

Abstract:

The muscle force determines the energy costs of locomotion and the loading of the musculoskeletal system. As the body size increases, the muscle force increases too. The observed less joint flexion in larger individuals could be a moderating mechanism to reduce muscle force when walking. To date, there is a lack of knowledge about the effect of body size and joint angles on muscle force. The aim of this study was to investigate how body size affects muscle force in the stance phase of walking and whether larger individuals can effectively compensate for the increase in muscle force through postural changes. We acquired kinematic, kinetic and electromyographic data for 19 men during normal walking and carrying additional 20 % of body weight. We estimated muscle force using the method of musculoskeletal modeling. We employed the multiple linear regression to assess independent effect of body mass, lower limb length, biiliac breadth and joint flexion angle on total (iF) and maximum (maxF) lower limb muscle force. The body mass had a great positive effect on the gluteus medius muscle force (maxF and iF) but did not affect the iliopsoas muscle force (maxF and iF) nor the vasti muscles force (iF). The lower limb length had a positive effect on the gluteus maximus muscle force (maxF) and a negative effect on the gluteus medius muscle force (iF). Biiliac breadth did not affect muscle force. The carrying load led to a significant increase in muscle force production (except for the iliopsoas muscle). Our results show that a larger body size does not always lead to an increase in muscle force during walking. Larger individuals can use moderation mechanisms to reduce force production. Human walking is adjusted to body size in ontogenesis and does not adapt to loading.

Key words: biomechanics, lower limb, body mass, muscle force, locomotion, musculoskeletal modeling