Advanced lightweight cooling - garment technology: functional improvements in thermosensitive patients with multiple sclerosis

AD. Meyer-Heim¹, M. Rothmaier², M. Weder², J. Kool¹, P. Schenk³, J. Kesselring¹
1. Department of Neurology, Rehabilitation Centre, CH-7317 Valens, Switzerland
2. Swiss Federal Institute for Materials Science and Technology (Empa), CH-9014 St. Gallen, Switzerland
3. Center for Organizational and Occupational Sciences COA, Swiss Federal Institute of Technology (ETH), CH-8092 Zurich, Switzerland

Background
Heat-sensitivity, resulting in clinical deterioration, is a phenomenon described in up to 80% of patients with multiple sclerosis. Lowering body temperature can improve clinical symptoms. Hence, there is a high interest in an efficacious, practical, lightweight and cost-saving cooling system.

Patients & Methods
Single blinded, balanced crossover study on twenty heat sensitive MS Patients with a EDSS >6.5. Outcome measurements: Skin temperature and ECG for measuring the heart rate variability (HRV) were continuously logged. Tympanic temperature was measured at the beginning and end of examination sessions. A neurological examination consisting of MS Functional Composite (MSFC), modified Ashworth scale, body sway by a static force platform and muscle strength was performed, followed by a structured interview about wearing comfort, subjective perception of cooling effect on bodily functions (general well-being, pain, voiding, sweating) with a scoring system from 1 to 10. Figure Thigh-cuff cooling garments. The arrow shows the filling tube for water to activate cooling system.

Results
Mean age within the study group was 48.7 yrs (range 27-66), median EDSS 5.5 (range 1.5-6.5). The temperature reduction of the skin was 4.3±2.1°C (range 1.8-6.5). There was no alteration in tympanic temperature in either group. The activated cooling garment significantly improved the total MSFC (p=0.017), timed 25-feet walk (p=0.035), 9HPT (p=0.012) and strength in lower limbs (p=0.004). In the structured interview we found a tendency in improvement of general well-being, pain, voiding, peripheral cooling, suggest improvement of a walking velocity, leg-strength, fine-motor hand skills and subjective benefits. Technical information was gained about the cooling activity, the practicability and handling of the device. These encouraging findings will promote further adaptations of the prototype to increase its cooling properties and ameliorate the practicability of the cooling garment.

Summary & Conclusion
In order to study the effectiveness of an advanced lightweight cooling-garment technology based on aquatic evaporation, a single blinded balanced crossover study was performed on twenty patients with multiple sclerosis. The results, using a tight-cuff cooling-garment prototype for peripheral cooling, suggest improvement of a walking velocity, leg-strength, fine-motor hand skills and subjective benefits. Technical information was gained about the cooling activity, the practicability and handling of the device. These encouraging findings will promote further adaptations of the prototype to increase its cooling properties and ameliorate the practicability of the cooling garment.