

**Sipilä S, Suominen H. Effects of strength and endurance training on thigh and leg muscle mass and composition in elderly women. J Appl Physiol. 1995 Jan;78(1):334-40**

Abstract

The effects of 18 wk of intensive strength and endurance training on knee extensor, knee flexor, and lower leg muscle mass and composition were studied in 76- to 78-yr-old women. Muscle cross-sectional area (CSA), lean tissue CSA, and relative proportion of fat were determined using computed tomography. The strength-trained women increased their total muscle lean tissue CSA of the thigh (1.5%;  $P = 0.035$ ), quadriceps CSA (4.5%;  $P = 0.021$ ), quadriceps lean tissue CSA (5.8%,  $P = 0.009$ ), and mean Hounsfield unit of the lower leg muscles (11.2%;  $P = 0.035$ ) compared with the changes that occurred in the control group during the experiment. The change in quadriceps lean tissue CSA because of the strength training was also significant compared with that in the endurance group. The relative proportion of fat within the quadriceps muscle decreased due to the strength training compared with the changes that occurred in the endurance group. The results show that intensive strength training can induce skeletal muscle hypertrophy in elderly women and thereby also reduce the relative amount of intramuscular fat, whereas the effects of endurance training are negligible.

**Sipilä S, Multanen J, Kallinen M, Era P, Suominen H. Effects of strength and endurance training on isometric muscle strength and walking speed in elderly women. Acta Physiol Scand. 1996 Apr;156(4):457-64**

Abstract

The separate effects of 18 weeks of intensive strength and endurance training on isometric knee extension (KE) and flexion (KF) strength and walking speed were studied in 76- to 78- year-old women. Maximal voluntary isometric force for both KE and KF was measured in a sitting position on a custom-made dynamometer chair at a knee angle of 60 degrees from full extension. Maximal walking speed was measured over a distance of 10 m. The endurance-trained women increased KE torque and KE torque/body mass after the first 9 weeks of training when compared with the controls. when comparing the baseline, 9 week and 18 week measurements within the groups separately, both the endurance- and strength-training groups increased KE torque, KE torque/body mass and walking speed. Individual changes in KE torque/body mass before and after 18 weeks of training averaged 19.1% in the strength group, 30.9% in the endurance group and 2.0% in the controls. This study indicates that in elderly women the effects of physical training on muscle strength and walking speed occur after endurance as well as strength training. The considerable interindividual variation in change of muscle performance is also worth noticing.

**Sipilä S, Suominen H. Quantitative ultrasonography of muscle: detection of adaptations to training in elderly women.** Arch Phys Med Rehabil. 1996 Nov;77(11):1173-8.

#### Abstract

**OBJECTIVE:** To develop quantitative ultrasonography in studying the adaptation of quadriceps muscle mass and composition to short-term physical training and rehabilitation in elderly women. **DESIGN:** Randomized control trial. **SETTING:** Measurements in a research laboratory and training in a fitness center and sports hall. **PARTICIPANTS:** Forty-two women, aged 76 to 78 years, with no indications against intensive physical exercise, randomly assigned to strength (n = 16), endurance (n = 15), and control (n = 11) groups. Twelve subjects from the strength, 12 from the endurance, and 11 from the control group completed the study. **INTERVENTION:** Supervised physical training 3 times a week for 18 weeks. Strength training: 3 to 4 sets of 8 to 10 repetitions with a load of 60% to 75% of the subjects' 1-repetition maximum. Endurance training: track walking and step aerobics at an intensity of 50% to 80% of maximum heart-rate reserve. **MAIN OUTCOME MEASURES:** Ultrasonographic measurements of the quadriceps cross-sectional area (CSA), thickness, and weighted mean grey shades of vastus lateralis (MGSVL) and femur (MGSF). **RESULTS:** No significant interaction of group by time was observed in any of the outcome measures. The changes observed in CSA in the strength group correlated with those measured by computed tomography reported earlier. MGSVL decreased and MGSF increased in the strength group, suggesting a decreased proportion of fat in the muscle. **CONCLUSIONS:** Quantitative ultrasonography is a potentially useful tool for studying skeletal muscle in elderly women. The precision and accuracy of the method, however, should be improved to reveal the adaptation of aging muscles to short-term physical training and rehabilitation programs.

**Sipilä S, Elorinne M, Alen M, Suominen H, Kovanen V. Effects of strength and endurance training on muscle fibre characteristics in elderly women.** Clin Physiol. 1997 Sep;17(5):459-74.

#### Abstract

The effects of 18 weeks' intensive strength and endurance training on fibre characteristics of the vastus lateralis muscle were studied in 76- to 78-year-old women. Type I and type IIa fibres constituted over 90% of the cell population and were almost equally represented. No changes were observed in the proportions of the different fibre types. When comparing the baseline and the 18-week measurements within the groups, the strength group showed a mean increase of 34% (P = 0.028) in mean type I fibre area. The frequency histograms showed an increased proportion of larger type I fibres after strength training and a decreased proportion of smaller type IIa fibres after endurance training. In the control subjects, the proportion of smaller type I and type IIa fibres increased during the

experimental period. The results indicate that intensive strength training induces type I fibre hypertrophy, whereas the effects of endurance training are less evident. The considerable variation found in the change in muscle fibre cross-sectional areas is also noteworthy.

**Kallinen M, Sipilä S, Alen M, Suominen H. Improving cardiovascular fitness by strength or endurance training in women aged 76-78 years. A population-based, randomized controlled trial. *Age Ageing*. 2002 Jul;31(4):247-54.**

**BACKGROUND:** there have been few population-based, randomized controlled trials on the effects of strength or endurance training on cardiovascular fitness in older women. **OBJECTIVE:** to study the effects of strength or endurance training on cardiovascular fitness in women aged 76-78 years. **DESIGN:** a population-based, randomized controlled trial. **SETTING:** exercise laboratory in a university faculty of sport and health sciences. **SUBJECTS:** we randomly assigned 42 medically-screened women aged 76-78 years, drawn from the population register to strength (n=16), endurance (n=15) or control (n=11) groups. **METHODS:** subjects in the two exercise groups performed a supervised, individually tailored 18-week strength or endurance training programme. Controls continued with physical activity at their normal level. **RESULTS:** the strength training group showed an increase in cycle ergometer peak power from 68.1 to 70.3 W (P=0.035 compared with controls). Their peak power per kg body weight increased from 1.02 to 1.05, while that of the endurance training group increased from 0.91 to 0.93 (P=0.027 and P=0.049 respectively). Peak oxygen uptake increased from 18.1 to 19.7 ml x kg(-1) x min(-1) in the strength and from 17.1 to 18.2 in the endurance group (non-significant). Six subjects (19%) in the exercise groups withdrew from the study because of health problems. **CONCLUSIONS:** even with its limitations, the study suggests that the effect of 18-week strength or endurance training on cardiovascular fitness among women aged  $\geq 75$  is relatively small. Furthermore, health problems can emerge during training programmes in medically-screened elderly women