INTRODUCTION

By 2030 there are expected to be over 71 million Americans (19.6% of the population) over age 65 [1], likely resulting in an increased prevalence of chronic diseases, such as coronary heart disease, stroke, and type 2 diabetes. Although walking is the most accessible form of physical activity that can lower the risk of such diseases, 25% of adults over age 55 have difficulty walking one-quarter of one mile [2].

Previous studies have analyzed walking by evaluating muscle function during gait [3-5] (how individual muscles support, brake and propel the body’s center of mass (COM)). Only one study has assessed muscle function during gait in healthy older adults rather than young adults [6]. However, their findings may not be representative of all older adults because the walking speed of the older subjects was 1.42 m/s, which is faster than what is typically reported [7].

Older adults walk with altered kinematic and kinetic patterns compared to young adults, even when walking speed is similar [7], which may also suggest altered muscle function in older adults during gait. Thus, the purpose of this study was to determine muscle function during gait in a healthy older adult population and contrast muscle function of healthy older adults with that of a young adult population.

METHODS

Kinematic, kinetic, and electromyography data of the gait of healthy older adults were collected at the University of Wisconsin-Madison as previously described [7]. For this study, a subset of ten healthy older adults (3M, 7F; Age: 73.9 ± 5.3 years; Height: 1.67 ± 0.10 m; Mass: 64.5 ± 10.2 kg) walking at a self-selected speed (1.31 ± 0.11 m/s) was analyzed, based on the suitability of the available data of each subject for simulation analyses.

RESULTS AND DISCUSSION

Healthy older and young adults use similar muscles to support (Figure 1), brake and propel (Figure 2) their COM during gait. However, older adults use each muscle to a different degree than young adults. To support their body during the first half of stance, both older adults and young adults primarily use their vasti (VAS) and tibialis anterior (TA). In addition to the vasti, older adults use gluteus medius (GMED) and gluteus maximus (GMAX) for support. Young
adults primarily use their TA during weight acceptance and their VAS and soleus (SOL) during the rest of early stance. GMED and GMAX also contribute to support during early stance in young adults, but to a lesser degree than observed in older adults. In late stance, SOL provides a majority of the support in older adults while young adults are primarily supported by gastrocnemius (GAS). VAS contributes to support during late stance in young, but not older, adults.

**CONCLUSIONS**

The greater use of muscles about the hip (GMED, GMAX, and BF) by older adults reflects a distal to proximal change in neuromuscular control observed previously [11]. These differences in muscle contributions to COM acceleration between the older and young adults may be due to several factors. Although kinematic differences between age groups have been observed in previous studies [6, 7], this finding is not consistent throughout the literature. In this study, although both groups walked at a similar speed, the older adults walked with a more extended hip, greater knee flexion during stance, and greater plantar flexion at toe off compared to the young adults. Kinematic differences could affect muscle moment arms ([R]), a muscle’s location on its force-length-velocity curve and thus its force (f), and the orientation and inertial properties of the body segments (the mass matrix: [M]−1), which together determine muscle contributions to acceleration (\(\ddot{q}\)) [3]:

\[
\ddot{q} = [M]^{-1} \ast [R]f
\]

However, age-related changes in muscle-tendon parameters, which could affect muscle forces and moment arms, were not modeled in this study. Future studies should examine the effects of age-related changes to neuromuscular properties on muscle function during gait. Finally, the findings of this study suggest a need to better understand the interplay between neuromuscular control, kinematics, and muscle function during gait in older adults.

**REFERENCES**