

Non-pharmacological treatments for shivering post neuraxial anaesthesia for caesarean section: a scoping review

Karen Neaton, Lucie Voldanova, Tracey Kiely & Cate Nagle

To cite this article: Karen Neaton, Lucie Voldanova, Tracey Kiely & Cate Nagle (01 Feb 2024): Non-pharmacological treatments for shivering post neuraxial anaesthesia for caesarean section: a scoping review, Contemporary Nurse, DOI: [10.1080/10376178.2024.2310256](https://doi.org/10.1080/10376178.2024.2310256)

To link to this article: <https://doi.org/10.1080/10376178.2024.2310256>



© 2024 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 01 Feb 2024.



Submit your article to this journal [↗](#)



Article views: 5





View related articles [↗](#)



View Crossmark data [↗](#)

REVIEW ARTICLE

Non-pharmacological treatments for shivering post neuraxial anaesthesia for caesarean section: a scoping review

Karen Neaton ^{a,b}, Lucie Voldanova^c, Tracey Kiely^d and Cate Nagle ^{e,f,*}

^aAnaesthetic and Post Anaesthetic Care Unit, Gold Coast University Hospital, Southport; ^bPost Anaesthetic Care Unit, Royal Brisbane and Women's Hospital, Herston; ^cDepartment of Anaesthesia, Royal Brisbane and Women's Hospital, Herston; ^dLoxton Hospital Complex, Loxton; ^eCentre of Nursing and Midwifery Research, James Cook University, Townsville; ^fTownsville Hospital and Health Service, Townsville Institute of Clinical Research and Innovation, Townsville

(Received 21 August 2023; accepted 21 January 2024)

Background: Shivering occurs more frequently for women having caesarean section under neuraxial anaesthesia compared to other patient groups and causes an increase in pain and interrupts bonding with her newborn.

Aim: This study aimed to report the evidence on non-pharmacological methods to treat shivering, defined as uncontrollable shaking, because of being cold, frightened, or excited, post neuraxial anaesthesia; the use of local anaesthesia inserted around the nerves of the central nervous system such as spinal anaesthesia and epidural in women having a caesarean section.

Methods: A scoping review was conducted using six electronic health databases that were searched with no restrictions placed on language, date, or study type.

Findings: Of the 1399 studies identified, following screenings only one study was deemed suitable for inclusion. The study, a randomised controlled trial, compared forced air warming blankets (intervention) with the usual care of warmed cotton blankets (control) and its impact on maternal and newborn outcomes. The only statistically significant difference found was the perceived thermal comfort of the mother.

Discussion: Non-pharmacological treatments for shivering are underrepresented in the literature; only one study identified where the impact of active warming was compared to warmed cotton blankets (usual care) for the measures of: oral temperature; degree of shivering; and thermal comfort pain scores. There was a decline in temperature in both groups at odds with some women reporting feeling too warm such that they asked for the active warmer to be turned down.

Conclusion: Social engagement strategies are interventions that send a signal of safety to the nervous system leading to a sense of calm and wellbeing and have biological plausibility and warrant evaluation. Recommendations for further research: design a robust study to test the effectiveness of social engagement strategies on shivering for women having caesarean section under neuraxial anaesthesia.

Keywords: Shivering; caesarean section; anesthesia obstetrical; scoping review

*Corresponding author. Email: cate.nagle@jcu.edu.au

Impact statement

Women who shiver post-epidural for a Caesarean section may do so because of fear not hypothermia.

Summary of relevance

Problem or issue

Shivering continues to be problematic for women having caesarean section as it causes distress, an increase in pain, and interrupts bonding with their newborn.

What is already known

Globally, caesarean section rates are increasing. Despite a paucity of evidence that shivering post neuraxial anaesthesia is related to perceived hypothermia, shivering is mainly treated with warming measures with variable results.

What this paper adds

The findings of this review call into question the use of heating for shivering in women post caesarean section under neuraxial anaesthesia. There is a perception that shivering is not a biological response to hypothermia but instead one of fear. In this case, social engagement strategies could potentially be more effective than warming. The potential of social engagement strategies has biological plausibility and warrants evaluation.

Plain language summary

This study reviewed the evidence of non-pharmacological treatments for women who shiver after an epidural for birth by Caesarean section. Shivering causes an increase in pain to the woman and interrupts bonding with her newborn but is not always related to a low body temperature. We screened 1399 articles and found only one study. In this study, forced air-warming blankets were compared to the usual care of warmed cotton blankets and found this had no impact on shivering; interestingly while women with the air-warming blankets felt warmer, the temperature of women in both groups decreased. Authors note that warming treatments can have unwanted side effects and the woman's temperature should be checked before warming treatments are applied. The authors conclude that other reasons for shivering need to be studied and the science proposing fear as a cause is presented with a call for more research into non-pharmacological strategies to address shivering.

Introduction

Shivering, defined as shaking uncontrollably as a result of being cold, frightened, or excited (New Oxford American Dictionary, 2015), is associated with spinal anaesthetic in up to 56.7% of patients overall, but occurs in up to 85% of women having a caesarean section under spinal anaesthesia (Chung et al., 2012). There is a lack of understanding regarding the cause of this shivering (Ram Kiran & Sanginani, 2019) and, not surprisingly, there is diversity in clinical practices and management protocols. Shivering can cause discomfort, interfere with monitoring (Roy et al., 2004), increase pain, intraocular and intracranial pressures, oxygen

consumption, hypoxemia (Chung et al., 2012) and, in the obstetric setting, can disrupt holding, bonding, and breastfeeding the newborn (Ram Kiran & Sangineni, 2019).

One hypothesis for shivering amongst women giving birth by caesarean section is that the drive to protect their offspring heightens the woman's sense of danger when she perceives her denervation from the neuraxial block as paralysis. Payne et al. (Payne et al., 2015) state that when muscles are activated to enable rescue in a situation of perceived or actual danger or stress and the system does not return to homeostasis, it continues to secrete neuroendocrine hormones. The nervous system can override this activation by trembling, shaking, or shivering. Of interest, shivering and sweating have also been detected in labour (Panzer et al., 1999) and post-natally (Panzer et al., 1999; Ravid et al., 2001) in women birthing vaginally; the authors conclude it to be multifactorial in aetiology.

Multiple studies dating back decades have tested the effectiveness of various medications (Harris et al., 1989; Lamontagne et al., 2019); however, the potential side effects on mother and baby, and the potential unavailability of medications, have been deemed problematic (Khezri et al., 2018; Xue et al., 2018). Drugs such as narcotics, Clonidine, and Dexmedetomidine are used and can cause respiratory depression and sedation (Verma & Kumar, 2016). Non-pharmacological treatments of shivering are less well studied but would be clinically relevant if efficacy was demonstrated.

Warming strategies such as warmed blankets and forced air warming are the main types of non-pharmacological warming strategies (Wagner et al., 2006) used to treat shivering, even though shivering does not always correlate to feeling cold or hypothermic. Xue et al. (Xue et al., 2018) propose shivering is both thermogenic and non-thermogenic, therefore warming measures, outside patient thermal discomfort, should only be used to treat hypothermia. Patient thermal comfort is mentioned in the literature (Chung et al., 2012; de Bernardis et al., 2016; Gang et al., 2017; Horn et al., 2002; Sultan et al., 2015), and shivering is often rated in terms of discomfort as well as leading to multiple complications such as interference with monitoring, increased pain, increased intraocular and intracranial pressure, increased oxygen consumption, hypoxemia, disruption to holding, bonding, and breastfeeding the newborn (Ram Kiran & Sangineni, 2019; Roy et al., 2004).

In the main author's workplace, thumb sucking has been observed to be effective in controlling shivering in the peri-operative environment for women having caesarean section under neuraxial anaesthesia. It was thought to act as a focus away from the shivering, thereby causing some relief. However, only one study (Ferrante, 2015) has been found incorporating adult participants and none for the obstetric population. Thumb sucking was studied in Italy where researchers performed a randomised controlled trial (RCT) of 40 participants between 5 and 25 years of age. The study found that thumb-sucking stimulated the nasal-palatal receptor of the trigemini, releasing physical and psychological tension (Falco, 2017; Ferrante, 2015). Releasing tension is important to maintaining homeostasis and a sense of comfort in the body (Critchley, 2005). Afferent information from the body is essential for the regulation of bodily functions and overall physiological integrity. Muscles of mastication are part of the special visceral efferent pathways for sending a message of safety by bringing physiological changes to the body, perhaps from old emotional associations with being pacified while feeding/suckling (Dana & Porges, 2018; Porges, 2021). Although this strategy worked to mitigate shivering, it interfered with nursing the baby and some mothers felt self-conscious about thumb sucking.

With a global increase in caesarean section rates (World Health Organization, 2022), the issue of shivering post neuraxial anaesthesia, the use of local anaesthesia inserted around the nerves of the central nervous system such as spinal anaesthesia and epidural anaesthesia, remains a frequently observed phenomenon in clinical nursing and midwifery practice and is

poorly understood. It is important to review and summarise the evidence on the effective treatments for shivering which have minimal side effects, are globally effective, cost-efficient, and sustainable. The primary aim of this study is to describe, collate and synthesise the evidence on non-pharmacological treatments for shivering post neuraxial anaesthesia in women having a caesarean section.

Methods

A scoping review of the literature using the Arksey and O'Malley framework (Arksey & O'Malley, 2005), with enhancements from Levac and colleagues (Levac et al., 2010) was conducted. The following steps were undertaken: development of a research question; selecting search terms; identifying databases; performing the search; identifying relevant studies; study selection; charting the data; and reporting the findings. While scoping reviews do not synthesise evidence, the Arksey and O'Malley's framework (Arksey & O'Malley, 2005) guides the gathering of studies (collation) to allow a description of characteristics and charting of data (tabulation) to identify evidence gaps and provide a comprehensive review of the evidence.

Selection criteria: Peer reviewed articles up to 29th September 2021 were included. There was no restriction placed on language, date, or study type. Included studies were to be specific to non-pharmacological treatments for shivering post neuraxial anaesthesia in women having caesarean section. Articles were excluded where full text was unavailable; theoretical papers, reviews, and trial protocols were also excluded.

An electronic search was conducted in: Medline (Ovid); CINAHL (Ovid); Cochrane (Clinical Trials); Embase; Emcare; and Scopus databases. Keywords included: shivering; epidural anesthesia, spinal anesthesia, obstetric anesthesia, anesthetic recovery, anaesthesia; epidural; spinal; obstetric*; anaesthe*; postanaesthe*; neuraxial; caesarean section; caesarean*; cesarean, c-section; abdominal delivery; abdominal deliveries and combined with the use of Boolean operators AND and OR. In addition to searches of databases, the reference lists of included studies and reviews were conducted to identify relevant studies.

The search results from databases were merged, and duplicates were removed using a reference management software (EndnoteX20). Articles were screened by title and abstract and then screened by full text read independently by two authors (KN and TK). All eligible studies and those classified as requiring more information were independently reviewed in full text by the same two reviewers who screened them for inclusion, with a third reviewer (LV) available to achieve consensus as required.

Data extraction: As detailed in the PRISMA flow diagram (Figure 1) of the 1399 articles identified, 612 were unique, following title and abstract screening, 19 articles underwent a full-text screen and 18 articles were excluded with reasons provided. One study was included in this scoping review. Despite a lack of restrictions on the language of publication, no publications were identified.

The data extraction table identified the following variables: study location; setting; study type; treatment; study size; the instrument/interventions used; participant characteristics; anaesthetic type; key findings; limitations; and gaps identified. These variables were also summarised in narrative form.

Results

An overview of the article included in this review can be found in the data extraction table (Table 1). The study was published in 2006 and involved a total of 62 participants. All participants were women giving birth via caesarean section, 18 years or older from Canada. The study

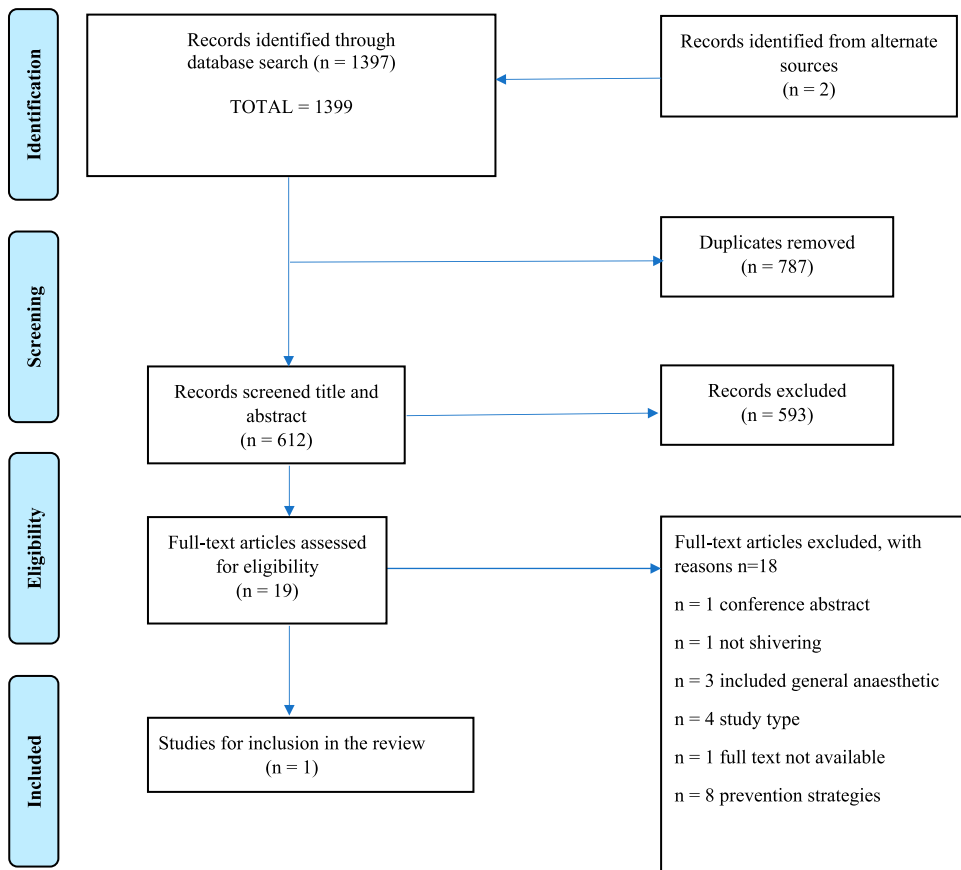


Figure 1. PRISMA Flow Diagram. *From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: [10.1136/bmj.n71](https://doi.org/10.1136/bmj.n71)

was an RCT that aimed to compare two methods of maternal warming, the active warming compared to the control, warmed cotton blankets that served as a proxy for usual care during caesarean delivery under spinal anaesthesia on maternal and newborn outcomes. A baseline of data and then records were made at 15-minute intervals until participants left the operating theatre. Data sets were oral temperature, degree of shivering, thermal comfort, and pain scores. The decline in temperature in both groups was a surprise result for the authors. Especially, considering some women reported feeling too warm that they asked for the active warmer to be turned down. The authors suggested that active warming of the lower part of the body be studied noting the vasodilation effects of the spinal anaesthetic. The study excluded women who were deemed at high risk of complications, which included those taking any medication other than vitamins.

Findings

Shivering was not the primary outcome studied and the standard 4-point shivering scale was abandoned during the study to simply report 'yes' or 'no'. Shivering occurred equally between the active warming and the control group and did not correlate to the significant

Table 1. Characteristics of the Included Study.

First Author (Year Published)	Location and setting	Study type	Treatment	Number of participants	Outcomes measured	Participant characteristics	Anaesthetic type	Key findings	Study limitations	Gaps identified
Fallis (2006)	Canada; Two acute care hospitals	RCT	Either forced air warming blanket or warmed cotton blanket	62 women and 62 newborns	Oral temperature, degree of shivering, Thermal comfort pain scores	Low risk pregnant women, ≥ 18 years, ≥ 37 weeks gestation, elective surgery	Spinal	No difference in temperature No difference in shivering Significant difference in thermal comfort No significant difference in pain scores	No blinding to the interventions Limited data for procedures over one hour Results are only generalisable to women undergoing caesarean delivery under spinal anaesthesia	How many cotton blankets used was not clearly reported Standard 4-point shivering tool abandoned during the study Not clear how the researchers saw the presence of shivering under the blankets Reporting of costs is outdated

decline in temperature of the women in both groups. A further point was made that perceived hypothermia remains commonplace in this cohort simply because the temperature is rarely monitored under the condition of women who are awake following caesarean section.

The study asked women for their views on thermal comfort and the actively warmed women sometimes asked for the temperature to be turned down ($n = 14$). No comment was made to indicate the correlation between thermal comfort and shivering. The study did not report any correlation between pain and shivering.

Discussion

Cotton blankets and active warming are the predominant methods to treat shivering in the peri-operative environment. However, blankets and active warming are mostly used as prevention rather than treatments for shivering (Chung et al., 2012; de Bernardis et al., 2016; Horn et al., 2002; Kiran & Sangineni, 2019; Kiran & Sangineni, 2019). It is easy to understand how this has occurred, given the operating theatre is a cold environment. Women and their caregivers could assume that feeling cold, or being hypothermic, was behind the shivering response. These assumptions occur despite the fact that pregnancy hormones are known to increase the basal body temperature (Steward & Raja, 2020) and circulating blood volume (Sanghavi & Rutherford, 2014; Sanghavi & Rutherford, 2014) leaving some women feeling excessively warm (Iftikhar, 2020; Iftikhar, 2023). Additionally, shivering is observed in normothermic and hyperthermic women and was deemed unrelated to core temperature (Panzer et al., 1999).

An accepted definition of shivering is absent from many studies. On one occasion it was referred to as 'peri-operative shivering-like tremor' (Horn et al., 2002) demarcating it from 'everyday' shivering, a response to feeling cold. Furthermore, some studies declare that the exact etiology of shivering is unknown (Gang et al., 2017; Horn et al., 2002). This reiterates the importance of using a standard definition for terms at the outset of studies (Arksey & O'Malley, 2005). Active warming blankets are made of paper and hot air is blown into them via a wide bore hose from a machine, and the warm air inflates the blanket making it bulky and noisy and generating air flow known to interfere with a sterile field (Watkins et al., 2023). This was the treatment studied, and it can complicate changing a woman's position and make insertion of the neuraxial block difficult, especially to and from the sitting position (de Bernardis et al., 2016). Additionally, nursing and midwifery care of the woman is often hindered by the blankets. There can be difficulty accessing monitoring and intravenous lines, bed transfers, and mother/infant bonding due to the weight of the blanket/s (Ram Kiran & Sangineni, 2019; Roy et al., 2004). Blankets also pose a cost to the organisation and environment. The cost of warming interventions was addressed in the study but is now outdated and the environmental costs were disregarded. Today, economic, and environmental considerations are vital.

In the lead author's workplace, thumb sucking has been recommended by nurses, midwives, and anaesthetists to eliminate shivering. Anecdotally it has been established as a treatment for at least 15 years. The origins of thumb sucking as a treatment for shivering are unknown but thought to be used over the years in the birth suite. No evidence to underpin the thumb-sucking practice was identified by this review.

A fear response in the body signals to the brain that a flight/fight action is imminent and necessary (Critchley, 2005). Porges (Porges, 2015) describes a neural-hierarchy of mechanisms to protect life which explains, when mammals are restrained, either physically or chemically, the nervous system reads this as life-threatening. In certain situations, the autonomic nervous system is not successful in activating muscular activity when a threat is detected (Payne et al., 2015). In this case, the system continues to secrete neuroendocrine hormones to achieve mobilisation.

Shivering is an attempt to metabolise the excess activation of hormones and return the body to normal functioning.

There are clear guidelines for clinical nursing and midwifery practice for chemical and physical restraints, but it is a new consideration for nurses and midwives to understand that the neuraxial block could be somatically perceived as a restraint. Porges and Peper (Porges & Peper, 2015), further explain this mechanism occurring through neuroception, which is the body's attempt at determining threats outside conscious awareness. These responses to perceived danger are reactive and occur unconsciously to ensure they are acted on instantaneously, as compared to conscious processing which can take seconds longer (ten Have-de Labije, 2006). Given this physiological explanation, the fear of paralysis caused by neuraxial anaesthesia could theoretically trigger a physiological response, causing the nervous system to override the fight/flight response and attempt to normalise the underlying biology by shivering (Critchley, 2005; Payne et al., 2015). Porges highlights that the safety definition is confusing. He said the social, cultural, and legal definitions and expectations of safety and risk have little to do with how our nervous system reacts (Dana & Porges, 2018; Porges, 2021).

Nurses and midwives understand the purpose and principles of building rapport. However, healthcare workers often underestimate the principle of interaction and feedback operating in neurobiological systems (ten Have-de Labije, 2006). When tension from anxiety rises high and is sustained, a discharge of the tension can manifest in a trembling response (ten Have-de Labije, 2006). Moreover, a survey of women having caesarean section with neuraxial anaesthesia placed paralysis as the primary fear expressed (Carvalho et al., 2005). The body does not understand or read the situation as any less dangerous even though the paralysis is temporary, as the body's feedback mechanisms are operating on a moment-to-moment basis.

An area where fear and anxiety have been overtly linked to the environment and relationship with the service provider is self-reported injection phobia amongst individuals with tattoos and piercings. In this study, the level of control that the participants perceived they had and the attitudes of the healthcare professionals were considered to impact the intensity of fear (Bolme et al., 2021, Bolme et al., 2021). Nurses and midwives can influence the intensity of fear in their patients because they oversee each care touchpoint.

In a study of patients with necrotising fasciitis, a potentially life-threatening condition, they described shivering despite being warm (Erichsen Andersson et al., 2018). This life-threat connection is likely understood at a cellular level, as the patient's conscious ability to notice their internal state is often overestimated (ten Have-de Labije, 2006). In contrast, Arkema described shivering as the main thing he remembered long after a traumatic event, saying his body quivered in fear before his mind could get there (Arkema, 2017).

One of the early phases of shivering, piloerection, acts to either trap air to retain heat or cause an animal to enlarge to become more intimidating, to scare off predators, or to attract a mate (Benedek & Kaernbach, 2011). In the animal world, it has also been linked to the emotional response of a mother who hears the call of her separated offspring (Benedek & Kaernbach, 2011). In unfamiliar situations, piloerection is more likely to occur in women than men (Benedek & Kaernbach, 2011). The link between piloerection and the subsequent phases of shivering and fear, in the context of neuraxial anaesthesia, seems to have been overlooked in the medical field and nurses and midwives are well placed in the care environment to assess the onset of this first stage of the shivering response. Checking a woman's temperature is paramount so reflexive warming does not occur, putting the woman and her baby into a higher risk category requiring further treatments (Mercier & Benhamou, 1997). When a mother is normothermic, heating her could lead to maternal and neonatal hyperthermia. Neonatal hyperthermia may raise the suspicion of infection and result in interventions to protect the baby from potential infection such as cannulation and giving the baby prophylactic antibiotics. This sequelae often leads to separating mother and baby.

There are other mechanisms that produce shivering described in the literature in the context of neuraxial anaesthesia. These mechanisms are the redistribution of heat from the core to the periphery, loss of thermoregulatory vasoconstriction below the level of the block, and a decreased thermoregulatory shivering threshold (Chung et al., 2012). Interestingly, these explanations fall short of explaining why the incidence of shivering is higher for women having caesarean section. In the absence of hypothermia, which requires active warming, there are strategies aimed at sending a signal of safety to the nervous system which have been observed in the author's clinical experience to allay shivering. Payne et al. (Payne et al., 2015) and Porges (Porges, 2015), call them social engagement strategies.

Social engagement strategies include a warm expression on the face, eye contact, a calm and prosodic voice, proximity to the patient, and reassuring touch (Porges, 2003, 2015). Additionally, these strategies work across all demographics to signal safety (Porges, 2015), do not add burden to the healthcare budget, and would likely add value to the woman's experience. The allure of these strategies is that they can be nurse and midwife initiated and they do not need to wait for a prescription to be written or a colleague to check a medication. Therefore, they are time and resource efficient. A systematic review reported patients to have a desire for an emotional connection with their anaesthesia providers (Falco, 2017). Nurses and midwives use these emotional connections to facilitate the therapeutic relationship and it is important that these connections are acknowledged, continued, and protected over the woman's journey.

Limitations and strengths: A limitation inherent to scoping reviews is that they do not seek to establish the quality of included studies; this limits both the generalisability and robustness of the findings (Ferrante, 2015). Another limitation of this study was that we made no differentiation between spinal and epidural approaches despite knowing there were documented differences in the incidence and effectiveness of treatments for shivering. However, since only a single study was found, it is not likely to impact the results. The lack of restriction of included studies by language, year of publication, and study design means that this scoping study presents a comprehensive report of the published, peer-reviewed evidence on this topic.

Impact paragraph

There is a lack of understanding regarding the increased incidence of shivering for women in this cohort and there is a diversity of clinical practices and management protocols. The authors highlight that fear is a common cause for shivering that is not mentioned in the literature in this context and incorporate contemporary knowledge of the nervous system to explain how the body experiences and manages dangerous and life-threatening situations at a biological level. From this perspective, the findings of this review call into question some of the existing treatments for shivering and open the discussion up to the potential for the use of social engagement strategies which are already proving effective in the fields of trauma therapy, neurology, paediatrics, biofeedback, and psychotherapy.

Conclusion

There is a paucity of non-pharmacological treatments for shivering. The only current, universally accepted, non-pharmacological treatment for shivering, based on this review and the author's clinical practice is warmed cotton blankets or active warming. This review is important because it veers the discussion in a fresh direction; away from managing hypothermia and towards managing unconscious fear. The mechanisms describing shivering as a response to the lack of safety at a biological level are available in the literature representing patients in the psychological field but not the medical field, more specifically, the peri-operative

environment. It is important to source interventions that are safe, effective, economical, and sustainable. Social engagement strategies open the opportunity to mitigate shivering and improve the patient experience.

Practice Recommendations: Nurses and midwives are encouraged to not presume that shivering post neuraxial anaesthesia for women having caesarean section is due to hypothermia and ask the woman if she is feeling cold and check her temperature to assess temperature status.

Research Recommendations: Robust methods including RCTs to inform practice. Evaluation of the effectiveness of social engagement strategies on shivering for women having caesarean section with neuraxial anaesthesia is needed.

Funding

The authors reported there is no funding associated with the work featured in this article.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Karen Neaton  <http://orcid.org/0000-0002-4712-5412>

Cate Nagle  <http://orcid.org/0000-0002-5661-6379>

References

- Arkema, C. E. (2017). Knees shaking uncontrollably. *Journal of Religion and Health.*, 56(1), 74–76. <https://doi.org/10.1007/s10943-015-0097-3>
- Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology*, 8(1), 19–32. <https://doi.org/10.1080/1364557032000119616>
- Benedek, M., & Kaernbach, C. (2011). Physiological correlates and emotional specificity of human piloerection. *Biological Psychology*, 86(3), 320–329. <https://doi.org/10.1016/j.biopsycho.2010.12.012>
- Bolme, J., Staniszewski, K., & Pedersen, T. (2021). Self-reported dental anxiety and injection phobia among individuals with tattoos and piercings. *Journal of Oral Science*, 63(4), 352–354. <https://doi.org/10.2334/josnusd.21-0136>
- Carvalho, B., Cohen, S. E., Lipman, S. S., Fuller, A., Mathusamy, A. D., & Macario, A. (2005). Patient preferences for anesthesia outcomes associated with cesarean delivery. *Anesthesia & Analgesia*, 101(4), 1182–1187. <https://doi.org/10.1213/01.ane.0000167774.36833.99>
- Chung, S. H., Lee, B. S., Yang, H. J., Kweon, K. S., Kim, H. H., Song, J., & Shin, D. W. (2012). Effect of preoperative warming during cesarean section under spinal anesthesia. *Korean Journal of Anesthesiology*, 62(5), 454–460. <https://doi.org/10.4097/kjae.2012.62.5.454>
- Critchley, H. D. (2005). Neural mechanisms of autonomic, affective, and cognitive integration. *Journal of Comparative Neurology*, 493(1), 154–166. <https://doi.org/10.1002/cne.20749>
- Dana, D., & Porges, S. (2018). *Polyvagal theory in therapy: Engaging the rhythm of regulation*. WW Norton.
- de Bernardis, R. C. G., Siaulys, M. M., Vieira, J. E., & Mathias, L. A. S. T. (2016). Perioperative warming with a thermal gown prevents maternal temperature loss during elective cesarean section. A randomized clinical trial. *Brazilian Journal of Anesthesiology*, 66(5), 451–455. <https://doi.org/10.1016/j.bjane.2014.12.007>
- Erichsen Andersson, A., Egerod, I., Knudsen, V. E., & Fagerdahl, A. M. (2018). Signs, symptoms and diagnosis of necrotizing fasciitis experienced by survivors and family: A qualitative nordic multi-center study. *BMC Infectious Diseases*, 18(1), 429. <https://doi.org/10.1186/s12879-018-3355-7>
- Falco, D. (2017). Patient satisfaction With anesthesia care what Do We know? *AANA Journal*, 85(4), 286–292.
- Ferrante, A. (2015). Finger or thumb sucking. New interpretations and therapeutic implications. *Minerva Pediatrica*, 67(4), 285–297.

- Gang, S., Zhengyuan, S., & Chunnan, J. (2017). The effectiveness of active warming for women undergoing elective caesarean section on maternal shivering: A meta-analysis. *Biomedical Research*, 28(20), 8728–8730.
- Harris, M. M., Lawson, D., Cooper, M. C., & Ellis, J. (1989). Treatment of shivering after epidural lidocaine. *Regional Anesthesia and Pain Medicine*, 14(1), 13–18.
- Horn, E. P., Schroeder, F., Gottschalk, A., Sessler, D. I., Hiltmeyer, N., Standl, T., & Schulte Esch, J. (2002). Active warming during cesarean delivery. Clinical trial; journal article; randomized controlled trial; research support, Non-U.S. Gov't; research support, U.S. Gov't. *Anesthesia & Analgesia*, 94(2), 409–414. <https://doi.org/10.1097/00000539-200202000-00034>
- Ifitikhar, N. (2020). Pregnancy and All Things Heat-Related (You, the Weather, Your Bath Water, and More). Retrieved December 20, 2020, from <https://www.healthline.com/health/pregnancy/hot-pregnant#research>
- Ifitikhar, N. (2023). Pregnancy and All Things Heat-Related (You, the Weather, Your Bath Water, and More) Retrieved December 9, 2023, from Healthline. <https://www.healthline.com/health/pregnancy/hot-pregnant>
- Khezri, M. B., Mosallaei, M. A.-S., Ebtehaj, M., & Mohammadi, N. (2018). 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(2), 151–157. <https://doi.org/10.22088/cjim.9.2.151>
- Kiran, K. S., & Sangineni, K. (2019). The effect of forced-air warmer, ondansetron or their combination on shivering in pregnant women coming for elective cesarean section under spinal anesthesia: A prospective. *Randomized Controlled Comparative Study. Anesth Essays Res.*, 13(1), 19–24. https://doi.org/10.4103/aer.AER_198_18
- Lamontagne, C., Lesage, S., Villeneuve, E., Lidzborski, E., Derstenfeld, A., & Crochetière, C. (2019). Intravenous dexmedetomidine for the treatment of shivering during cesarean delivery under neuraxial anesthesia: A randomized-controlled trial. *Canadian Journal of Anesthesia/Journal canadien d'anesthésie*, 66(7), 762–771. <https://doi.org/10.1007/s12630-019-01354-3>
- Levac, D., Colquhoun, H., & O'Brien, K. K. (2010). Scoping studies: Advancing the methodology. *Implementation science: IS*, 5(1), 69–69. <https://doi.org/10.1186/1748-5908-5-69>
- Mercier, F., & Benhamou, D. (1997). Hyperthermia related to epidural analgesia during labor. *International Journal of Obstetric Anesthesia*, 6(1), 19–24. [https://doi.org/10.1016/S0959-289X\(97\)80047-7](https://doi.org/10.1016/S0959-289X(97)80047-7)
- New Oxford American Dictionary. 2015. Shivering. Retrieved September 29, 2022, from https://www.oxfordlearnersdictionaries.com/definition/english/shiver_1?q=shivering
- Panzer, O., Ghazanfari, N., Sessler, D. I., Yucel, Y., Greher, M., Akca, O., Donner, A., Germann, P., & Kurz, A. (1999). Shivering and shivering-like tremor during labor with and without epidural analgesia. *Anesthesiology: The Journal of the American Society of Anesthesiologists*, 90(6), 1609–1616. <https://pubs.asahq.org/anesthesiology/article/90/6/1609/38060/Shivering-and-Shivering-like-Tremor-during-Labor>
- Payne, P., Levine, P. A., & Crane-Godreau, M. A. (2015). Somatic experiencing: Using interoception and proprioception as core elements of trauma therapy. *Frontiers in Psychology*, 6, 93–93. <https://doi.org/10.3389/fpsyg.2015.00093>
- Porges, S. (2021). Keynote Speaker. presented at: The Many Voices of Polyvagal Theory; 5th November, 2021 2021; Online. Session One. Retrieved November 6, 2021.
- Porges, S. W. (2003). Social engagement and attachment: A phylogenetic perspective. *Annals of the New York Academy of Sciences*, 1008(1), 31–47. <https://doi.org/10.1196/annals.1301.004>
- Porges, S. W. (2015). Making the world safe for our children: Down-regulating defence and Up-regulating social engagement to 'optimise' the human experience. *Children Australia.*, 40(2), 114–123. <https://doi.org/10.1017/cha.2015.12>
- Porges, S. W., & Peper, E. (2015). When Not saying NO does not mean yes: Psychophysiological factors involved in date rape. *Biofeedback*, 43(1), 45–48. <https://doi.org/10.5298/1081-5937-43.1.01>
- Ravid, D., Gidoni, Y., Bruchim, I., Shapira, H., & Fejgin, M. (2001). Postpartum chills phenomenon: Is it a feto-maternal transfusion reaction? *Acta Obstetrica et Gynecologica Scandinavica*, 80(2), 149–151. <https://doi.org/10.1034/j.1600-0412.2001.080002149.x>
- Roy, J.-D., Girard, M., & Drolet, P. (2004). Intrathecal meperidine decreases shivering during cesarean delivery under spinal anesthesia. *Anesthesia & Analgesia*, 98(1), 230–234. <https://doi.org/10.1213/01.ANE.0000093251.42341.74>
- Sanghavi, M., & Rutherford, J. (2014). Cardiovascular physiology of pregnancy. *Circulation*, 130(12), 1003–1008. <https://doi.org/10.1161/CIRCULATIONAHA.114.009029>

- Steward, K., & Raja, A. (2020). Physiology, Ovulation And Basal Body Temperature. Retrieved December 20, 2020 from <https://www.ncbi.nlm.nih.gov/books/NBK546686/>
- Sultan, P., Habib, A. S., Cho, Y., & Carvalho, B. (2015). The effect of patient warming during caesarean delivery on maternal and neonatal outcomes: A meta-analysis. *BJA: The British Journal of Anaesthesia*, 115(4), 500–510. <https://doi.org/10.1093/bja/aev325>
- ten Have-de Labije, J. (2006). When patients enter with anxiety on the forefront. *Ad Hoc Bulletin of Short-Term Dynamic Psychotherapy*, 10, 36–69.
- Verma, N. K., & Kumar, M. (2016). Comparison of clonidine, dexmedetomidine and tramadol for control of post spinal shivering: A randomized double blind clinical study. *International Journal of Life-Sciences Scientific Research*, 2, 658–664. <https://doi.org/10.21276/IJLSSR.2016.2.6.3>
- Wagner, D., Byrne, M., & Kolcaba, K. (2006). Effects of comfort warming on preoperative patients. *AORN Journal*, 84(3), 427–448. [https://doi.org/10.1016/s0001-2092\(06\)63920-3](https://doi.org/10.1016/s0001-2092(06)63920-3)
- Watkins, W., Jaffe, R., & Brock-Utne, J. (2023). Bair hugger: A potential enemy within the operating room. *Infection Control & Hospital Epidemiology*, 44(1), 164–166. <https://doi.org/10.1017/ice.2022.98>
- World Health Organization. (2022). WHO statement on caesarean section rates. World Health Organization. Retrieved September 29, 2022 from <https://www.who.int/news-room/questions-and-answers/item/who-statement-on-caesarean-section-rates-frequently-asked-questions#:~:text=The%20work%20conducted%20by%20WHO,maternal%20and%20newborn%20mortality%20rates>
- Xue, X., Lv, Y., Zhao, Y., Leng, Y., & Zhang, Y. (2018). Efficacy of prophylactic epidural ketamine for reducing shivering in patients undergoing caesarean section with combined spinal-epidural anesthesia. *Biomedical Reports*, 8(5), 485–490. <https://doi.org/10.3892/br.2018.1072>