Toe flexor strength in elite female gymnasts compared to toe flexor strength-trained men

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Summary

The strength of toe flexor muscles (TF) seems to create a good prerequisite for jump performance. Since gymnastics is a typical jumping and landing sport, we expected increased TF strength in elite gymnasts. The analysis showed that elite female gymnasts' TF revealed 80% to 86% higher strength compared to male sport students, and the same strength level compared to TF strength-trained men. TF in elite gymnastics seem to be highly loaded and have to be of particular interest for training and performance enhancement.

Introduction

There is some evidence that intrinsic foot muscles propel the body forward during locomotion [1]. Nearly 80% of intrinsic foot muscles consists of toe flexor muscles (TF) [2] proceeding from the heel to the distal phalanges of the toes. TF' strength capacity has the potential to enhance jump performance [3]. Since the ability to jump is a performance-limiting factor in gymnastics, we hypothesized that elite female gymnasts' TF strength is higher than in male sport students, but similar to TF strength-trained men.

Methods

28 female gymnasts (15 ± 2 y, 47 ± 9 kg, 1.56 ± 0.09 m) of the German national team and a basic control group of sport students (n = 28, 25 ± 3 y, 77 ± 8 kg, 1.83 ± 0.06 m) performed three maximum voluntary isometric contractions (MVC) of TF for each foot. TF strength was determined by measuring the moment about the transverse axis of a custom-made dynamometer in 25 degrees toe dorsiflexion. The external moments of force about the axis represented the moments of force produced by the TF [3]. The best of three trials was used for further analysis. Peak moments were determined as the mean value of a 2 s time window of the plateau region. Data were compared to a previous study with the same dynamometer, where a TF strength training group (15 men, 24 ± 4 y, 77 ± 9 kg, 1.85 ± 0.07 m) performed a heavy resistance TF strength training with 90% of MVC for 7 weeks [3]. Statistics: Kolmogorov-Smirnov, unpaired t-test.

Results and Discussion

TF strength significantly differed ($p < 0.001$) between elite female gymnasts (left: 0.41 ± 0.08 Nm kg^{-1}, right: 0.45 ± 0.09 Nm kg^{-1}) and male sport students (left: 0.22 ± 0.05 Nm kg^{-1}, right: 0.25 ± 0.06 Nm kg^{-1}). There were no significant differences ($p > 0.05$) between the TF strength of elite female gymnasts and the male strength training group after 7 weeks of TF strength training (left: 0.38 ± 0.07 Nm kg^{-1}, $p = 0.07$, right: 0.40 ± 0.08 Nm kg^{-1}, $p = 0.07$).

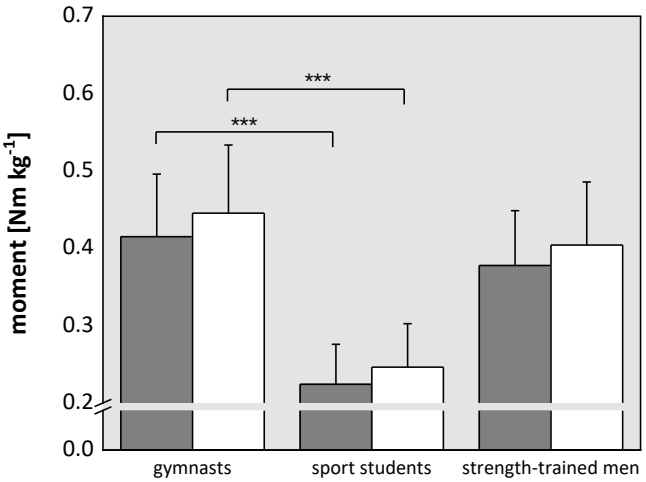

Figure 1: Moments about the dynamometer's axis normalized to body mass caused by TF contraction for the left (grey) and right (white) foot (***$p < 0.001$)

Adolescent female gymnasts showed 80% to 86% higher TF strength than male sport students, but nearly the same strength level as adult men after 7 weeks heavy resistance TF strength training [3].

Conclusions

TF in elite gymnastics seem to be highly loaded and have to be of particular interest for training and performance enhancement.

References

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