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### Original Article

#### Abstract

**Introduction:** Understanding the biomechanical impact of carrying a backpack when walking downhill can be valuable in designing injury prevention programs and physical preparation plans. The aim of this study was to compare the range of motion of lower limb joints during walking on flat and sloped surfaces in middle-aged climbers with and without backpacks.

**Materials and Methods:** In the present study, 14 middle-aged mountaineers performed 4 walking trials with and without a backpack on a treadmill with a slope of 0 degrees and a negative slope of 15 degrees. Three-dimensional motion analysis system was used to record kinematic data. The range of motion (ROM) of the ankle, knee, and thigh joints was processed in the sagittal plane. If data followed a normal distribution, paired t-test was used.

**Results:** On a slope of -15 degrees with a backpack, hip joint ( $P = 0.044$ ) and ankle joint ( $P = 0.007$ ) ROM was significantly lower than without a backpack. In the case of using a backpack, knee joint ROM was significantly lower on a 0 degree slope ( $P = 0.038$ ) and -15 degrees slope ( $P = 0.029$ ) compared to without a backpack. Moreover, ankle joint ROM significantly differed only when using a backpack ( $P = 0.032$ ). Furthermore, for the knee and thigh joints, there was a significant difference in the ROM between slopes with ( $P = 0.006$  and  $P = 0.012$ , respectively) and without a backpack ( $P = 0.025$  and  $P = 0.015$  respectively).

**Conclusion:** Carrying a backpack with 25% of the body weight on a negative slope has significant effects on the ROM of the lower limb joints. It seems that negative slope may have far greater effects than load on the ROM of the lower limb joints, especially the ankle joint in middle-aged climbers. Since downhill descent is a part of every climbing program, using a light backpack and optimizing the style of carrying the backpack is recommended to climbers to prevent injuries and improve performance.

**Keywords:** Walking; Backpacking; Range of motion; Negative slope; Climbers; Middle-aged

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