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The effects of aerobic exercise on muscle strength and physical performance among community dwelling older people from the Hertfordshire Cohort Study: a randomised controlled trial

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To the Editor: There is considerable interest in the role of physical activity interventions to address the age-related loss of skeletal muscle mass. Resistance exercise is consistently associated with improvement in muscle strength and physical performance (PP) in older adults but the influence of aerobic exercise on these outcomes is less clear. Studies of the influence of aerobic exercise on muscle have typically taken place among specific patient populations and less so in older people. We studied the effects of a fully supervised 12 week aerobic exercise intervention on muscle strength and PP among the community-dwelling healthy older men and women who participated in the Hertfordshire Physical Activity Intervention Trial (HPAT),¹ a sub-study of the Hertfordshire Cohort Study.²

METHODS

The HPAT has been described previously.¹ In brief, 100 men and women (aged 67 to 76 years, 44% women) were randomised to an aerobic exercise programme or a non-intervention control group; 96 attended 12 week follow-up.

The exercise group participated in fully supervised 1 hour sessions on a cycle ergometer at a gymnasium in Hitchin, Hertfordshire three times weekly over 12 weeks, with exercise intensity maintained by heart rate monitoring. Participants in the control group were asked to continue with their usual levels of physical activity.

Muscle strength and PP were assessed at the beginning and end of the study by staff unaware of group allocation using a Jamar dynamometer to assess grip strength³ and a PP battery including a timed up and go (TUG) test,⁴ timed 3 metre walk, chair rises and standing balance.⁵

Multilevel linear regression models were used to analyse differences in change from baseline in muscle strength and each PP measure between the exercise and control groups.

The study had ethical approval from the Hertfordshire Local Research Ethics Committee (LREC ref. 05/Q0201/23). All participants gave written informed consent.

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Author Contributions: FM Finucane, SJ Griffin, NJ Wareham, C Cooper, and A Aihie Sayer designed the study and took overall responsibility for it.

HJ Denison, HE Syddall, HJ Martin and R Dodds conducted and interpreted the statistical analysis and prepared the manuscript. All authors reviewed and approved the final manuscript.

RESULTS

There was a 0.75 (95% CI: 0.03 to 1.48) second greater improvement in the 6m TUG performance in the exercise group compared with the control group ($p=0.04$). Average TUG times decreased from 11.0 seconds (s) (± 2.0) at baseline to 10.2 s (± 1.6) at follow-up among the exercise group in comparison with no change among the control group (Table 1). The improvement in TUG performance in the exercise group was slightly greater among men (0.87 seconds; 95%CI: -0.06 to 1.81) than women (0.57 seconds; 95%CI: -0.56 to 1.70).

There were no significant differences between groups in change in grip strength, 3 metre walk, one-legged balance and chair rises time over the 12 week follow-up. Restriction to the per-protocol sample of 85 participants (37 exercise and 48 controls) who completed 85% of their exercise sessions did not alter the results.

DISCUSSION

The literature describing the effects of aerobic exercise on skeletal muscle function is limited. Shigematsu⁶ investigated the effect of a dance-based aerobic exercise intervention on indices of falling among older Japanese women; their exercise group showed significantly greater single-leg balance, functional reach, and faster walking time around two cones compared with a control group, but no significant changes in either strength or motor processing measurements.

Marques⁷ and Mangani⁸ have described the effect of aerobic versus resistance exercise on muscle strength and PP in older people. Their results suggested that aerobic exercise improves measures of PP such as gait speed and balance; resistance exercise was necessary to improve muscle strength. Randomised controlled trials of combined resistance and aerobic exercise interventions have demonstrated improvements in both PP and muscle strength.^{9;10}

Previous exercise interventions have typically been conducted in specific patient populations; a strength of HPAT is that all participants were drawn from a population-based sample. A limitation of HPAT is that the recruitment rate was relatively low (18%), possibly owing to the commitment and intensive phenotyping required from participants.

Physical activity levels typically decline in later life. Effective community based interventions to increase physical activity with a view to improving muscle strength and PP must be both attractive and manageable for older people; aerobic exercise activities could comprise an important part of such interventions. Further research is required to assess the longer term effects of different types of physical activity on muscle strength and PP outcomes in older people.

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Table 1
Physical Performance at Baseline and Follow-up

Outcome	Control baseline	Control follow-up	Exercise baseline	Exercise follow-up	Difference (95%CI) ^b	<i>p value for difference</i>
Maximum grip strength (kg)	36.0 (10.8)	36.5 (10.3)	37.0 (9.4)	36.7 (9.4)	−0.85 (−2.28,0.57)	<i>0.24</i>
Chair rises time (s)	16.9 (5.2)	17.1 (4.6)	16.2 (3.4)	15.9 (3.6)	−0.46 (−2.02,1.11)	<i>0.57</i>
6m timed up and go (s)	10.7 (2.6)	10.6 (1.9)	11.0 (2.0)	10.2 (1.6)	−0.75 (−1.48,−0.03)	<i>0.04</i>
3m walk (s)	2.9 (0.6)	3.1 (0.6)	3.1 (0.6)	3.0 (0.6)	−0.25 (−0.52,0.03)	<i>0.08</i>
Eyes closed one legged balance time (s) ^a	3.1 (1.9)	2.9 (1.9)	2.5 (1.8)	2.6 (1.7)	1.11 (0.84,1.46)	<i>0.47</i>

Kg: kilograms; s: seconds; m: metres; 95%CI: 95% confidence interval

All cells of the table based on 48 observations

Values are means and standard deviations.

^aThe eyes closed one legged balance time was log_e transformed for analysis; means and standard deviations for this outcome are therefore geometric, and its difference is proportional

^bDifference represents the difference in the average within-person baseline to follow-up change for each outcome in the control compared with the exercise group