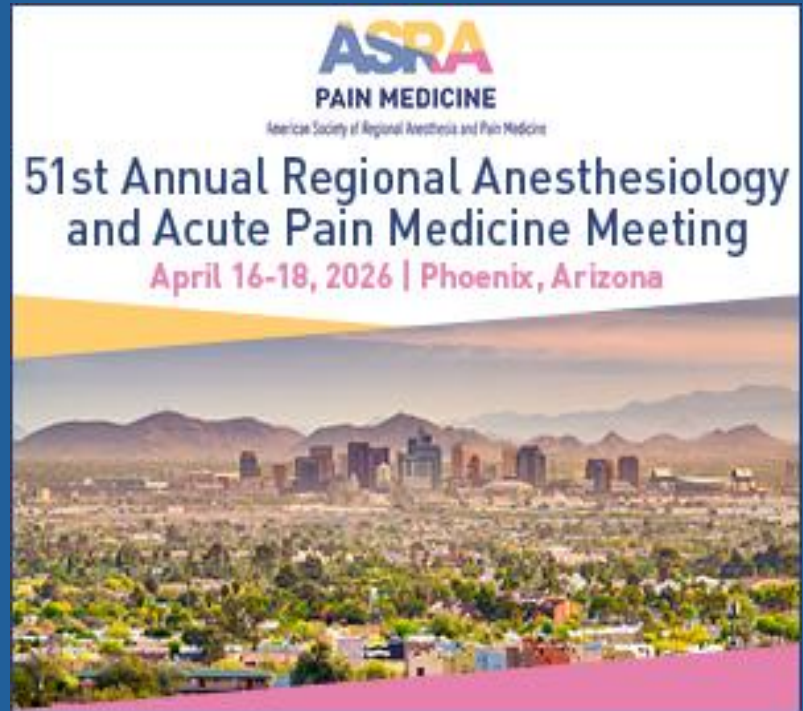


Effect of Warmed Local Anesthetics for Regional Anesthesia on Onset Time and Duration: A Meta-Analysis

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INTRODUCTION

- Experimental data suggest that **increasing local anesthetic temperature may enhance nerve membrane permeability and accelerate drug diffusion**, potentially influencing block characteristics.
- Clinical evidence remains inconsistent across peripheral and neuraxial techniques, with unclear effects on sensory and motor blockade.

MATERIALS & METHODS

- We conducted a **meta-analysis to evaluate whether warming local anesthetics affects the duration of sensory and motor blockade compared with room-temperature solutions**.
- Protocol registered prior to data collection in accordance with PRISMA 2020 (OSF: 10.17605/OSF.IO/4QTRN).
- Two independent reviewers performed study selection and full-text review; discrepancies resolved by consensus (Figure 1)
- Primary outcome: sensory and motor block onset time.**

RESULTS

- Thirty-four studies met inclusion criteria (**32 randomized controlled trials, 2 comparative studies**) out of 850 records identified. Statistical heterogeneity was substantial ($I^2 > 75\%$).
- Warmed local anesthetics** were associated with **faster sensory onset (MD ≈ -241 s; 11 studies) and motor onset (MD ≈ -288 s; 9 studies)**, with the greatest effect observed in peripheral nerve blocks using bupivacaine and ropivacaine; neuraxial techniques showed smaller and less consistent effects.
- Postoperative pain scores and opioid consumption** were modestly reduced in warmed groups, with several studies **demonstrating lower VAS scores and decreased 24-hour analgesic requirements**.
- Despite significant heterogeneity, **safety outcomes were comparable** across groups.

Figure 1. PRISMA flow diagram of screening process

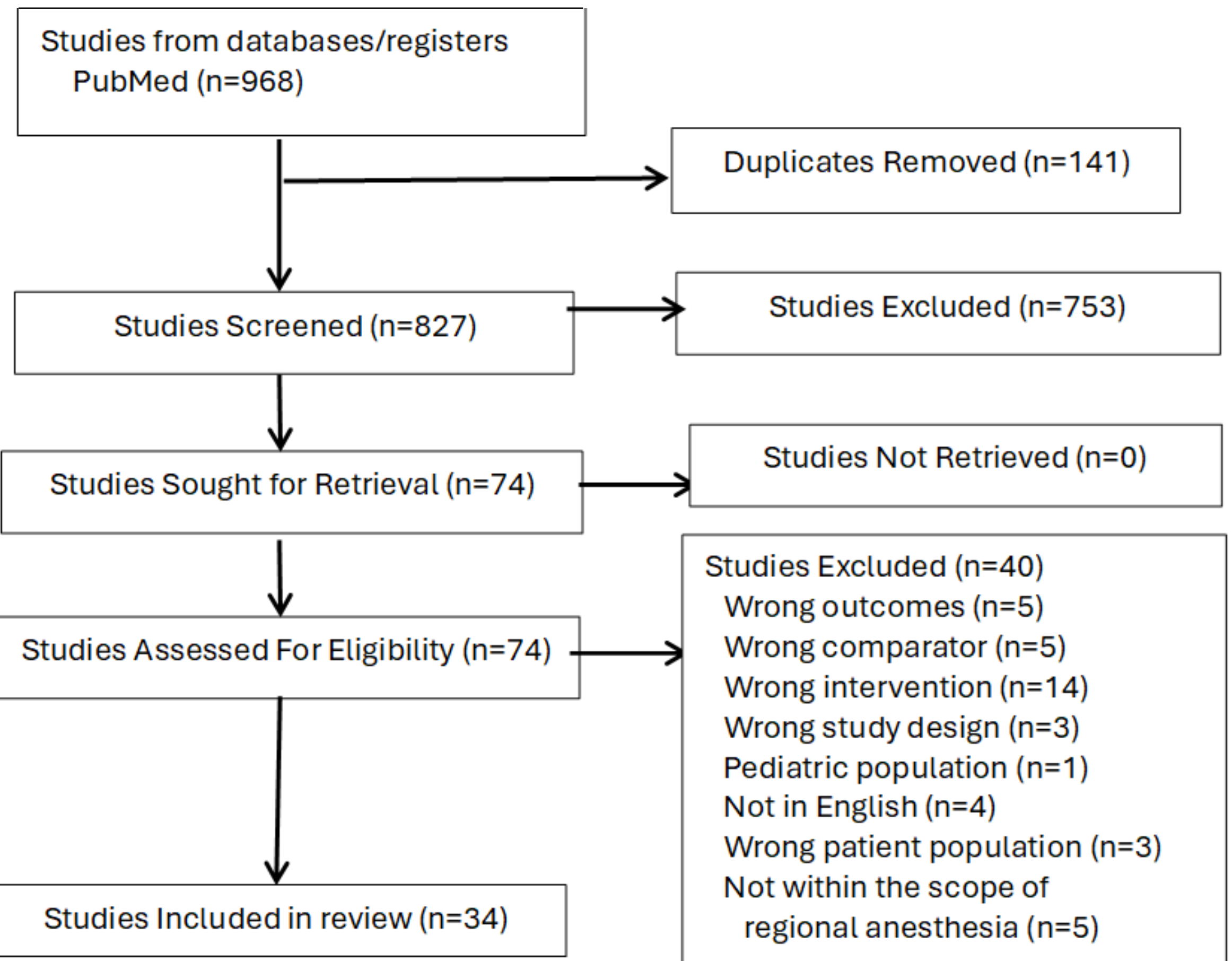


Figure 2. Mean Difference Sensory Block Onset Time

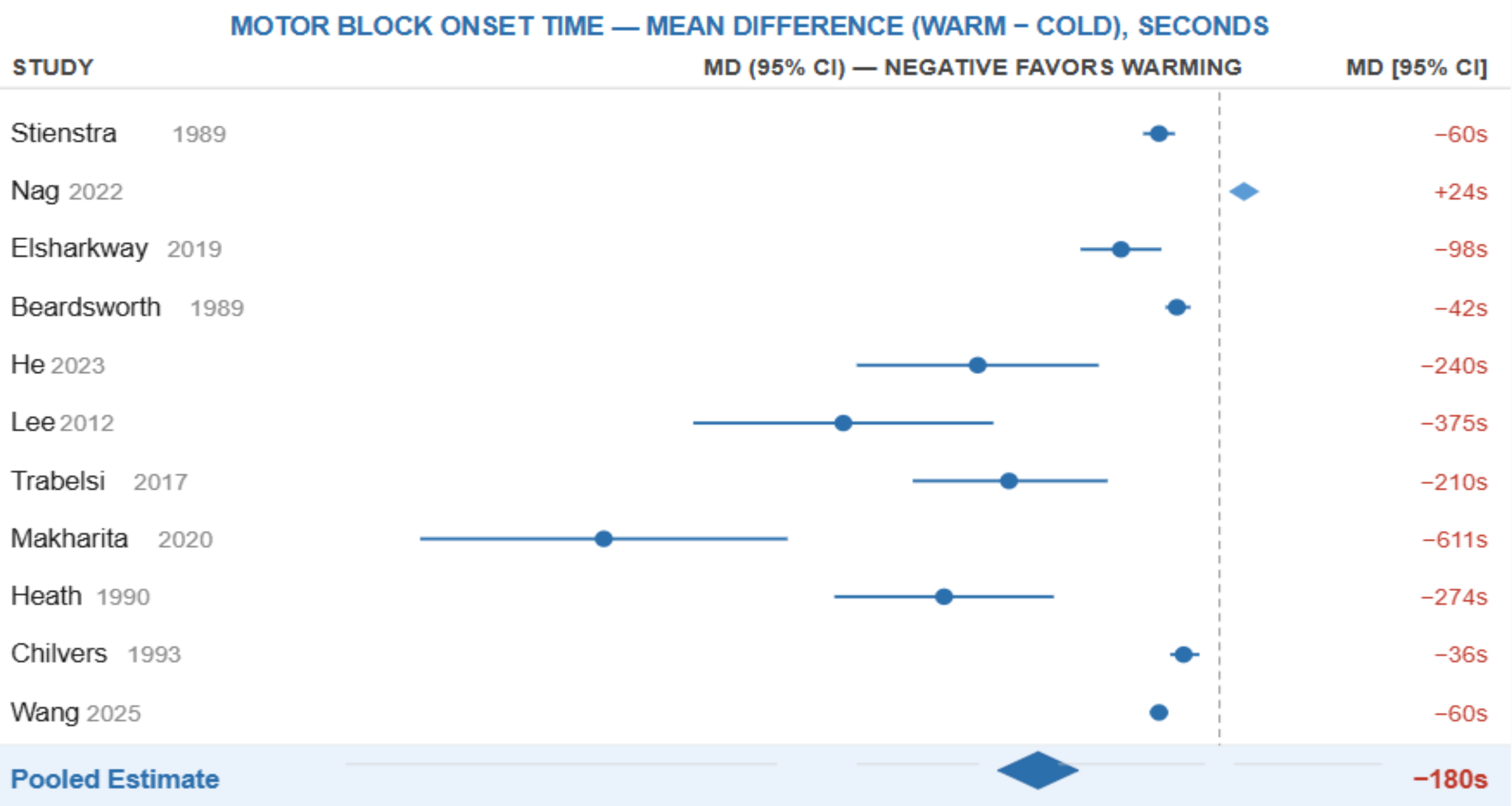
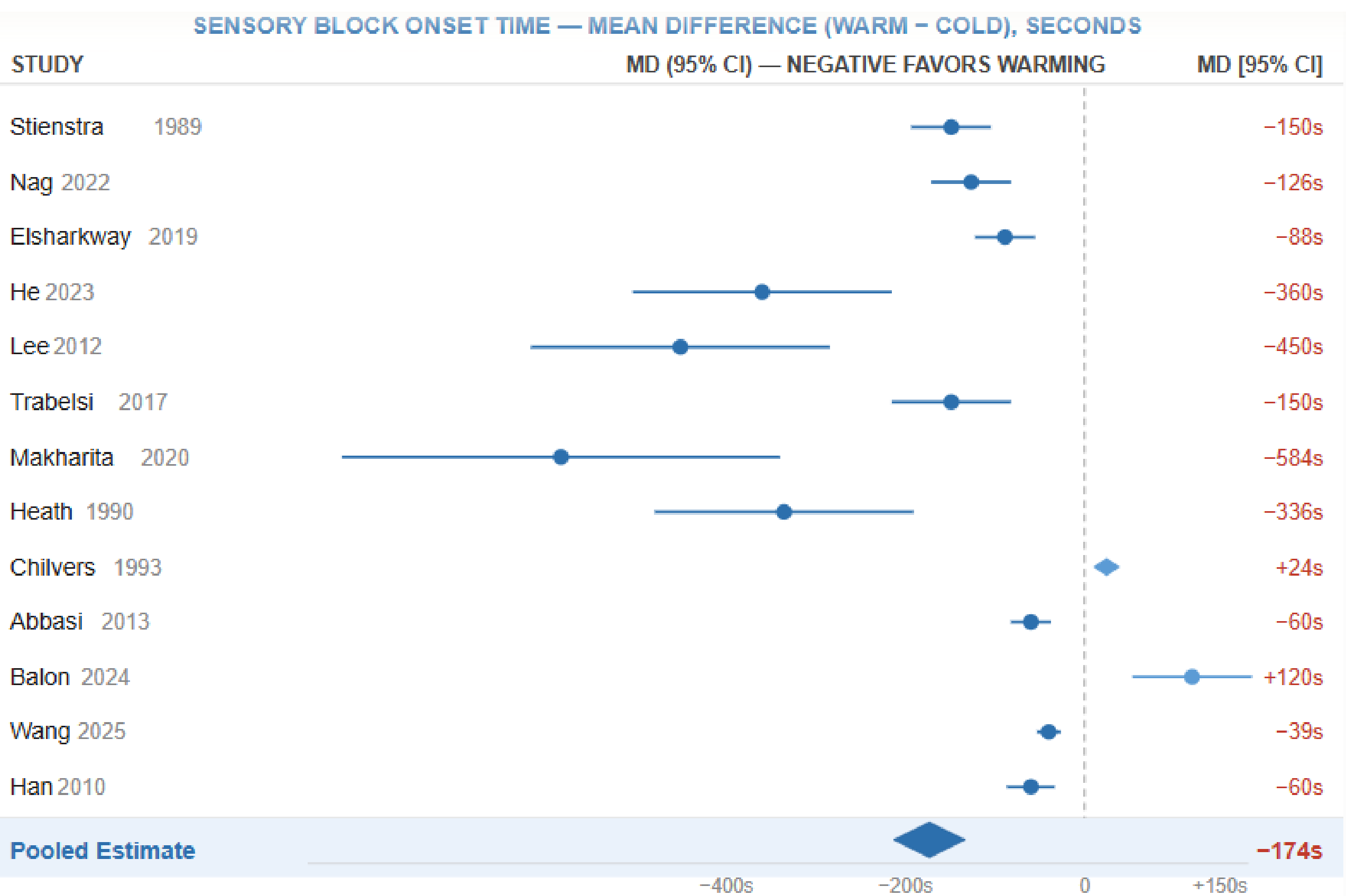


Figure 3. Mean Difference Motor Block Onset Time



DISCUSSION

- Warming local anesthetics appears to shorten sensory and motor block onset**, particularly peripheral nerve blocks, with less consistent effects in neuraxial anesthesia.
- Possible explanation for this significant difference in **peripheral nerve blocks is because tissue membrane diffusion depends directly on the non-ionized fraction of the anesthetic**
- Possible explanation for less consistent effects in **epidural blocks is due to meningeal barriers and longitudinal spread of anesthetic** and for less prominent effects in **spinal blocks is due to anesthetic being directly exposed to CSF, allowing rapid equilibration**.

Take Away Points

Warmed local anesthetics were associated with shorter motor and sensory block onset time, and a moderate reduction in postoperative pain scores and opioid consumption.

These findings suggest a benefit of warming, especially for longer-acting agents, such as bupivacaine and ropivacaine.

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