Association Between Peak Vertical Ground Reaction Forces During Running and Jumping in Collegiate Distance Runners
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Asymmetrical peak vertical ground reaction forces (pVGRF) during running have been associated with patellofemoral pain and other overuse injuries. Comparing the magnitude and sidedness of pVGRF asymmetries during running to asymmetries during other tasks, such as jumping, may provide useful information regarding the source of the asymmetry and potential injury risk.

**Purpose:** To determine the association between pVGRFs during jumping and running in healthy, collegiate cross country runners and assess a potential gender difference in the strength of association.

**Methods:** Data from 39 healthy NCAA Division I cross country runners (men, 20; age: 20.1 ± 1.1yr; height: 1.7 ± 0.1m; weight: 62.5 ± 8.6kg) were reviewed. Ground reaction forces were recorded during three counter-movement jumps and treadmill running at 3.80m/s; pVGRFs were averaged across jumps and gait cycles, respectively. Directional, between-limb percent asymmetry in pVGRFs during the jump takeoff phase and stance phase of the gait cycle were calculated. Between-limb asymmetry was assessed using a paired t-test. Associations between pVGRF during jumping and running were assessed using Pearson’s r correlations.

**Results:** The pVGRFs were similar (p > 0.26) between limbs during both running (right, 26.3 ± 2.2 N/kg; left, 26.2 ± 2.3 N/kg) and jumping (right, 10.2 ± 0.9N/kg; left, 10.3 ± 1.1N/kg). On average, runners demonstrated 2.2 ± 1.6% and 4.9 ± 4.2% asymmetry during running and jumping, respectively. Among all runners, there was a significant, positive correlation between pVGRF asymmetry during jumping and running (r = 0.530, p = 0.001). When assessing genders separately, the association increased among women (r = 0.699, p = 0.001) and became non-significant among men (r = 0.420, p = 0.054).

**Conclusion:** In collegiate cross country runners, the sidedness of asymmetry in pVGRFs during jumping was similar to those during running. Asymmetries during jumping were twice as large as those during running. The jumps were performed as a maximum effort task, which may have contributed to increased asymmetries compared to those observed during running. As the association was stronger among women runners, differences between limbs may be carried across tasks in women more so than in men.