Does long-term exposure to skiing enhance dynamical leg control in old age?

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Multiple studies have reported age-related declines in neural control including rate of force development (RFD) [1, 2]. The ability to generate force and motion quickly (i.e., a high RFD) is a key component in preventing falls, a major risk in adults over the age of 65. Exposure to certain types of training and activity has been shown to change muscle structure (e.g., fiber type and cross-sectional area) and induce neural adaptations that affect the RFD, force magnitude, recruitment, and duration of muscle activation [3]. This study retrospectively investigated the effects of long-term exposure to competitive skiing on age-related changes in dynamical control of the leg with the recently validated Lower Extremity Dexterity (LED) test. This test is based on the ability to use low forces to compress a compliant and slender spring prone to buckling with the foot [4]. Subjects were instructed to use their right foot to compress the spring as far as possible (Fig. 1), reach the maximal level instability they can control, and hold it for at least ten seconds (Fig. 2).

The control group consisted of thirty-three healthy older adult participants (11M, 22F; 74.9±8.6 yrs) who regularly participated in exercise regimens. The treatment group contained thirty-eight healthy skiers (27M, 11F; 70.2±7.6 yrs) who participated in competitive skiing at an international level and have skied an average of 62.7±11.5 years and 53±33 days during the last year. We found no significant differences between the two groups in mean LED test performance. However, the treatment participants tended to demonstrate less age-related decreases in LED test performance. To further investigate this, we sub-divided the subjects by gender and did linear regressions with respect to age, (Fig. 3). While there were no significant differences in performance between male skiers and non-skiers, there were significant differences between female skiers and non-skiers ($p < 0.001$). Female participants with long-term exposure to skiing actually improved in performance with age. These results, together with the known differences in LED test performance between young men women [4], underscore the need to investigate gender differences in motor control and its response to treatment.

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Figure 1. Experimental set-up for LED test. The test limb posture was standardized (i.e. hip and knee flexion angles between 75–80°) with the foot positioned on the test device. Participants were positioned in an upright partially seated posture on a bicycle saddle. The left foot was positioned such that the hip and knee were extended. Participants were instructed to support their weight equally through the bicycle saddle and the left leg to unload the right leg. The forearms rested on a crossbar adjusted to the level of the xiphoid process. Visual feedback was provided.

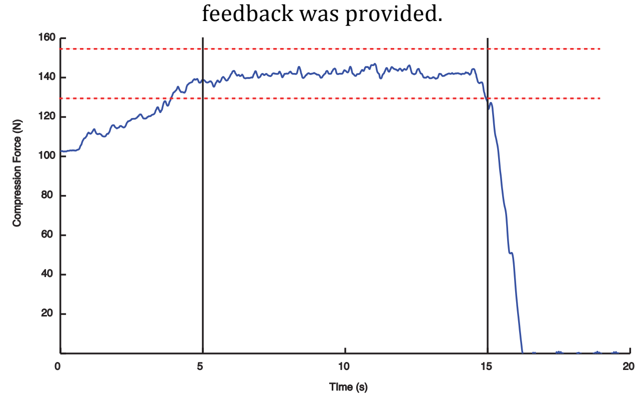

Figure 2: Sample data from LED test. The dependent variable for the LED-test was the highest average vertical force over during the sustained hold phase of each trial. Maximal values were considered for analysis if the coefficient of variation was ≤ 10% for each moving window time step. The mean of the best three trials was used for analysis.

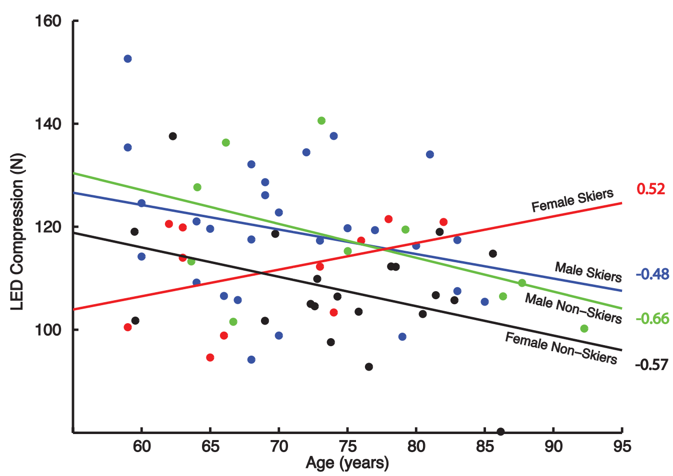

Figure 3: LED test performance versus age. Regressions of LED test performance vs. age for the four subgroups. While both male and female skiers demonstrated less decreases in age-related performance, performance from female skiers improved significantly with age. The slope of female skiers was significantly greater than female non-skiers ($p < 0.001$). There were no significant differences between slope of the fit lines for male skiers and non-skiers.