

Wearable Hip-Assist Robot Reduces Muscle Fatigue and Metabolic Energy Cost in Elderly Persons

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Objective

The purpose of the present study was to investigate the effect of newly developed wearable hip-assist robot on muscle fatigue and cardiopulmonary metabolic energy cost during walking in elderly persons.

Methods

Twenty elderly persons (age means: 71.5 ± 3.71 , 11 males) participated in this study. The Gait Enhancing Mechatronic System version 3.0 (GEMS V3, Samsung Electronics Co., Ltd., Korea), which functions as a wearable hip-assist robot was used in this experiment. All participations performed randomly assigned three conditions (free gait without robot assistance [FG], robot-assist gait with zero torque [RAG-Z] and robot-assist gait [RAG]) of treadmill walking during 6 min at self-selected speed. In all conditions, muscle fatigue were acquired and analyzed using the 12-channel wireless surface electromyography system (Desktop DTS system, Noraxon, USA) and cardiopulmonary metabolic energy cost ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) were obtained from portable cardiopulmonary metabolic system (COSMED K4B2, Rome, IT).

Results

The RAG condition demonstrated lesser lower extremity muscle fatigue during 6 minutes treadmill walking than the FG and RAG-Z. Furthermore, net cardiopulmonary metabolic energy cost during 6 minutes treadmill walking was significantly lower in the RAG (decreased of 33.14% than FA) than the FA and RAG-Z ($P < 0.05$) (Figure 1).

Conclusion

These results demonstrate that a newly developed wearable hip assist robot, the GEMS V3, is a potentially useful device for improving gait function by reducing the muscle fatigue and also by decreasing cardiopulmonary metabolic cost during walking in elderly persons. We will perform a study to confirm the effect of gait training effect of GEMS V3 with neural disorder patients in the near future.

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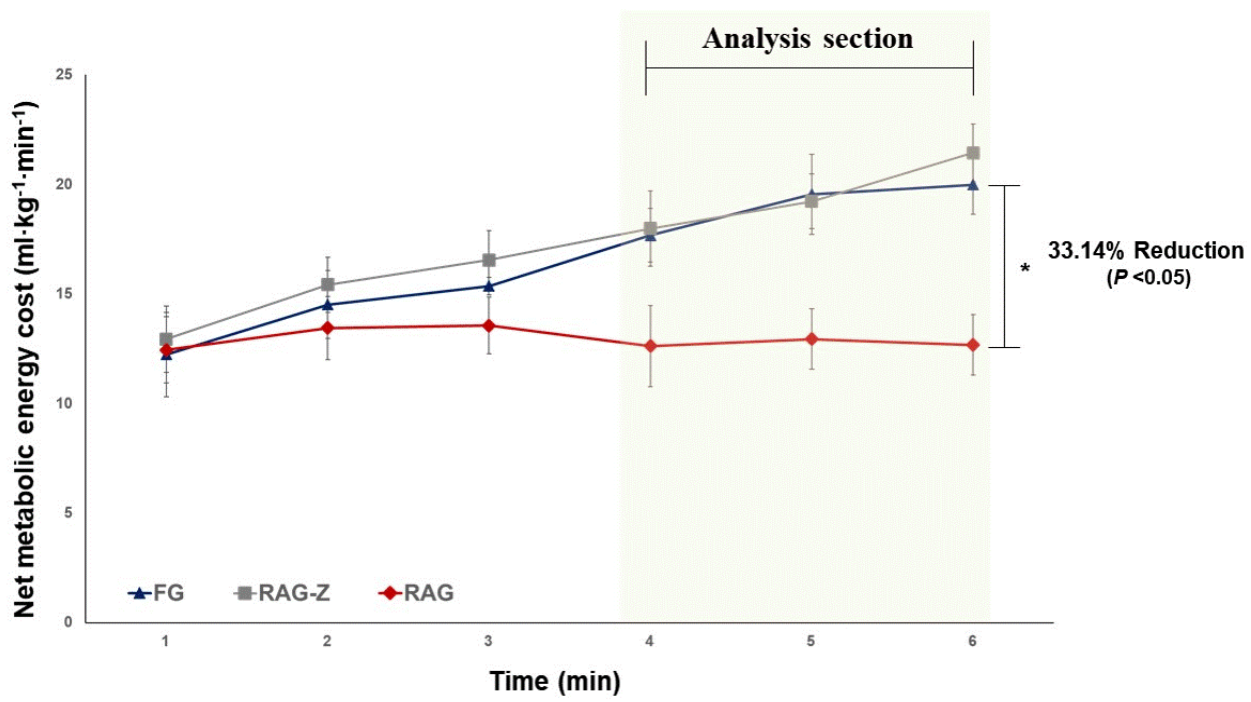


Fig 1. Trajectory of change in Net metabolic energy consumption with 3 conditions (FG vs. RAG-Z vs. RAG). FG: free gait without robot assistance, RAG-Z: robot-assist gait with zero torque, RAG: robot-assist gait