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Validation of auditory evoked skin responses as a method of assessing sympathetic nervous system function

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Introduction

- Blockade of sympathetic nerve fibres during labour epidural analgesia may have negative consequences, including hypotension and hyperthermia.¹
- The skin has a dual sympathetic supply:²
 - Noradrenergic -> active vasoconstriction
 - Cholinergic -> active vasodilation and sweating
- It is hypothesised that epidural hyperthermia is caused by cholinergic sympathetic blockade inhibiting active vasodilation and sweating, which limits heat loss.¹
- Cholinergic and noradrenergic sympathetic function can be quantified with sudomotor (sweat) and vasomotor (vasoconstriction) evoked skin responses, respectively.³
- The “gold standard” method of evoking sympathetic skin responses is cervical magnetic stimulation.³ However, magnetic stimulation is contraindicated in obstetric patients.
- Auditory stimulation (loud clicks) is an alternative method of evoking these responses,⁴ but its use has not been validated.

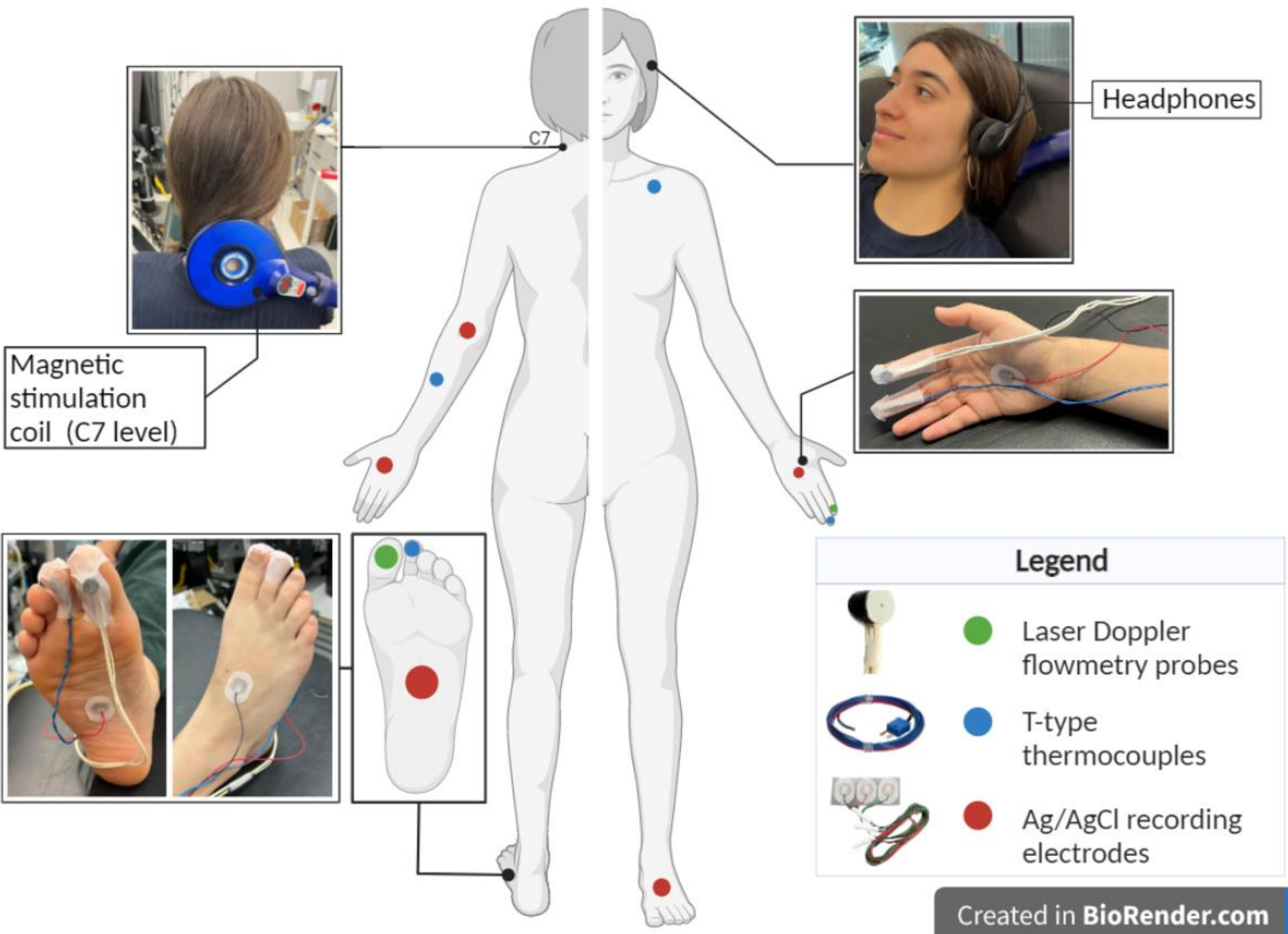
Aims and Hypothesis

- Aim: To compare sudomotor and vasomotor response characteristics following magnetic and auditory stimulation, including test-retest reliability.
- Hypothesis: Auditory stimulation is as reliable as cervical magnetic stimulation in evoking sympathetic skin responses.

Methods

- 12 healthy participants made two visits to the MSk Lab. On each visit they received 10 auditory and 10 magnetic stimuli. The stimulus order was randomised.
- Stimuli (Figure 1):
 - Magnetic: delivered over the C7 spinous process (circular coil, 65% max. output).
 - Auditory: delivered through headphones (100 – 120 dB, 120 Hz, 10 ms).
- Recordings (Figure 1):
 - Sudomotor responses: hand and foot electrodermal potentials were recorded with Ag/AgCl electrodes.
 - Vasomotor responses: finger and toe skin blood flow was recorded with laser doppler flowmetry.
 - Finger and toe skin temperature was recorded with T-type thermocouples.
- Sudomotor response amplitude and latency, and vasomotor reduction rate were calculated (Figure 2).
- Comparisons were made with 3-way repeated measures ANOVA.

Figure 1:
Experiment
set up



Results

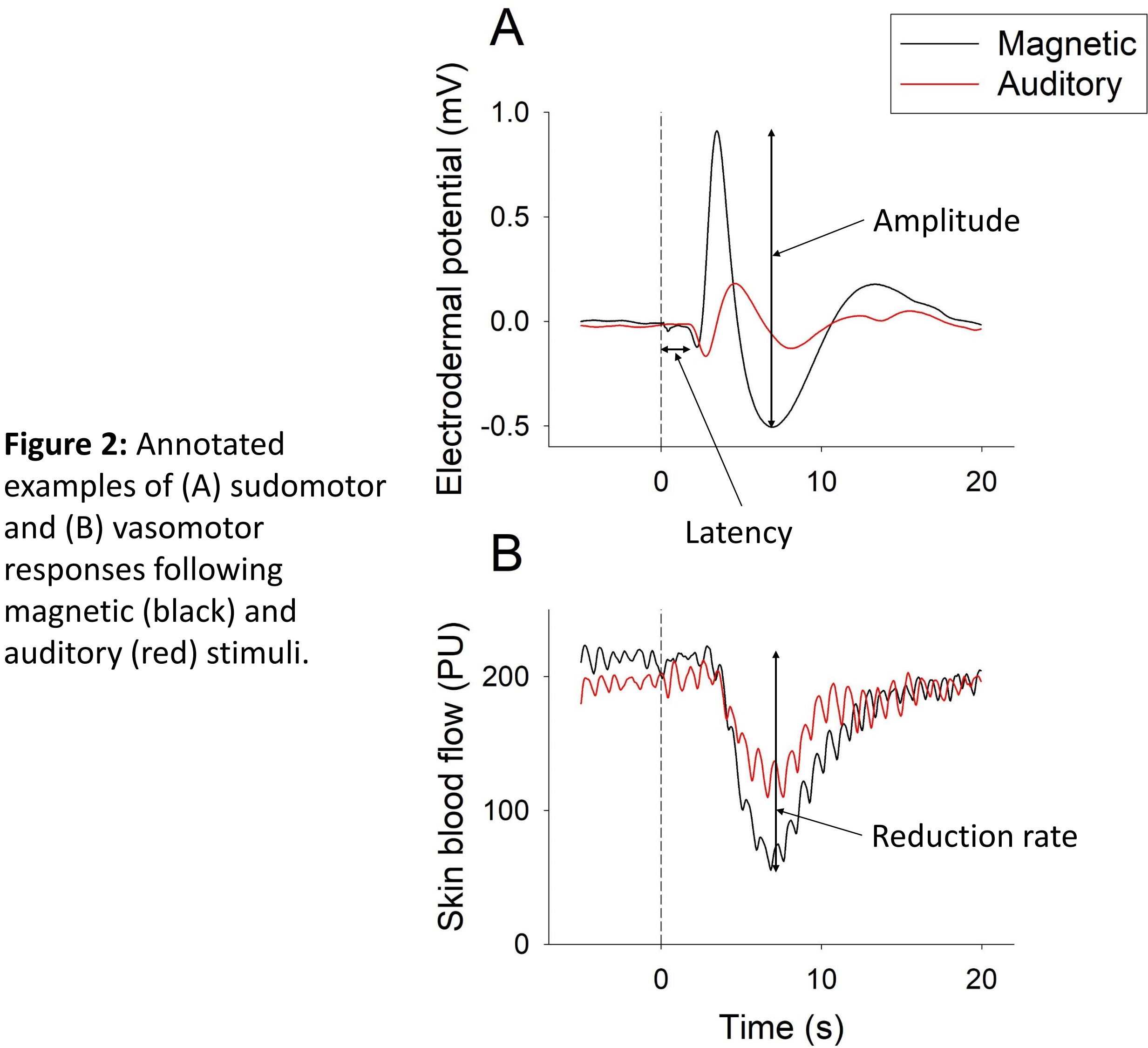


Figure 2: Annotated examples of (A) sudomotor and (B) vasomotor responses following magnetic (black) and auditory (red) stimuli.

Table 1: Participant Demographics	
Age (years)	25.3 (6.4)
BMI (kg.m ⁻²)	24.5 (4.4)
Sex (female)	4 (33%)
Ethnicity (white)	6 (50%)
Values are mean (SD) and n (%)	

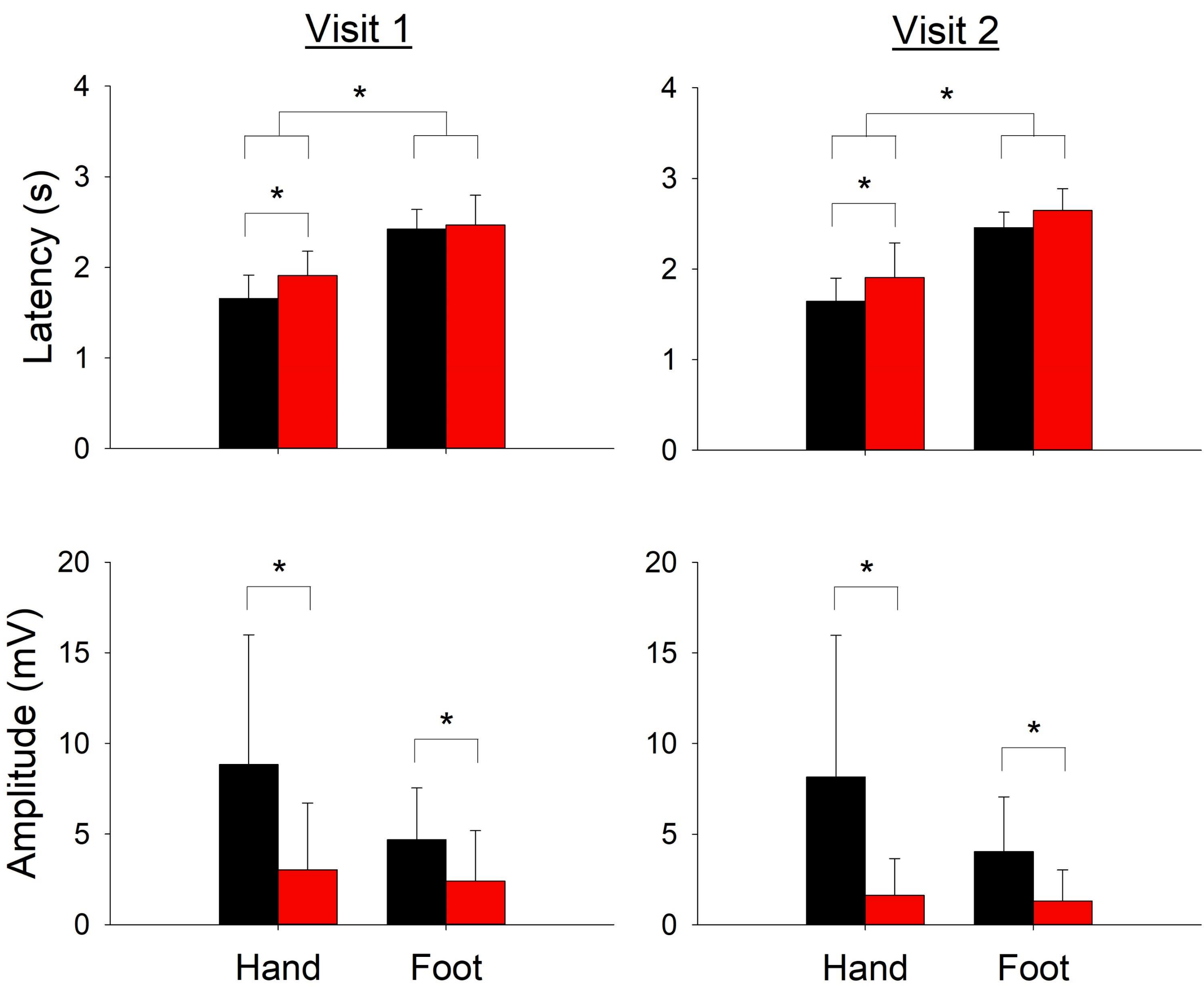


Figure 3: Mean (SD) sudomotor response latency and amplitude in the hand and foot on the 2 visits following magnetic (black) and auditory (red) stimulation. * indicates p < 0.05.

Results

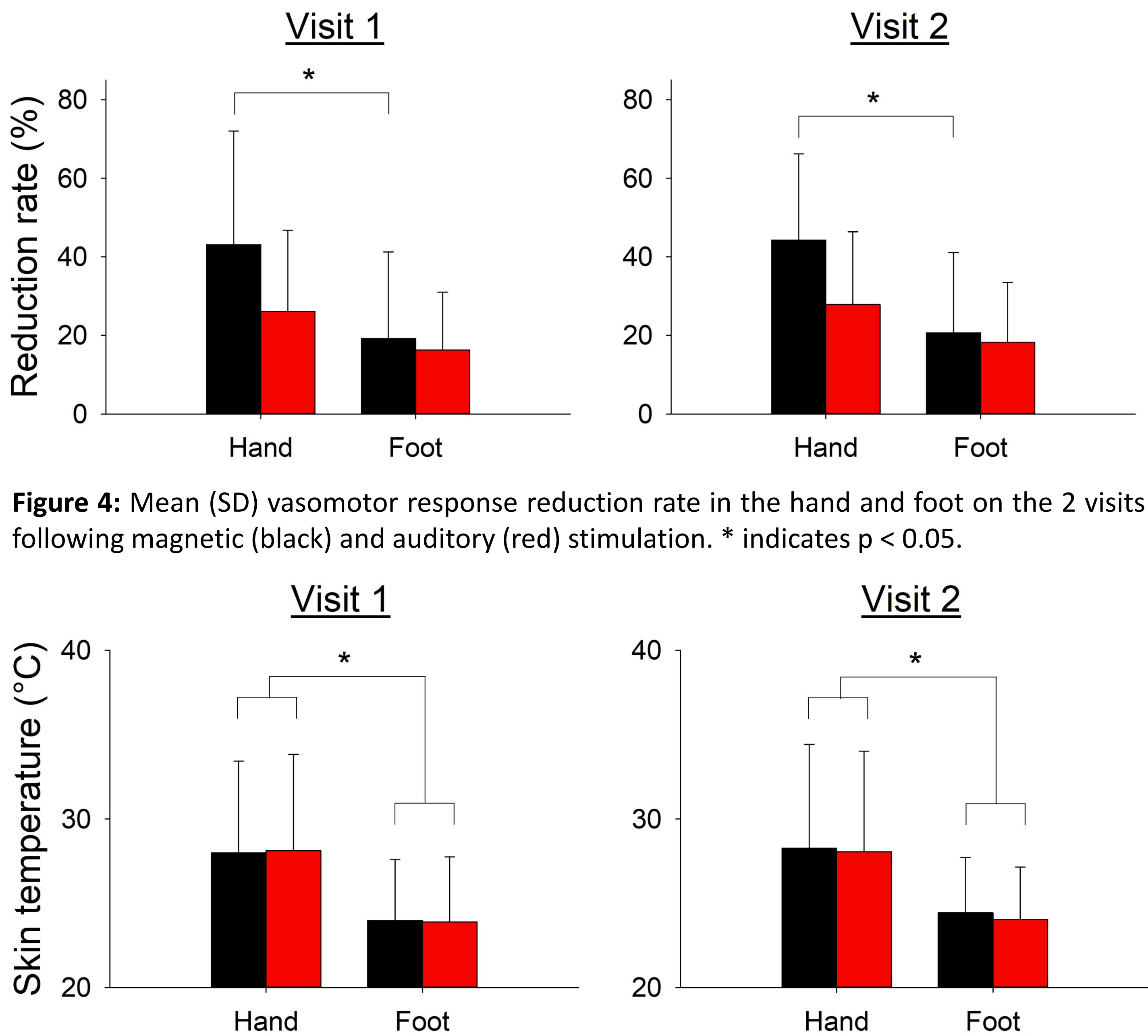


Figure 4: Mean (SD) vasomotor response reduction rate in the hand and foot on the 2 visits following magnetic (black) and auditory (red) stimulation. * indicates p < 0.05.

Figure 5: Mean (SD) skin temperature in the hand and foot on the 2 visits during magnetic (black) and auditory (red) stimulation. * indicates p < 0.05.

Discussion

- This study is the first to demonstrate that auditory stimulation is a valid method of evoking vasomotor skin responses
- The smaller response amplitudes and reduction rates following auditory stimulation are due to sub-maximal activation of sympathetic pathways⁴
- The longer sudomotor response latencies following auditory stimulation are due to the greater length of the stimulated neural pathway⁴
- The test-retest reliability demonstrates that auditory stimulation is a reliable method of assessing cutaneous sympathetic function.
- Auditory-evoked skin responses can be used to assess sympathetic blockade during labour epidural analgesia

References

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