An Electronic Temperature-Controlled Cane Improves Gait Stability and Autonomic Balance in Middle-to-Older-Aged Adults Kuan-Miao Chou, Cheng-Hsun Yang, Ming-Yi Liu. *Gerontechnology* 25(s)

Purpose This study evaluated the immediate effects of a short-term intervention using an electronic temperature-controlled cane on gait stability, heart rate variability (HRV), and bilateral symmetry of meridian energy in middle-to-older-aged adults. We aimed to integrate biomedical measurements with traditional meridian assessment into a cross-disciplinary health-technology framework. **Method** Design: Single-group pre–post study. Participants: Thirty community-dwelling adults (mean age 63.1 ± 6.5 years; 18 women, 12 men) able to walk independently and without acute cardiovascular/neuromuscular disorders. Intervention: An electronic temperature-controlled cane with an adjustable heated grip (≈35–42 °C) providing continuous thermal and tactile stimulation during ambulation. Procedures: Pretest included a standardized walking task, 5-min resting HRV, and 12-meridian electroconductance symmetry assessment; posttest repeated the protocol using the temperature-controlled cane. Outcomes: Gait parameters (e.g., step length, cadence), HRV indices (RMSSD, HF, LF/HF), and meridian symmetry (%). Statistics: Paired comparisons with effect sizes and confidence intervals; non-parametric sensitivity analyses as needed. **Results & Discussion** After switching to the temperature‑controlled cane, participants generally exhibited improved gait stability. Specifically, stride length increased from 52.4 cm to 58.7 cm, and cadence improved from 96.2 to 102.5 steps/min. Figure 1 shows higher parasympathetic-related HRV indices, with RMSSD rising from 21.5 ms to 27.8 ms and HF power increasing from 210 to 342 ms²; meanwhile, LF/HF decreased from 1.85 to 1.62. Meridian assessments indicated greater left–right symmetry (Figure 2). This suggests that both mind and body were stable and the autonomic nervous system was well-regulated. Proposed mechanisms include thermal stimulation enhancing distal circulation and proprioceptive feedback, vagal-related modulation of autonomic balance, and more stable grip/tactile cues during ambulation. Clinically, such canes may serve as dual-purpose mobility supports and sensory-thermal interventions for older adults. Limitations include the single-group design and inter-individual thermal sensitivity; future randomized crossover trials with longer follow-up and free-living monitoring are warranted.

References

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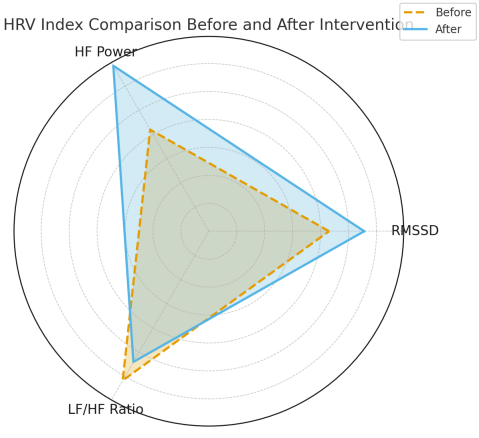

Figure 1. Changes in three key HRV indicators before and after intervention

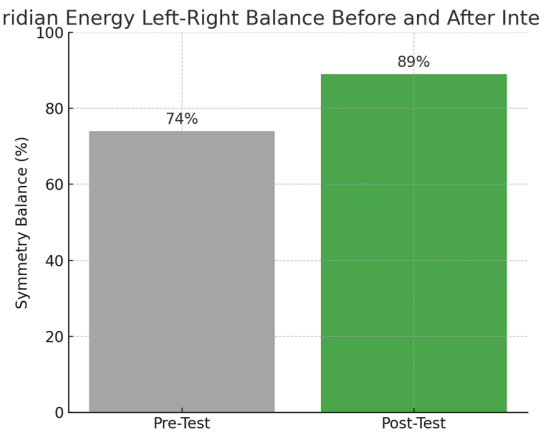

Figure 2. Percentage variation of symmetry in electrical conductivity values of the twelve meridians.