Shared genetic effect on muscle strength, muscle power and maximal walking speed in older female twins

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Introduction
Muscle weakness is associated with reduced walking speed and an increased risk of disability, particularly among older people. Although strength, power and walking speed are highly correlated, previous studies have investigated the heritability of these traits separately. Currently, it is not known whether there are genes having a general effect on functional capacity or if the contribution of genes is specific for muscle performance and walking speed. The purpose of the present study was to examine whether isometric knee extensor strength, leg extensor power and maximal walking speed shared genetic or environmental effects in common.

Methods
Muscle performance and maximal walking speed were measured as part of the Finnish Twin Study on Aging from 101 monozygotic (MZ) and 116 dizygotic (DZ) female twin pairs aged 63-76 yr. Maximal voluntary isometric knee extensor strength (IKES) was measured on the dominant side in a sitting position using an adjustable dynamometer chair (Good Strength, Mëttur LTD, Finland). Leg extensor power (LEP) of single leg was measured using the Nottingham Leg Extensor Power Rig (Bassey and Short 1990). First, the dominant leg was measured, followed by the non-dominant leg. In the muscle performance for each subject the best performance with the highest value was accepted as the result. Maximal walking speed (MWS) over 10 meters was measured in the laboratory corridor using photocells for timing. Test was done twice and the faster performance was documented as the result. Quantitative genetic models for twin data were constructed using the Mx-program.

Results
The bivariate genetic model for IKES and MWS (Fig. 1). In the final reduced ACE model strength and walking speed shared a genetic effect (A1) in common. Additionally, both IKES and MWS have their own specific non-shared environmental effects (E1, E2). Remaining variance in walking speed was accounted for by specific shared environmental effect (C2). The bivariate genetic model for LEP and MWS (Fig. 2). Eventually, a reduced ACE model was obtained. Moreover, AE model was fitted well to data. The reduced ACE model was consequently selected as it offered the most appropriate theoretical interpretation of the present data. This model contained genetic effect (A1) in common for LEP and MWS, and specific shared environmental effect (C1, C2) and non-shared environmental effect (E1, E2) for LEP and MWS. In the trivariate genetic modelling, IKES, LEP and MWS had a genetic effect in common accounted for 47% (95 % CI 33-60%) of the variation in IKES, 36% (95% CI 22-49%) in LEP and 26% (95% CI 14-40%) in MWS. These three traits also had the non-shared environmental effect in common explaining 12% (95% CI 11-62%) of the variation in IKES, 16% (95% CI 2-51%) in LEP and 3% (95% CI 0-12%) in MWS. Remaining variance was accounted for by trait specific environmental effects.

Conclusion
The results of the present study showed that muscle strength and muscle power have a common genetic background with maximal walking speed. However, on the average half of the variation in traits was explained by environmental effects, which emphasizes the importance of the physical activity, training and interventions to maintain and improve functional performance. The common genetic effect explained partly the phenotypic correlation between these traits.

References