47 (0.3 to 0.72)	206 fewer per 1000 (from 109 fewer to 272 fewer)	LOW	CRITICAL
Estimated blood loss (Better indicated by lower values)												
3 (Butwick 2007; Chung 2012; Chebbout 2017)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	73	74	-	MD 11.23 higher (42.26 lower to	LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Forced air warming	Control	Relative (95% CI)	Absolute		
										64.71 higher)		
SUBGROUP: Estimated blood loss –no additional warming (Better indicated by lower values)												
2 (Butwick 2007; Chung 2012)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	serious[8,9]	none	30	30	-	MD 41.8 higher (28.78 lower to 112.38 higher)	VERY LOW	CRITICAL
SUBGROUP: Estimated blood loss – both groups also with maintained warmed IV fluids (41 C) (Better indicated by lower values)												
1 (Chebbout 2017)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	serious[8,10]	none	43	44	-	MD 30 lower (111.96 lower to 51.96 higher)	VERY LOW	CRITICAL
Maternal temperature change (peri-op change) (Better indicated by lower values)												
1 (Butwick 2007)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	very serious[8,11]	none	15	15	-	MD 0 higher (0.25 lower to 0.25 higher)	VERY LOW	IMPORTANT
Maternal temperature change (intra-op change) (Better indicated by lower values)												
3 (Chung 2012; Fallis 2006; Munday 2018)	randomised trials	very serious [7]	very serious[12]	no serious indirectness	serious[8,13]	none	72	70	-	MD 0.06 higher (0.21 lower to 0.33 higher)	VERY LOW	IMPORTANT
Maternal temperature (intra-op, within 30mins) (Better indicated by higher values)												
2 (Chebbout 2017; Horn 2014)	randomised trials	very serious [1]	very serious[12]	no serious indirectness	serious [8,14]	none	62	65	-	MD 0.11 lower (0.4 lower to 0.17 higher)	VERY LOW	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Forced air warming	Control	Relative (95% CI)	Absolute		
Maternal temperature (intra-op, immediately post-delivery) (Better indicated by higher values)												
1 (Horn 2014)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	serious[8,15]	none	19	21	-	MD 0.1 lower (0.38 lower to 0.18 higher)	VERY LOW	IMPORTANT
Maternal temperature (intra-op, end of surgery) (Better indicated by higher values)												
4 (Chebbout 2017; Fallis 2006; Horn 2002; Horn 2014)	randomised trials	very serious [1]	very serious[16]	no serious indirectness	serious [8,17]	none	109	110	-	MD 0.4 higher (0.01 to 0.8 higher)	VERY LOW	IMPORTANT
Maternal temperature (post-op, recovery room, 15mins) (Better indicated by higher values)												
1 (Chebbout 2017)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	serious[8,18]	none	43	44	-	MD 0.1 higher (0.02 to 0.18 higher)	VERY LOW	IMPORTANT
Thermal comfort (pre-op) (Better indicated by higher values)												
2 (Horn 2002; Horn 2014)	randomised trials	very serious [1]	serious[19]	no serious indirectness	serious[8,20]	none	34	36	-	MD 6.46 higher (2.2 to 10.73 higher)	VERY LOW	IMPORTANT
Thermal comfort (intra-op, immediately post-delivery) (Better indicated by higher values)												
1 (Horn 2014)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	serious[8,21]	none	19	21	-	MD 8 higher (1.37 to 14.63 higher)	VERY LOW	IMPORTANT
Thermal comfort (intra-op, end of surgery) (Better indicated by higher values)												
1 (Horn 2014)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	19	21	-	MD 16 higher (9.79 to 22.21 higher)	LOW	IMPORTANT
Thermal comfort (post-op) (Better indicated by higher values)L												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Forced air warming	Control	Relative (95% CI)	Absolute		
3 (Butwick 2007; Chung 2012; Munday 2018)	randomised trials	very serious [7]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	55	55	-	MD 0.23 higher (0.17 lower to 0.63 higher)	LOW	IMPORTANT
SUBGROUP: Thermal comfort (post-op) - post-op, recovery room, discharge (Better indicated by higher values)												
2 (Butwick 2007; Chung 2012)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	serious[8,22]	none	30	30	-	MD 3.28 higher (0.98 lower to 7.54 higher)	VERY LOW	IMPORTANT
SUBGROUP: Thermal comfort (post-op) - peri-operative (Better indicated by higher values)												
1 (Munday 2018)	randomised trials	very serious [23]	no serious inconsistency	no serious indirectness	serious[8,24]	none	25	25	-	MD 0.2 higher (0.2 lower to 0.6 higher)	VERY LOW	IMPORTANT
Wound infection												
1 (Chebbout 2017)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	very serious[3]	none	1/43 (2.3%)	3/44 (6.8%)	RR 0.34 (0.04 to 3.15)	45 fewer per 1000 (from 65 fewer to 147 more)	VERY LOW	IMPORTANT

[1] *Unclear ROB in 4 (or more) domains in each study*
[2] *i2=81% (using random effects model)*
[3] *95%CI crosses two MID boundaries (0.8 to 1.25)*
[4] *OIS<300: No relative measure CI for assessment, sample size <300*
[5] *risk difference calculated due to zero cases in both arms*
[6] *absolute effect calculated from risk difference*
[7] *High ROB in 2 domains in one (or more) studies, unclear in 4+ domains in 2 (or more) studies*
[8] *MID = +/- 0.5*SD in control group*
[9] *95%CI crosses one MID boundary (+/-58.75)*
[10] *95%CI crosses one MID boundary (+/-100)*
[11] *95%CI crosses two MID boundaries (+/-0.15)*
[12] *i2=70% (using random effects model)*
[13] *95%CI crosses one MID boundary (+/-0.245)*

[14] *95%CI crosses one MID boundary (+/-0.175)*
[15] *95%CI cross one MID boundary (+/-0.25)*
[16] *i2=94% (using random effects model)*
[17] *95%CI crosses one MID boundary (+/-0.2)*
[18] *95%CI crosses one MID boundary (+/-0.1)*
[19] *i2=58%*
[20] *95%CI crosses one MID boundary (+/-4.25)*
[21] *95%CI crosses one MID boundary (+/-4.5)*
[22] *95%CI crosses one MID boundary (+/-5.48)*
[23] *High ROB in 2 domains*
[24] *95%CI crosses on MID boundary (+/-0.37)*

Comparison 3: Forced air warming (FAW) + warmed IV fluid versus control

Quality assessment							**No of patients**		**Effect**			
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	FAW + warmed IV fluid	Control	Relative (95% CI)	Absolute	**Quality**	**Importance**
Incidence of hypothermia (peri-op)												
1 (Cobb 2016)	randomised trials	no serious risk of bias[1]	no serious inconsistency	no serious indirectness	serious[2]	none	14/22 (63.6%)	20/22 (90.9%)	RR 0.7 (0.5 to 0.99)	273 fewer per 1000 (from 9 fewer to 455 fewer)	MODERATE	CRITICAL
Incidence of shivering (intra-op)												
1 (Cobb 2016)	randomised trials	no serious risk of bias[1]	no serious inconsistency	no serious indirectness	serious[2]	none	5/22 (22.7%)	10/22 (45.5%)	RR 0.5 (0.2 to 1.23)	227 fewer per 1000 (from 364 fewer to 105 more)	MODERATE	CRITICAL
Incidence of shivering (post-op)												
1 (Cobb 2016)	randomised trials	no serious risk of bias[1]	no serious inconsistency	no serious indirectness	very serious[3]	none	4/22 (18.2%)	4/22 (18.2%)	RR 1 (0.29 to 3.5)	0 fewer per 1000 (from 129 fewer to 455 more)	LOW	CRITICAL
Estimated blood loss[4] (Better indicated by lower values)												
1 (Cobb 2016)	randomised trials	no serious risk of bias[1]	no serious inconsistency	no serious indirectness	very serious[5]	none	22 median [IQR] 950 [800-1000] mL	22 median [IQR] 975 [800-1000] mL	-[4]	median diff 25 lower [4]	LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	FAW + warmed IV fluid	Control	Relative (95% CI)	Absolute		
Maternal temperature (intra-op, recovery room, baseline) (Better indicated by higher values)												
1 (Cobb 2016)	randomised trials	no serious risk of bias[1]	no serious inconsistency	no serious indirectness	serious[6,7]	none	22	22	-	MD 0.4 higher (0.1 to 0.7 higher)	MODERATE	IMPORTANT
Thermal comfort (post-op, recovery room, discharge)[4] (Better indicated by higher values)												
1 (Cobb 2016)	randomised trials	no serious risk of bias[1]	no serious inconsistency	no serious indirectness	very serious[5]	none	22 median [IQR] 100 [95-100]	22 median [IQR] 90 [70-100]	-[4]	median difference 10 higher [4]	LOW	IMPORTANT

[1] *Unclear ROB in one domain*
[2] *95%CI crosses one MID (0.8 to 1.25)*
[3] *95%CI crosses two MIDs (0.8 to 1.25)*
[4] *effect could not be calculated*
[5] *OIS<300: No relative measure CI for assessment, sample size <300*
[6] *95%CI crosses on MID (+/- 0.25)*
[7] *MID = +/-0.5*SD in control group*

Comparison 4: Warmed mattress/under-body pad versus control

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed mattress/ under-body pad	Control	Relative (95% CI)	Absolute		
Incidence of hypothermia												
3 (Chakladar 2014; Chebbout 2017; Paris 2014)	randomised trials	very serious [1]	no serious inconsistency	no serious indirectness	serious[2]	none	13/179 (7.3%)	23/178 (12.9%)	RR 0.56 (0.3 to 1.06)	57 fewer per 1000 (from 90 fewer to 8 more)	VERY LOW	CRITICAL
SUBGROUP: Incidence of hypothermia - undefined time point												
2 (Chakladar 2014; Chebbout 2017)	randomised trials	serious [3]	no serious inconsistency	no serious indirectness	serious[2]	none	3/102 (2.9%)	11/102 (10.8%)	RR 0.27 (0.08 to 0.93)	79 fewer per 1000 (from 8	LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed mattress/ under-body pad	Control	Relative (95% CI)	Absolute		
										fewer to 99 fewer)		
SUBGROUP: Incidence of hypothermia – postpartum												
1 (Paris 2014)	randomised trials	very serious [4]	no serious inconsistency	no serious indirectness	very serious[5]	none	10/77 (13%)	12/76 (15.8%)	RR 0.82 (0.38 to 1.79)	28 fewer per 1000 (from 98 fewer to 125 more)	VERY LOW	CRITICAL
Incidence of shivering												
1 (Chakladar 2014)	randomised trials	serious [6]	no serious inconsistency	no serious indirectness	very serious[5]	none	10/58 (17.2%)	8/58 (13.8%)	RR 1.25 (0.53 to 2.94)	34 more per 1000 (from 65 fewer to 268 more)	VERY LOW	CRITICAL
Estimated blood loss (Better indicated by lower values)												
2 (Chebbout 2017; Paris 2014)	randomised trials	very serious [7]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	121	120	-	MD 0.41 lower (56.12 lower to 55.3 higher)	LOW	CRITICAL
Maternal temperature (intra-op) (Better indicated by higher values)												
3 (Chakladar 2014; Chebbout 2017; Paris 2014)	randomised trials	very serious [1]	serious[9]	no serious indirectness	no serious imprecision[8]	none	179	178	-	MD 0.06 higher (0.01 to 0.12 higher)	VERY LOW	IMPORTANT
SUBGROUP: Maternal temperature (intra-op) - start/first 30mins (Better indicated by higher values)												
2 (Chakladar 2014; Chebbout 2017)	randomised trials	serious [3]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	102	102	-	MD 0.03 higher (0.04 lower to 0.1 higher)	MODERATE	IMPORTANT
SUBGROUP: Maternal temperature (intra-op) - anytime in operating room (Better indicated by higher values)												
1 (Paris 2014)	randomised trials	very serious [4]	no serious inconsistency	no serious indirectness	serious[8,10]	none	77	76	-	MD 0.12 higher (0.03 to 0.21 higher)	VERY LOW	IMPORTANT
Maternal temperature (intra-op, recovery room, baseline) (Better indicated by higher values)												
2 (Chakladar 2014; Chebbout 2017)	randomised trials	serious [3]	very serious[11]	no serious indirectness	serious[8,12]	none	102	102	-	MD 0.09 higher (0.11 lower to 0.28 higher)	VERY LOW	IMPORTANT
Maternal temperature (post-op, recovery room) (Better indicated by higher values)												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed mattress/ under-body pad	Control	Relative (95% CI)	Absolute		
2 (Chebbout 2017; Paris 2014)	randomised trials	very serious [7]	very serious[13]	no serious indirectness	serious[8,14]	none	121	120	-	MD 0.16 higher (0.16 lower to 0.48 higher)	VERY LOW	IMPORTANT
Maternal temperature (post-op, postpartum) (Better indicated by higher values)												
1 (Paris 2014)	randomised trials	very serious [4]	no serious inconsistency	no serious indirectness	no serious imprecision[8]	none	77	76	-	MD 0.98 higher (0.81 to 1.15 higher)	LOW	IMPORTANT
Wound infection												
1 (Chebbout 2017)	randomised trials	very serious [15]	no serious inconsistency	no serious indirectness	very serious[5]	none	2/44 (4.5%)	3/44 (6.8%)	RR 0.67 (0.12 to 3.8)	22 fewer per 1000 (from 60 fewer to 191 more)	VERY LOW	IMPORTANT

[1] High ROB in at least 2 domains in one study, unclear ROB in at least 2 domains in two studies
[2] 95%CI crosses one MID (0.8 to 1.25)
[3] Unclear ROB in at least 2 domains in both studies
[4] High ROB in 3 domains, unclear in one domain
[5] 95%CI crosses two MIDs (0.8 to 1.25)
[6] Unclear ROB in 2 domains
[7] High ROB in 2+ domains in one study, unclear in 4 domains in one study
*[8] MID = +/- 0.5*SD in control group*
[9] i2=56%
[10] 95%CI crosses one MID boundary (+/- 0.18)
[11] i2=78% (with random effects model)
[12] 95%CI crosses one MID boundary (+/-0.15)
[13] i2=94% (with random effects model)
[14] 95%CI crosses one MID boundary (+/-0.16)
[15] Unclear ROB in 4 domains

ACTIVE WARMING MEASURES VERSUS OTHER ACTIVE WARMING

Comparison 5: Forced air warming versus warmed IV fluids

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Forced air warming	Warmed IV fluids	Relative (95% CI)	Absolute		
Incidence of shivering												
1 (Chung 2012)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	3/15 (20%)	2/15 (13.3%)	RR 1.5 (0.29 to 7.73)	67 more per 1000 (from 95 fewer to 897 more)	VERY LOW	CRITICAL
Estimated blood loss (Better indicated by lower values)												
1 (Chung 2012)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[3,4]	none	15	15	-	MD 80 higher (20.2 lower to 180.2 higher)	VERY LOW	CRITICAL
Maternal temperature change (intra-op, 45 minutes after intervention) (Better indicated by higher values)												
1 (Chung 2012)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[3,5]	none	15	15	-	MD 0.1 lower (0.35 lower to 0.15 higher)	VERY LOW	IMPORTANT
Thermal comfort (Better indicated by higher values)												
1 (Chung 2012)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[3,6]	none	15	15	-	MD 0.3 lower (9.36 lower to 8.76 higher)	VERY LOW	IMPORTANT

[1] *Unclear ROB in 6 domains*
[2] *95%CI crosses two MID boundaries (0.8 to 1.25)*
[3] *MID = +/-0.5*SD in control group*
[4] *95%CI crosses one MID boundary (+/-70)*
[5] *95%CI crosses one MID boundary (+/-0.15)*
[6] *95%CI crosses two MID boundaries (+/- 6.05)*

Comparison 6: Forced air warming versus mattress warming

Quality assessment							No of patients		Effect			
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Forced air warming	Mattress warming	Relative (95% CI)	Absolute	Quality	Importance
Incidence of hypothermia (<36 C)												
1 (Chebbout 2017)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	0/43 (0%)	0/44 (0%)	See comment3	0 more per 1000 (from 40 fewer to 40 more)4	VERY LOW	CRITICAL
Estimated blood loss (Better indicated by lower values)												
1 (Chebbout 2017)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[5]	none	43	44	-	MD 20 lower (110.85 lower to 70.85 higher)	LOW	CRITICAL
Maternal temperature (pre-op, 15 minutes after anaesthetic) (Better indicated by higher values)												
1 (Chebbout 2017)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[5]	none	43	44	-	MD 0 higher (0.08 lower to 0.08 higher)	LOW	IMPORTANT
Maternal temperature (intra-op, recovery room, baseline) (Better indicated by higher values)												
1 (Chebbout 2017)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[5]	none	43	44	-	MD 0 higher (0.08 lower to 0.08 higher)	LOW	IMPORTANT
Maternal temperature (post-op, recovery room, 15 min) (Better indicated by higher values)												
1 (Chebbout 2017)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[5,6]	none	43	44	-	MD 0.1 higher (0.02 to 0.18 higher)	VERY LOW	IMPORTANT
Wound infection												
1 (Chebbout 2017)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[7]	none	1/43 (2.3%)	2/44 (4.5%)	RR 0.51 (0.05 to 5.44)	22 fewer per 1000 (from 43 fewer to 202 more)	VERY LOW	IMPORTANT

[1] *Unclear ROB in 4 domains*
[2] *OIS<300: No relative measure CI for assessment, sample size <300*
[3] *risk difference calculated due to zero cases in both arms*
[4] *absolute effect calculated from risk difference*
[5] *MID = +/- 0.5*SD in control group*
[6] *95%CI crosses one MID boundary (+/-0.1)*
[7] *95%CI crosses two MID boundaries (0.8 to 1.25)*

Comparison 7: Warmed mattress/under body pad versus other warming CLUSTER

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed mattress/ under body pad	Other warming	Relative (95% CI)	Absolute		
Incidence of hypothermia												
2 (Grant 2015; Paris 2014)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2,3]	none	98/208 (47.1%)	119/204 (58.3%)	RR 0.82 (0.7 to 0.96)	105 fewer per 1000 (from 23 fewer to 175 fewer)	VERY LOW	CRITICAL
SUBGROUP: Incidence of hypothermia - Warmed IV fluids, tinfoil hats, warmed blankets												
1 (Grant 2015)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2,3]	none	88/131 (67.2%)	105/131 (80.2%)	RR 0.84 (0.72 to 0.97)	128 fewer per 1000 (from 24 fewer to 224 fewer)	VERY LOW	CRITICAL
SUBGROUP: Incidence of hypothermia - Warmed IV fluids (maintained)												
1 (Paris 2014)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[4]	none	10/77 (13%)	14/73 (19.2%)	RR 0.68 (0.32 to 1.43)	61 fewer per 1000 (from 130 fewer to 82 more)	VERY LOW	CRITICAL
Estimated blood loss - Warmed IV fluids (maintained) (Better indicated by lower values)												
1 (Paris 2014)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[5,6]	none	77	73	-	MD 37.11 lower (101.5 lower to 27.28 higher)	VERY LOW	CRITICAL
Maternal temperature (intra-op) (Better indicated by higher values)												
2 (Grant 2015; Paris 2014)	randomised trials	very serious[1]	very serious[7]	no serious indirectness	very serious [2,5,8]	none	208	204	-	MD 0.08 higher (0.14 lower to 0.31 higher)	VERY LOW	IMPORTANT
SUBGROUP: Maternal temperature (intra-op) - Warmed IV fluids, tinfoil hats, warmed blankets (Better indicated by higher values)												
1 (Grant 2015)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious [2,5,9]	none	131	131	-	MD 0.2 higher (0.08 to 0.32 higher)	VERY LOW	IMPORTANT
SUBGROUP: Maternal temperature (intra-op) - Warmed IV fluids (maintained) (Better indicated by higher values)												
1 (Paris 2014)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[5]	none	77	73	-	MD 0.03 lower (0.12 lower to 0.06 higher)	LOW	IMPORTANT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Warmed mattress/ under body pad	Other warming	Relative (95% CI)	Absolute		
Maternal temperature (post-op, recovery room) (Better indicated by higher values)												
2 (Grant 2015; Paris 2014)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2,5]	none	320	314	-	MD 0.05 higher (0.03 lower to 0.13 higher)	VERY LOW	IMPORTANT
SUBGROUP: Maternal temperature (post-op, recovery room) - Warmed IV fluids, tinfoil hats, warmed blankets (Better indicated by higher values)												
1 (Grant 2015)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2,5]	none	243	241	-	MD 0 higher (0.11 lower to 0.11 higher)	VERY LOW	IMPORTANT
SUBGROUP: Maternal temperature (post-op, recovery room) - Warmed IV fluids (maintained) (Better indicated by higher values)												
1 (Paris 2014)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[5,10]	none	77	73	-	MD 0.11 higher (0.01 lower to 0.23 higher)	VERY LOW	IMPORTANT
Maternal temperature (post-op, postpartum) - Warmed IV fluids (maintained) (Better indicated by higher values)												
1 (Paris 2014)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[5]	none	77	73	-	MD 0.05 higher (0.1 lower to 0.2 higher)	LOW	IMPORTANT
Wound infection - Warmed IV fluids, tinfoil hats, warmed blankets												
1 (Grant 2015)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2,4]	none	4/243 (1.6%)	1/241 (0.41%)	RR 3.97 (0.45 to 35.24)	12 more per 1000 (from 2 fewer to 142 more)	VERY LOW	IMPORTANT

[1] *High ROB in at least 2 domains per study*
[2] *Downgraded once for cluster RCT with insufficient information available for design effect adjustment*
[3] *95%CI crosses one MID (0.8 to 1.25)*
[4] *95%CI crosses two MIDs (0.8 to 1.25)*
[5] *MID = +/- 0.5*SD in control group*
[6] *95%CI crosses one MID boundary (+/-78)*
[7] *i2=89% (with random effects model)*
[8] *95%CI crosses one MID boundary (+/-0.2)*

[9] *95%CI crosses one MID boundary (+/-0.25)*
[10] *95%CI crosses one MID boundary (+/-0.18)*

Thermal insulation measures

Comparison 8: Higher versus lower ambient temperature

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Higher ambient temperature	Lower ambient temperature	Relative (95% CI)	Absolute		
Incidence of hypothermia <36 C												
1 (Duryea 2016)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2,3]	none	104/390 (26.7%)	132/401 (32.9%)	RR 0.81 (0.65 to 1.01)	63 fewer per 1000 (from 115 fewer to 3 more)	VERY LOW	CRITICAL
Wound infection												
1 (Duryea 2016)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2,4]	none	0/390 (0%)	1/401 (0.25%)	POR 0.14 (0.00 to 7.01)	2 fewer per 1000 (from 2 fewer to 15 more)	VERY LOW	IMPORTANT

[1] *High ROB in 4 domains*
[2] *Downgraded once for cluster RCT with insufficient information available for design effect adjustment*
[3] *95%CI crosses one MID (0.8 to 1.25)*
[4] *95%CI crosses two MIDs (0.8 to 1.25)*

Pharmacological therapy

Comparison 9: 5-HT3 antagonist versus control

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	5-HT3 antagonist	Control	Relative (95% CI)	Absolute		
Incidence of shivering												
1 (Browning 2013)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	23/56 (41.1%)	28/60 (46.7%)	RR 0.88 (0.58 to 1.33)	56 fewer per 1000 (from 196 fewer to 154 more)	VERY LOW	CRITICAL
Incidence of shivering (reached score 2-4)												
1 (Browning 2013)	randomised trials	serious[1]	no serious inconsistency	no serious indirectness	very serious[2]	none	18/56 (32.1%)	20/60 (33.3%)	RR 0.96 (0.57 to 1.63)	13 fewer per 1000 (from 143 fewer to 210 more)	VERY LOW	CRITICAL

[1] *High ROB in one domain, unclear in one domain*
[2] *95%CI crosses two MID boundaries (0.8 to 1.25)*

Comparison 10: Opioid-like analgesic (pethidine) versus other opioid (morphine)

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Opioid-like analgesic (pethidine)	Other opioid (morphine)	Relative (95% CI)	Absolute		
Incidence of shivering												
1 (Hong 2005)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2]	none	2/60 (3.3%)	9/59 (15.3%)	RR 0.22 (0.05 to 0.97)	119 fewer per 1000 (from 5 fewer to 145 fewer)	VERY LOW	CRITICAL
SUBGROUP: Incidence of shivering - peth (10mg) vs morphine (0.1mg)												
1 (Hong 2005)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[3]	none	1/30 (3.3%)	5/29 (17.2%)	RR 0.19 (0.02 to 1.56)	140 fewer per 1000 (from 169 fewer to 97 more)	VERY LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Opioid-like analgesic (pethidine)	Other opioid (morphine)	Relative (95% CI)	Absolute		
SUBGROUP: Incidence of shivering - peth (10mg) vs morphine (0.2mg)												
1 (Hong 2005)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[3]	none	1/30 (3.3%)	4/30 (13.3%)	RR 0.25 (0.03 to 2.11)	100 fewer per 1000 (from 129 fewer to 148 more)	VERY LOW	CRITICAL

[1] *Unclear ROB in 5 domains*
[2] *95%CI crosses one MID boundary (0.8 to 1.25)*
[3] *95%CI crosses two MID boundaries (0.8 to 1.25)*

Comparison 11a: Opioid-like analgesic versus control FOR PREVENTION

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Opioid-like analgesic	Control	Relative (95% CI)	Absolute		
Incidence of shivering												
3 (Hong 2005; Roy 2004; Sutherland 1991)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	24/156 (15.4%)	55/157 (35%)	RR 0.44 (0.29 to 0.66)	196 fewer per 1000 (from 119 fewer to 249 fewer)	LOW	CRITICAL
SUBGROUP: Incidence of shivering - pethidine (25mg)												
1 (Sutherland 1991)	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	no serious imprecision	none	5/47 (10.6%)	17/47 (36.2%)	RR 0.29 (0.12 to 0.73)	257 fewer per 1000 (from 98 fewer to 318 fewer)	LOW	CRITICAL
SUBGROUP: Incidence of shivering - pethidine (10mg)												
1 (Hong 2005)	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	serious[3]	none	1/30 (3.3%)	7/30 (23.3%)	RR 0.14 (0.02 to 1.09)	201 fewer per 1000 (from 229	VERY LOW	CRITICAL

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Opioid-like analgesic	Control	Relative (95% CI)	Absolute		
										fewer to 21 more)		
SUBGROUP: Incidence of shivering - meperidine (0.2mg/kg)												
1 (Roy 2004)	randomised trials	serious[4]	no serious inconsistency	no serious indirectness	serious[3]	none	9/20 (45%)	17/20 (85%)	RR 0.53 (0.32 to 0.89)	400 fewer per 1000 (from 94 fewer to 578 fewer)	LOW	CRITICAL
SUBGROUP: Incidence of shivering - morphine (0.1mg)												
1 (Hong 2005)	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	very serious[5]	none	5/29 (17.2%)	7/30 (23.3%)	RR 0.74 (0.26 to 2.07)	61 fewer per 1000 (from 173 fewer to 250 more)	VERY LOW	CRITICAL
SUBGROUP: Incidence of shivering - morphine (0.2mg)												
1 (Hong 2005)	randomised trials	very serious[2]	no serious inconsistency	no serious indirectness	very serious[5]	none	4/30 (13.3%)	7/30 (23.3%)	RR 0.57 (0.19 to 1.75)	100 fewer per 1000 (from 189 fewer to 175 more)	VERY LOW	CRITICAL

[1] *Unclear ROB in 5 domains in 2 studies, high ROB in one domain and unclear in one domain in one study*
[2] *Unclear ROB in 5 domains*
[3] *95%CI crosses one MID (0.8 to 1.25)*
[4] *High ROB in one domain, unclear in one domain*
[5] *95%CI crosses two MIDs (0.8 to 1.25)*

Comparison 11b: Opioid-like analgesic (Pethidine) versus control FOR MANAGEMENT

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Opioid-like analgesic (Meperidine)	Control	Relative (95% CI)	Absolute		
Incidence of shivering (2 mins post infusion)												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Opioid-like analgesic (Meperidine)	Control	Relative (95% CI)	Absolute		
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	8/20 (40%)	19/20 (95%)	RR 0.42 (0.24 to 0.73)	551 fewer per 1000 (from 256 fewer to 722 fewer)	LOW	CRITICAL
Incidence of shivering (5 mins post infusion)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	5/20 (25%)	15/20 (75%)	RR 0.33 (0.15 to 0.74)	502 fewer per 1000 (from 195 fewer to 637 fewer)	LOW	CRITICAL
Incidence of shivering (15mins post)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	3/20 (15%)	17/20 (85%)	RR 0.18 (0.06 to 0.51)	697 fewer per 1000 (from 417 fewer to 799 fewer)	LOW	CRITICAL
Incidence of shivering (30 mins post)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	6/20 (30%)	18/20 (90%)	RR 0.33 (0.17 to 0.66)	603 fewer per 1000 (from 306 fewer to 747 fewer)	LOW	CRITICAL
Incidence of shivering (60 mins post)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision	none	5/20 (25%)	14/20 (70%)	RR 0.36 (0.16 to 0.8)	448 fewer per 1000 (from 140 fewer to 588 fewer)	LOW	CRITICAL
Maternal core temp (2mins post) (Better indicated by higher values)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	very serious[2,3]	none	20	20	-	MD 0 higher (0.12 lower to 0.12 higher)	VERY LOW	IMPORTANT
Maternal core temp (5mins post) (Better indicated by higher values)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	serious[2,4]	none	20	20	-	MD 0.1 lower (0.26 lower to 0.06 higher)	VERY LOW	IMPORTANT
Maternal core temp (15mins post) (Better indicated by higher values)												

Quality assessment							No of patients		Effect		Quality	Importance
No of studies	Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Opioid-like analgesic (Meperidine)	Control	Relative (95% CI)	Absolute		
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[2]	none	20	20	-	MD 0.3 lower (0.42 to 0.18 lower)	LOW	IMPORTANT
Maternal core temp (30mins post) (Better indicated by higher values)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[2]	none	20	20	-	MD 0.5 lower (0.62 to 0.38 lower)	LOW	IMPORTANT
Maternal core temp (60mins post) (Better indicated by higher values)												
1 (Casey 1988)	randomised trials	very serious[1]	no serious inconsistency	no serious indirectness	no serious imprecision[2]	none	20	20	-	MD 0.4 lower (0.56 to 0.24 lower)	LOW	IMPORTANT

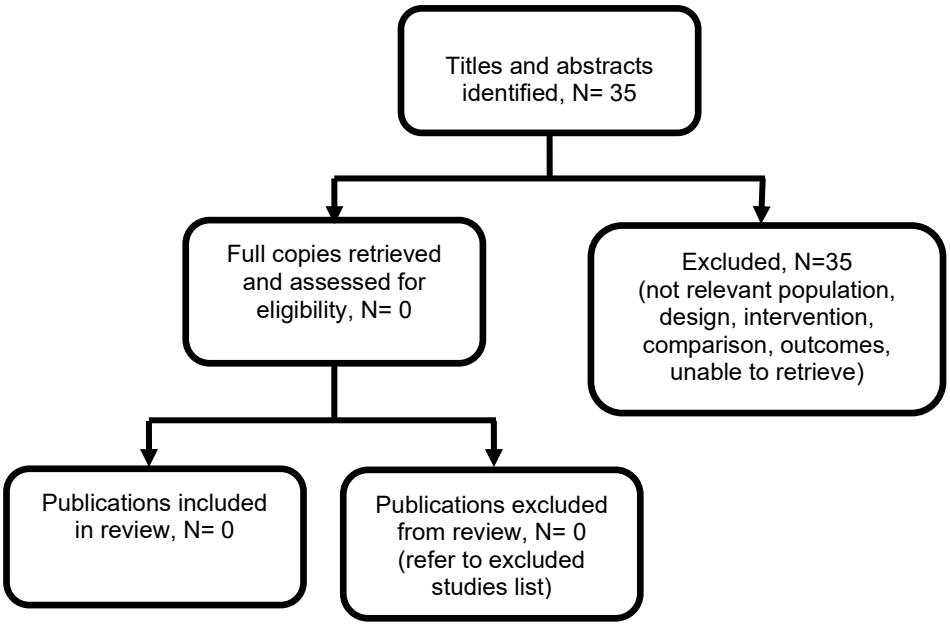
[1] *Unclear ROB in 6 domains*
[2] *MID = 0.5*SD in control group*
[3] *95%CI crosses 2 MID boundaries (+/-0.1)*
[4] *95%CI crosses one MID boundary (+/-0.15)*

Appendix G – Economic evidence study selection

Economic evidence study selection for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

No evidence was identified which was applicable to this review question.

Figure 2: Study selection flow chart



Appendix H – Economic evidence tables

Economic evidence tables for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

No evidence was identified which was applicable to this review question.

Appendix I – Economic evidence profiles

Economic evidence profiles for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

No evidence was identified which was applicable to this review question

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Appendix J – Economic analysis

Economic evidence analysis for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

No economic analysis was conducted for this review question.

Appendix K – Excluded studies

Excluded studies for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

Clinical studies

Table 5: Excluded studies and reasons for their exclusion

Study	Reason for Exclusion
Abdel-Ghaffar, H. S., Moeen, S. M., Prophylactic Granisetron for post-spinal anesthesia shivering in Caesarean Section: a randomized controlled clinical study, Acta Anaesthesiologica Scandinavica, (no pagination), 2018	Study from Egypt (developing country).
Adesiyan, A. O., Kushimo, O. T., Tobi, K. U., Intrathecal fentanyl does not increase bupivacaine-induced adverse thermoregulatory effects in women undergoing caesarean section under spinal anaesthesia, International journal of obstetric anesthesia. Conference: annual meeting of the obstetric anaesthetists' association 2017. Belgium, 31, S20, 2017	Conference abstract.
Allen, T. K., Habib, A. S., Inadvertent Perioperative Hypothermia Induced by Spinal Anesthesia for Cesarean Delivery Might Be More Significant Than We Think: Are We Doing Enough to Warm Our Parturients?, Anesthesia and Analgesia, 126, 7-9, 2018	Narrative opinion paper. No primary data.
Anaraki, A. N., Mirzaei, K., The Effect of Different Intrathecal Doses of Meperidine on Shivering during Delivery Under Spinal Anesthesia, International Journal of Preventive Medicine, 3, 706-12, 2012	Study from Iran (developing country).
Atashkhoyi, S., Iranpour, A., Effect of tramadol on prevention of shivering after spinal anesthesia for cesarean section, BJOG, 115, 90, 2008	Conference abstract.
Atashkhoyi, S., Negargar, S., Effect of tramadol for prevention of shivering after spinal anesthesia for cesarean section, Journal of maternal-fetal & neonatal medicine, 21, 61, 2008	Conference abstract.
Azam, M., Asad, N., Butt, T. A., Ahmad, W., Efficacy of prophylactic intravenous ketamine vs tramadol for prevention of intraoperative shivering in spinal anesthesia for patient undergoing cesarean section, Pakistan journal of medical and health sciences, 12, 455â□□458, 2018	Study from Pakistan (developing country).
Badawy, A. A., Mokhtar, A. M., The role of ondansetron in prevention of post-spinal shivering (PSS) in obstetric patients: A double-blind randomized controlled trial, Egyptian journal of anaesthesia, 33, 29-33, 2017	Study from Egypt (developing country).
Bao, Z., Zhou, C., Wang, X., Zhu, Y., Intravenous dexmedetomidine during spinal anaesthesia for caesarean section: A meta-analysis of randomized trials, Journal of International Medical Research, 45, 924-932, 2017	Systematic review: analyses cannot be used in entirety, included studies checked for inclusion (excluded as all were from developing/non-OECD countries).
Bernardis, R. C. G. D., Siaulys, M. M., Vieira, J. E., Mathias, L. A. S. T., Perioperative warming with a thermal gown prevents maternal temperature loss during elective cesarean section. A randomized clinical trial, Brazilian Journal of Anesthesiology, 66, 451-455, 2016	Study from Brazil (developing country).

Study	Reason for Exclusion
Butwick, A. J., Lipman, S. S., Andes, L., Cohen, S. E., Carvalho, B., Does forced air-warming reduce hypothermia and shivering for patients undergoing cesarean section with spinal anesthesia?, Anesthesiology, 102, 29, 2005	Conference abstract. Full text included.
Canturk, M., Canturk, F. K., Kocaoglu, N., Hakki, M., The effects of crystalloid warming on maternal body temperature and fetal outcomes: a randomized controlled trial, Brazilian Journal of Anesthesiology, 2018	Non-English language article.
Capogna, G., Celleno, D., IV clonidine for post-extradural shivering in parturients: a preliminary study, British Journal of Anaesthesia, 71, 294-5, 1993	Non-relevant intervention
Chakladar, A., Harper, C. M., Peri-operative warming in caesarean sections: guidance would be NICE, Anaesthesia, 65, 212-3, 2010	Editorial/Commentary only
Chan, A. M., Ng, K. F., Tong, E. W., Jan, G. S., Control of shivering under regional anesthesia in obstetric patients with tramadol, Canadian Journal of Anaesthesia, 46, 253-8, 1999	Non-relevant intervention
Chen, A. K., Kwan, W. F., Harrity, W. V., The effect of epidural butorphanol and fentanyl on shivering during cesarean section, Regional Anesthesia, 16, 30, 1991	Conference abstract
de Figueiredo Locks, G., Incidence of shivering after cesarean section under spinal anesthesia with or without intrathecal sufentanil: a randomized study, Revista Brasileira de Anestesiologia, 62, 676-84, 2012	Study from Brazil (developing country)
El-Deeb, A., Barakat, R., Could ephedrine replace meperidine for prevention of shivering in women undergoing Cesarean Section under spinal anesthesia? A randomized study, Egyptian Journal of Anaesthesia, 28, 237â□□241, 2012	Study from Egypt (developing country)
Faiz, S. H. R., Rahimzadeh, P., Imani, F., Bakhtiari, A., Intrathecal injection of magnesium sulfate: shivering prevention during cesarean section: a randomized, double-blinded, controlled study, Korean Journal of Anesthesiology, 65, 293â□□298, 2013	Study from Iran (developing country)
Feng, L. S., Hong, G., Yan, Z., Qiu, L. Y., Liang, L. A., Intrathecal sufentanil does not reduce shivering during neuraxial anesthesia: A meta-analysis, Medical Science Monitor, 22, 258-266, 2016	Non-relevant intervention (Sufentanil not licensed in UK)
Gang, S., Zhengyuan, S., Chunnan, J., The effectiveness of active warming for women undergoing elective caesarean section on maternal shivering: A meta-analysis, Biomedical Research (India), 28, 8728-8730, 2017	Systematic review: analyses cannot be used in entirety, included studies checked for inclusion
Goyal, Parveen, Kundra, Sandeep, Sharma, Shruti, Grewal, Anju, Kaul, Tej, Singh, M, Efficacy of intravenous fluid warming for maintenance of core temperature during lower segment cesarean section under spinal anesthesia, Journal of Obstetric Anaesthesia and Critical Care, 1, 73-77, 2011	Study from developing/non-OECD country
Gulhas,N., Tekdemir,D., Durmus,M., Yucel,A., Erdil,F.A., Yologlu,S., Ersoy,M.O., The effects of ephedrine on maternal hypothermia in caesarean sections: a double blind randomized clinical trial, European Review for Medical and Pharmacological Sciences, 17, 2051-2058, 2013	Study from developing country (Turkey). Specific sub-population of women who developed hypotension.
Han, J. W., Kang, H. S., Choi, S. K., Park, S. J., Park, H. J., Lim, T. H., Comparison of the Effects of Intrathecal Fentanyl and Meperidine on Shivering after Cesarean Delivery under Spinal Anesthesia, Korean Journal of Anesthesiology, 52, 657â□□662, 2007	Non-English language article.

Study	Reason for Exclusion
He, L., Xu, J. M., Liu, S. M., Chen, Z. J., Li, X., Zhu, R., Intrathecal dexmedetomidine alleviates shivering during cesarean delivery under spinal anesthesia, Biological & pharmaceutical bulletin, 40, 169-173, 2017	Study in developing/non-OECD country
Hernandez-Bernal, C. E., Martinez-Sanchez, A., Oriol-Lopez, S. A., Castelazo-Arredondo, J. A., Tremor and epidural blocking in caesarean, Revista mexicana de anestesiologia, 32, 107â□□113, 2009	Non-English language.
Honarmand, A., Safavi, M., Hirmanpour, A., Afzali, S., The effect of intravenous hydrocortisone (1 or 2 mg/kg) on postoperative shivering in cesarean section with spinal anesthesia, Journal of isfahan medical school, 35, 821â□□827, 2017	Study from developing country (Iran).
Hui,C.K., Huang,C.H., Lin,C.J., Lau,H.P., Chan,W.H., Yeh,H.M., A randomised double-blind controlled study evaluating the hypothermic effect of 150 microg morphine during spinal anaesthesia for Caesarean section, Anaesthesia, 61, 29-31, 2006	Study from developing/non-OECD country
Jabalameli, M., Radmanesh, A., Comparing the efficacy of prophylactic intravenous dexamethasone and pethidine on postoperative shivering in elective cesarean section under spinal anaesthesia, Journal of isfahan medical school, 32, 678â□□689, 2014	Not English
Jabalameli, M., Sadeghi, A., Hirmanpour, A., Prevention of shivering during regional anesthesia in cesarean section: comparison of the two different doses of ketamine and placebo, Journal of isfahan medical school, 34, 1168â□□1173, 2016	Not English
Javaherforoosh, F., Akhondzadeh, R., Aein, K. B., Olapour, A., Samimi, M., Effects of tramadol on shivering post spinal anesthesia in elective cesarean section, Pakistan journal of medical sciences, 25, 12â□□17, 2009	Study from developing country (Iran).
Jeon, W. J., Kim, D. H., Choi, D. H., Patient Controlled Sedation Using Propofol during Regional Anesthesia for Cesarean Section, Korean Journal of Anesthesiology, 39, 534â□□541, 2000	Non-English language.
Ji, W., Wang, C., Lin, P., Effects of intrathecal morphine on shivering in parturients during cesarean section, Journal of clinical anesthesiology, 1, 20â□□21, 2000	Not English
Khan,Z.H., Zanjani,A.P., Makarem,J., Samadi,S., Antishivering effects of two different doses of intrathecal meperidine in caesarean section: a prospective randomised blinded study, European Journal of Anaesthesiology, 28, 202-206, 2011	Study from developing country (Iran).
Khezri, M. B., Al-sadat Mosallaei, M., Ebtehaj, M., Mohammadi, N., Comparison of preemptive effect of intravenous ketorolac versus meperidine on postoperative shivering and pain in patients undergoing cesarean section under spinal anesthesia: a prospective, randomized, double-blind study, Caspian journal of internal medicine, 9, 151â□□157, 2018	Study from developing country (Iran).
Khezri, M. B., Bandari, A. M., Asefzade, S., Atlasbaf, A., The effect of diclofenac na supp on postoperative shivering in patients undergoing elective cesarean section surgery, Pakistan journal of medical sciences, 27, 1145â□□1148, 2011	Study from developing country (Iran).
Kishore, N., Payaayaayal, Y. S., Kumar, N., Chauhan, N., In spinal anaesthesia for cesarean section the temperature of bupivacaine affects the onset of shivering but not the incidence: a randomized control trial, Journal of clinical and diagnostic research, 10, UC18â□□UC21, 2016	Study from developing country (India).

Study	Reason for Exclusion
Kose, E. A., Honca, M., Dal, D., Akinci, S. B., Aypar, U., Prophylactic ketamine to prevent shivering in parturients undergoing Cesarean delivery during spinal anesthesia, Journal of Clinical Anesthesia, 25, 275-80, 2013	Study from developing country (Turkey).
Kwan, W. F., Chen, B. J., Wu, Y., Chuah, E. C., Epidural butorphanol but not nalbuphine ceases shivering in parturients during cesarean section, Anesthesia and Analgesia, 80, S259, 1995	Conference abstract.
Lamontagne, C., Lidzborski, E., Crochetiere, C., Villeneuve, E., Lesage, S., Intravenous dexmedetomidine for the treatment of shivering during cesarean delivery under neuraxial anesthesia, Canadian Journal of Anesthesia, 64, S5-S6, 2017	Conference abstract
Lema, G. F., Gebremedhn, E. G., Gebregzi, A. H., Desta, Y. T., Kassa, A. A., Efficacy of intravenous tramadol and low-dose ketamine in the prevention of post-spinal anesthesia shivering following cesarean section: a double-blinded, randomized control trial, International Journal of Women's Health, 9, 681â□□688, 2017	Study from developing/non-OECD country
Li, Z., Tian, M., Zhang, C. Y., Li, A. Z., Huang, A. J., Shi, C. X., Xin, D. Q., Qi, J., Li, K. Z., A Randomised Controlled Trial to Evaluate the Effectiveness of Intrathecal Bupivacaine Combined with Different Adjuvants (Fentanyl, Clonidine and Dexmedetomidine) in Caesarean Section, Drug research, 65, 581â□□586, 2015	Study from developing/non-OECD country
Liu, Jie, Wang, Yong, Ma, Wuhua, Shivering prevention and treatment during cesarean delivery under neuraxial anesthesia: a systematic review, Minerva Anestesiologica, 2018	Systematic review: analyses cannot be used in entirety, included studies checked for inclusion
Liu, W. H., Luxton, M. C., The effect of prophylactic fentanyl on shivering in elective caesarean section under epidural analgesia, Anaesthesia, 46, 344-8, 1991	Non-relevant intervention
McCarroll, S. M., Cartwright, P., Weeks, S. K., Donati, F., Warming intravenous fluids and the incidence of shivering during caesarean sections under epidural anaesthesia, Canadian anaesthetists' society journal, 33, 72â□□73, 1986	Conference abstract
Moola, S., Lockwood, C., Effectiveness of strategies for the management and/or prevention of hypothermia within the adult perioperative environment, International Journal of Evidence-Based Healthcare, 9, 337-45, 2011	Systematic review: analyses cannot be used in entirety, included studies checked for inclusion
Moola, Sandeep, Lockwood, Craig, The effectiveness of strategies for the management and/or prevention of hypothermia within the adult perioperative environment: systematic review, JBI library of systematic reviews, 8, 752-792, 2010	Systematic review: analyses cannot be used in entirety, included studies checked for inclusion
Munday, J., Hines, S., Wallace, K., Chang, A. M., Gibbons, K., Yates, P., A systematic review of the effectiveness of warming interventions for women undergoing cesarean section, Worldviews on Evidence-Based Nursing, 11, 383-93, 2014	Systematic review: analyses cannot be used in entirety, included studies checked for inclusion
Munday,J., Hines,S., Wallace,K., Chang,A.M., Gibbons,K., Yates,P., The clinical effectiveness of interventions to assist perioperative temperature management for women undergoing cesarean section: A systematic review, JBI Database of Systematic Reviews and Implementation Reports, 11, 45-111, 2013	Duplicate article of systematic review.
Najafianaraki, A., Mirzaei, K., Akbari, Z., Macaire, P., The effects of warm and cold intrathecal bupivacaine on shivering during	Study from developing country (Iran).

Study	Reason for Exclusion
delivery under spinal anesthesia, Saudi journal of anaesthesia, 6, 336-40, 2012	
Nallam, Srinivasa Rao, Cherukuru, Kavya, Sateesh, Gokul, Efficacy of Intravenous Ondansetron for Prevention of Postspinal Shivering during Lower Segment Cesarean Section: A Double-Blinded Randomized Trial, Anesthesia, essays and researches, 11, 508-513, 2017	Study from developing country (India).
Nasseri, K., Ghadami, N., Nouri, B., Effects of intrathecal dexmedetomidine on shivering after spinal anesthesia for cesarean section: a double-blind randomized clinical trial, Drug design, development & therapy, 11, 1107-1113, 2017	Study from developing country (Iran).
Nasseri, K., Shami, S., Sarshivie, F., Intrathecal morphine decreases shivering during caesarean section under spinal anesthesia, Regional Anesthesia and Pain Medicine, Conference: 35th Annual European Society of Regional Anaesthesia and Pain Therapy Congress, ESRA 2016. Netherlands. Conference Start: 20160907. Conference End: 20160910. 41, e125, 2016	Conference abstract
Nct,, Effect of a Warming Mattress on Perioperative Hypothermia Following Cesarean Delivery, Https://clinicaltrials.gov/show/nct02837913, 2016	Trial registration only. No data.
Nct,, A Study to Determine the Effectiveness of a Warming Mattress in Preventing Inadvertent Peri-operative Hypothermia and Shivering in Patients Undergoing Elective Cesarean Section, Https://clinicaltrials.gov/show/nct01054209, 2010	Trial registration only. No data.
Nct,, Active Warming Versus Non Active Warming During Caesarean Section for Preventing Neonatal Hypothermia, Https://clinicaltrials.gov/show/nct03316716, 2017	Trial registration only. No data.
Nct,, Pre-warming Prevents Hypothermia in Elective Cesarean Section, Https://clinicaltrials.gov/show/nct02091466, 2014	Trial registration only. No data.
Nct,, Shivering Treatment After Cesarean Delivery: meperidine vs. Dexmedetomidine, Https://clinicaltrials.gov/show/nct03115047, 2017	Trial registration only. No data.
Nct,, Intravenous Dexmedetomidine for Treatment of Shivering During Cesarean Section Under Neuraxial Anesthesia, Https://clinicaltrials.gov/show/nct02384343, 2015	Trial registration only. No data.
Nct,, Evaluation of the Active Warming Effects on Maternal and Neonatal Outcome During Cesarean Delivery, Https://clinicaltrials.gov/show/nct03473470, 2018	Trial registration only. No data.
Onyekwulu, F. A., Agu, E. E., Amucheazi, A. O., Efficacy of intravenous tramadol in the control of shivering following spinal anaesthesia for caesarean section, Nigerian Postgraduate Medical Journal, 23, 116-20, 2016	Study from developing country (Nigeria).
Oshvandi, Khodayar, Hasan Shiri, Fatemeh, Safari, Mahmoud, Fazel, Mohamad Reza, Salavati, Mohsen, Hassan Tehrani, Tayebeh, Effect of Pre-warmed Intravenous Fluid Therapy on Prevention of Postoperative Shivering after Caesarean Section, Hayat, 17, 5-15, 2012	Full text only available in Arabic
Oshvandi, Khodayar, Shiri, Fatemeh Hasan, Fazel, Mohammad Reza, Safari, Mahmoud, Ravari, Ali, The effect of pre-warmed intravenous fluids on prevention of intraoperative hypothermia in cesarean section, Iranian journal of nursing and midwifery research, 19, 64-9, 2014	Study from developing country (Iran).

Study	Reason for Exclusion
Parsa, T., Dabir, S., Radpay, B., Efficacy of pethidine and buprenorphine for prevention and treatment of postanesthetic shivering, Tanaffos, 6, 54â□□58, 2007	Study from developing country (Iran).
Patel, M. D., Balachander, H., Bhat, R. R., Krishanappa, S., Nagappa, M., Intravenous vs intrathecal fentanyl in prevention of intraoperative shivering, Journal of Anaesthesiology Clinical Pharmacology, 26, 11-14, 2010	Study from developing country (India).
Pazuki, S., Kamali, A., Shahrokhi, N., Jamilian, M., Comparison of the effects of intrathecal midazolam and tramadol with the conventional method of postoperative pain and shivering control after elective cesarean section, Biomedical and pharmacology journal, 9, 995â□□1003, 2016	Study from developing country (Iran).
Ponte, J., Collett, B. J., Walmsley, A., Anaesthetic temperature and shivering in epidural anaesthesia, Acta Anaesthesiologica Scandinavica, 30, 584-7, 1986	Non-relevant intervention
Rastegarian, A., Ghobadifar, M. A., Kargar, H., Mosallanezhad, Z., Intrathecal meperidine plus lidocaine for prevention of shivering during cesarean section, The Korean journal of pain, 26, 379-86, 2013	Study from developing country (Iran).
Reidy, J., Preston, R., Douglas, J., Sherlock, R., Tyler, J., The effect of maternal warming during cesarean delivery on neonatal temperature, UNPUBLISHED MANUSCRIPT, 2008	Unavailable (unpublished manuscript)
Roth, Jonathan V., Hypothermia During Cesarean Delivery, Anesthesia and Analgesia, 126, 2151-2152, 2018	Letter to editor.
Roy, J. D., Girard, M., Drolet, P., Guay, J., Cesarean section: the effect of intrathecal meperidine on shivering, Canadian Journal of Anesthesia, 48, A4, 2001	Conference abstract.
Sachidananda, Roopa, Basavaraj, K., Shaikh, Safiya I., Umesh, G., Bhat, Triveni, Arpitha, B., Comparison of Prophylactic Intravenous Magnesium Sulfate with Tramadol for Postspinal Shivering in Elective Cesarean Section: A Placebo Controlled Randomized Double-blind Pilot Study, Anesthesia, essays and researches, 12, 130-134, 2018	Study from developing country (India)
Sadegh, Ali, Tazeh-Kand, Nasrin Faridi, Eslami, Bita, Intrathecal fentanyl for prevention of shivering in spinal anesthesia in cesarean section, Medical journal of the Islamic Republic of Iran, 26, 85-9, 2012	Study from developing country (Iran)
Shami, S., Nasseri, K., Shirmohammadi, M., Effect of low dose intrathechal meperidine on the incidence of shivering during cesarean section under spinal anesthesia; a randomized, placebo-controlled, double blind-clinical trial, Regional Anesthesia and Pain Medicine, Conference: 35th Annual European Society of Regional Anaesthesia and Pain Therapy Congress, ESRA 2016. Netherlands. Conference Start: 20160907. Conference End: 20160910. 41, e38, 2016	Conference abstract
Shami, S., Nasseri, K., Shirmohammadi, M., Sarshivi, F., Ghadami, N., Ghaderi, E., Pouladi, M., Barzanji, A., Effect of low dose of intrathecal pethidine on the incidence and intensity of shivering during cesarean section under spinal anesthesia: a randomized, placebo-controlled, double-blind clinical trial, Drug design, development & therapy, 10, 3005-3012, 2016	Study from developing country (Iran)
Sharkey, A., Gulden, R. H., Lipton, J. M., Giesecke, A. H., Effect of radiant heat on the metabolic cost of postoperative shivering, British Journal of Anaesthesia, 70, 449-50, 1993	Mixed population of women undergoing CS or tubal ligation.

Study	Reason for Exclusion
Siedentopf, J. P., Does surrounding temperature influence the rate of hypothermia during Caesarean section?, British Journal of Anaesthesia, 119, 838, 2017	Letter to the editor.
Sultan, P., Carvalho, B., Does the addition of active body warming to in-line intravenous fluid warming prevent maternal hypothermia during elective caesarean section? A randomised controlled trial, International Journal of Obstetric Anesthesia, 35, 115-116, 2018	Letter to the editor
Sultan, P., Habib, A. S., Cho, Y., Carvalho, B., The Effect of patient warming during Caesarean delivery on maternal and neonatal outcomes: a meta-analysis, British Journal of Anaesthesia, 115, 500-10, 2015	Systematic review: analyses cannot be used in entirety, included studies checked for inclusion
Sun, H. L., Ling, Q. D., Sun, W. Z., Wu, R. S. C., Wu, T. J., Wang, S. C., Chien, C. C., Lower limb wrapping prevents hypotension, but not hypothermia of shivering, after the introduction of epidural anesthesia for cesarean delivery, Anesthesia and Analgesia, 99, 241-244, 2004	Study from developing/non-OECD country
Sun, Y., Xu, Y., Wang, G. N., Comparative Evaluation of Intrathecal Bupivacaine Alone, Bupivacaine-fentanyl, and Bupivacaine-dexmedetomidine in Caesarean Section, Drug research, 65, 468â□□472, 2015	Study from developing/non-OECD country
Talakoub, R., Meshkati, ShN, Tramadol versus meperidine in the treatment of shivering during spinal anesthesia in cesarean section, Journal of research in medical sciences, 11, 151â□□155, 2006	Study from developing country (Turkey). Letter to the editor.
Techanivate, A., Rodanant, O., Tachawattanawisal, W., Somsiri, T., Intrathecal fentanyl for prevention of shivering in cesarean section, Journal of the Medical Association of Thailand, 88, 1214-21, 2005	Study from developing country (Thailand).
Tsai, Y. C., Chu, K. S., A comparison of tramadol, amitriptyline, and meperidine for postepidural anesthetic shivering in parturients, Anesthesia & Analgesia, 93, 1288-92, 2001	Study from developing/non-OECD country
Verma, A., Bhandari, D., Dhande, P., Jain, S., Tidke, S., Comparative evaluation of dexmedetomidine and tramadol for attenuation of post-spinal anaesthesia shivering, Journal of clinical and diagnostic research, 12, UC01â□□UC04, 2018	Study from developing country (India).
Woolnough, M. J., Newton, R. S., Walters, M., Chebbout, R., Active warming for elective caesarean section: a randomised controlled trial, International journal of obstetric anesthesia., 26, S10, 2016	Conference abstract
Xue, X., Lv, Y., Zhao, Y., Leng, Y., Zhang, Y., Efficacy of prophylactic epidural ketamine for reducing shivering in patients undergoing caesarean section with combined spinal-epidural anesthesia, Biomedical reports, 8, 485â□□490, 2018	Study from developing/non-OECD country
Zabetian, H., Jahromi, A. S., Karami, M. Y., Ghobadifar, M. A., Antishivering effect of low dose meperidine in caesarean section under spinal anesthesia: A randomized double-blind placebo-controlled trial, International Journal of Pharmacology, 9, 305-11, 2013	Study from developing country (Iran).
Zhang, J., Zhang, X., Wang, H., Zhou, H., Tian, T., Wu, A., Dexmedetomidine as a neuraxial adjuvant for prevention of perioperative shivering: Meta-analysis of randomized controlled trials, PLoS ONE, 12, e0183154, 2017	Systematic review. Five studies assessed C-section, all five assessed for inclusion

Economic studies

No economic evidence was identified for this review.

Appendix L – Research recommendations

Research recommendations for review question: What are the procedures to prevent and manage hypothermia and shivering in women having a caesarean birth in the pre-operative, peri-operative and post-operative periods?

No research recommendations were made for this review question.