AGE-RELATED DIFFERENCES IN DROP-JUMP PERFORMANCE ARE ELIMINATED BY MATCHING TRICEPS SURAE MUSCLE STRENGTH AND ACHILLES TENDON STIFFNESS

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INTRODUCTION

Reduced leg-extensor muscle strength and tendon stiffness in old age have been associated with changes in locomotor performance and motor task execution strategy (Karamanidis and Arampatzis, 2005; Kulmala *et al.,* 2014). However, if leg-extensor muscle-tendon unit (MTU) mechanical properties are the only primary drivers of these alterations seen with ageing remains unclear. Therefore, we examined if matching triceps surae (TS) muscle strength and Achilles tendon (AT) stiffness eliminates potential age-related differences in drop jump (DJ) performance and motor task execution strategy in younger and middle-aged adults.

METHODS

Twelve younger (20-30y) and 12 middle-aged (50-65y) adults participated in the study. Ankle plantarflexion moments and AT stiffness of both legs were assessed during isometric voluntary plantarflexion contractions using simultaneous dynamometry and ultrasonography. Tendon elongation during loading was assessed by manually tracking the myotendinous junction of the gastrocnemius medialis muscle and AT stiffness was determined in the linear region of the force-length relationship. The groups showed no significant differences in maximal ankle plantarflexion moment (young: 3.2±0.4Nm/kg; middle-aged: 3.1±0.5Nm/kg) or AT stiffness (580±122 vs. 590±108N/mm). On a separate measurement day, the matched participants performed a series of DJs from different starting heights (13, 23, 33 and 39cm) onto a force plate.

RESULTS

Matched middle-aged and younger adults showed similar DJ heights for all starting heights (from lowest to highest starting height: 19.0±5.0 vs. 18.9±4.5cm; 22.7±4.7 vs. 23.2±4.3cm; 23.0±4.8 vs. 25.0±3.6cm; 22.7±4.7 vs. 25.5±5.9cm). There were significant age effects ($p<.05$) on ground contact time, maximum vertical ground reaction force and mechanical power, with higher ground contact times (on average 35-43%) but lower forces (on average 34-44%) and hence lower mechanical power (from lowest to highest starting height: 1498±545 vs. 2496±869W; 2222±320 vs. 3737±894W; 2475±529 vs. 4547±832W; 3034±435 vs. 5210±1050W) for the middle-aged compared to younger adults, independent of starting height. There were significant correlations between DJ performance and TS muscle strength and AT stiffness for all starting heights ($.41\leq r\leq .81$; $p<.05$).

DISCUSSION

Our results illustrate that age-related differences in jumping task performance are eliminated, independent of starting height and hence task demand, when younger and middle-aged adults are matched for TS muscle strength and AT stiffness. However, age-related differences in ground contact times, ground reaction forces and mechanical power were detected for all starting heights, meaning that young and middle-aged adults used different motor task execution strategies. This indicates that while changes in leg-extensor MTU mechanical properties may be the primary drivers of reduced locomotor performance with ageing, they may not be major contributors to motor task execution strategy during jumping.

CONCLUSION

Drop jump performance appears to be unaffected when TS muscle strength and AT stiffness are maintained with age and therefore, countering the degeneration of these properties may help prevent the deterioration of locomotor performance seen with ageing.

REFERENCES

Karamanidis, K, Arampatzis, A, (2005). *J Exp Biol*, 208, 3907–3923. doi: 10.1242/jeb.01830

Kulmala, J-P et al., (2014). *J R Soc Interface*, 11, 20140858. doi: 10.1098/rsif.2014.0858

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