

# EFFECT OF PROVIDING FOOT SUPPORT ON LOWER LEG TEMPERATURE FOR SEDENTARY WORKERS

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# Background

- Prolonged sitting with the legs inactive results in decreases in lower leg circulation that are a health concern (Beasley *et al.*, 2003).
- Poor leg circulation causes swelling of the lower limbs, especially among sedentary computer workers.
- Prolonged sitting can also result in foot swelling by 2.7% in a moving leg and 3.7% in a static leg over an 8 hours period (Noddeland & Winkel, 1988).
- Prolonged standing causes foot volume to increase 1.17% after 15 minutes, 2.27% after 60 minutes, and 3.31% after 120 minutes (Pottier *et al.*, 1969).
- The greatest detrimental increases in leg volume occur when using a sit/stand chair that compresses the thighs followed by standing, and leg swelling is least when sitting (Chester *et al.*, 2002) .

# Study Design

- Fourteen subjects were recruited from a University student population, 7 subjects were men and 7 were women. All subjects were in normal health. Subjects each were paid \$25. All signed an informed consent form approved by the University Committee on Human Subjects.
- Subjects sat for 20 minutes either with their legs dangling and unsupported, or supported on a flat surface.

# Procedure

- Ss were given time to acclimate and to rest their legs then were randomly assigned to one of two test orders
- Subjects sequentially completed each test condition in a counterbalanced.
- S wore standard shorts so that their lower legs were exposed and their feet were bare.
- Ss sat still on a table for a 20 minutes period in each of the two conditions. In the condition without foot support each subject sat on the table with his/her legs dangling. Subjects did not have any back support. Subjects were asked to try to keep their legs stationary and not to swing or wiggle these.
- During this time they were free to move their torso from the waist up, and they were allowed to read and turn pages, to look around etc., but they were not allowed to recline/lean back on their hands, shift body weight/position. In the foot support condition subjects sat in a similar way, but now they were able to place their feet on a flat surface for support.

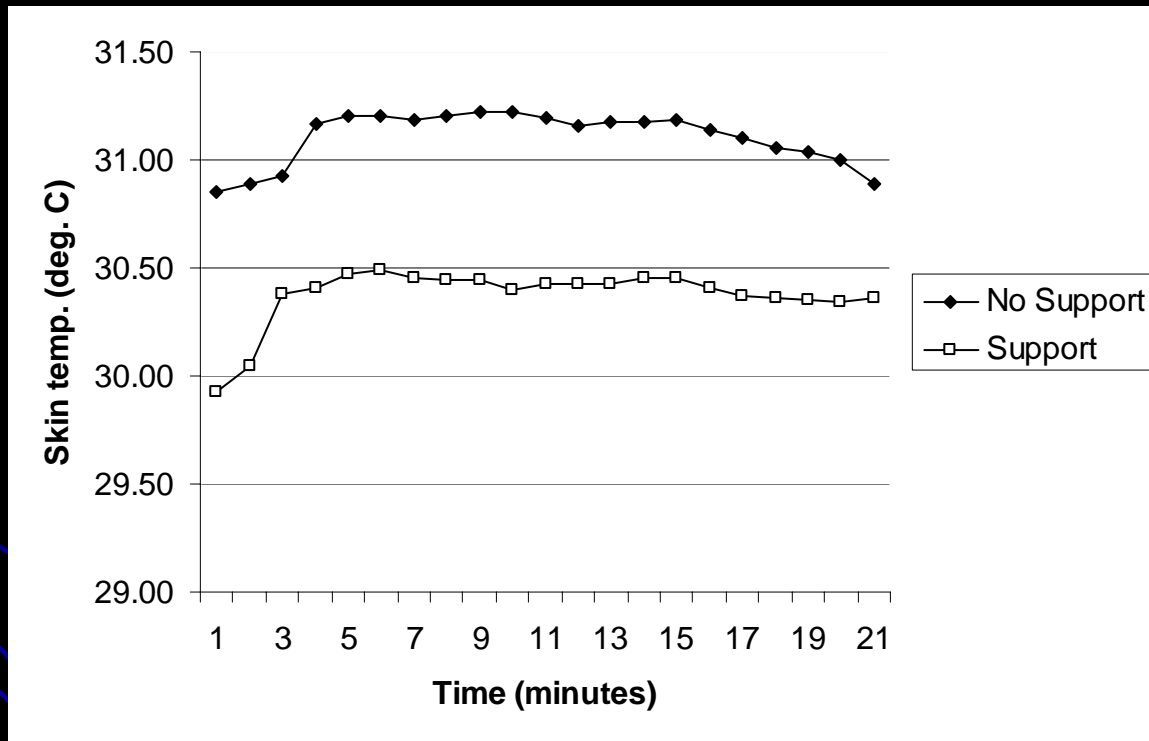
# Measures

- At the start of each session the initial surface temperature of the table was recorded using a surface temperature thermometer.
- An infrared video camera that was placed at a fixed distance of three meters from the subject to capture an image of their whole lower leg.
- For all conditions the subject sat with their left side against a white background to provide a constant thermal emissivity background for recording right leg thermal images. The camera had a cross-hair cursor that was aimed at a fixed region of the subject's right lower leg just above the ankle. The same reference point was used for all subjects in all conditions.
- The infrared camera displayed the image of the lower leg on a TV monitor and it also displayed the skin temperature. A skin surface temperature reading was taken every minute for the duration of each session. A digital photograph of the lower leg was recorded every 2 minutes for subsequent analysis of the calf skin temperature using the IR camera.
- Air conditioning units were used to regulate the ambient thermal conditions in the laboratory.
- The air temperature, air velocity (instantaneous and average), relative humidity and plane radiant heat were recorded throughout each session to ensure minimal variation in climate conditions.
- At the end of the 20 minutes session the experimenter allowed the subject to leave the table and move around for a while. The surface temperature was read again at the spot where the subject had been sitting.
- Foot and calf skin surface temperature measures were taken using infrared thermography.

# Results

- There was a significant difference in foot skin surface temperature between conditions ( $t(20) = 38.718$ ,  $p = 0.000$ ): skin temperature was consistently higher when sitting with the feet dangling and unsupported ( $31.11\text{ }^{\circ}\text{C} \pm 0.03\text{ }^{\circ}\text{C}$ ) compared to sitting with the feet supported ( $30.37\text{ }^{\circ}\text{C} \pm 0.03\text{ }^{\circ}\text{C}$ ).

# Results

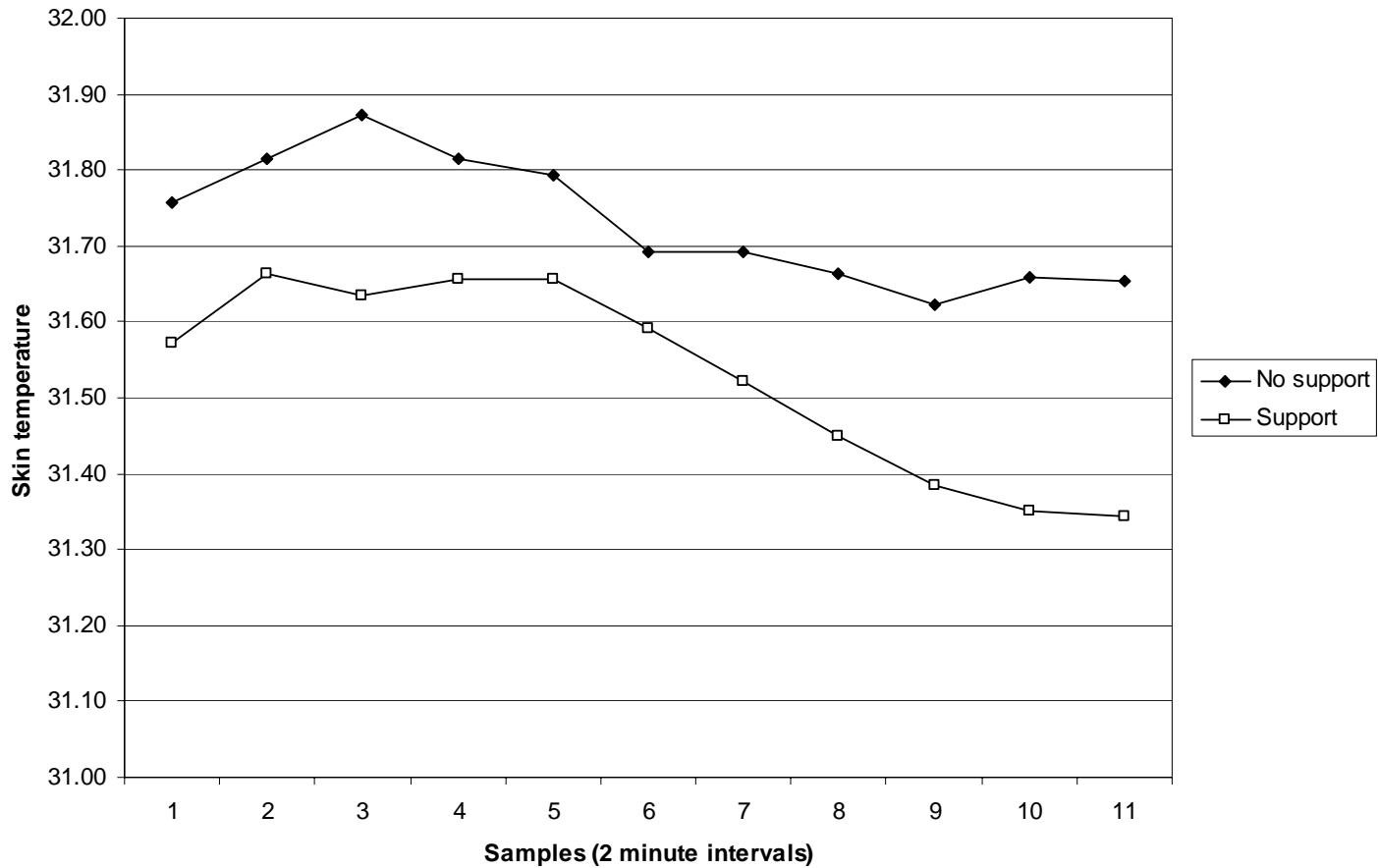


# Results

- There was also a significant difference in the calf skin temperature between conditions ( $t(10) = 9.562$ ,  $p = 0.000$ ), and calf SST was higher when the feet were unsupported ( $31.73^{\circ}\text{C} \pm 0.03^{\circ}\text{C}$ ) than when they were supported ( $31.53^{\circ}\text{C} \pm 0.04^{\circ}\text{C}$ : see Figure 2).



# Results



Hedge, A. and Bhambore, M (2003) Effect of providing foot support on lower leg temperature for sedentary workers. Proceedings of the Human Factors and Ergonomics Society 47th Annual Meeting, Oct. 13-17, Denver, CO, 937-941.

# Results

- There was a statistically significant difference in air temperatures between the two conditions ( $t(20) = -3.907$ ,  $p = 0.001$ ), and average air temperatures were slightly warmer during the support condition (support =  $27.32^{\circ}\text{C} \pm 0.02^{\circ}\text{C}$ ; no support =  $27.27^{\circ}\text{C} \pm 0.02^{\circ}\text{C}$ ), the magnitude of this difference is very small and the direction of the difference is the opposite of what was observed with leg temperatures, so it cannot explain the SST differences that were found.

# Conclusions

- The results suggest that the use of some kind of foot support surface, influences lower leg circulation, but not necessarily beneficially.
- Sitting with the legs supported rather than dangling resulted in decreases in foot and calf SSTs. This may indicate less need for muscle activity to maintain limb position, which in turn may decrease circulation if the legs remain static.
- The decrease in calf skin temperature that was found may be indicative of decreased leg circulation. Consequently, it is important to balance the benefits of foot support against those of circulatory stagnation that can arise from static leg posture.