Comparison of horizontal ground reaction force and vertical stiffness in braking and propulsion phase between normal and over striding runners.

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Summary

The study investigates the differences in anteroposterior ground reaction force and vertical stiffness between normal striding and over striding runners during braking and propulsion phases. Amateur runners aged 18-25 years with at least two years of experience in running were analyzed using 2D video analysis and force plates. Key variables measured include Breaking/Propulsion (B/P) time ratio, Peak Braking Force (PBF), Peak Propulsion Force (PPF), Ground Contact Time (GCT), and mass specific vertical stiffness. Statistical analysis revealed significant differences between the two groups, highlighting how over striding affects running efficiency and injury risk. Optimizing running form is crucial for performance enhancement and injury prevention.

Introduction

Running is a fundamental form of human locomotion and stands out as one of the most accessible and popular forms of exercise worldwide. However, improper running form can lead to various acute and chronic musculoskeletal injuries, such as achilles tendinopathy, medial tibial stress syndrome, patellofemoral pain syndrome, plantar fasciitis, and ankle sprains [1].

Running consists of two primary phases: the stance phase, during which the foot makes contact with the ground, and the swing phase, during which the foot is lifted off the ground. The stance phase can be further divided into a propulsion phase and a braking phase based on the direction of the horizontal ground reaction force (GRF) [2].A critical factor influencing running performance is vertical stiffness, vertical stiffness is defined as the ratio of the center of mass's (CoM) vertical displacement to the vertical force experienced while running. Optimizing vertical stiffness not only enhances propulsion but also minimizes energy loss, contributing to improved overall running efficiency and speed [3]. Ultimately, running performance can be significantly affected by over striding. Understanding these dynamics is essential for improving running technique and reducing injury risk.

Methods

The subjects of this study was amateur runners aged 22 ± 3 years with minimum two years of running experience were selected using simple random sampling method and sorted as normal striding runners (n_1=15) and over striding runners (n_2=10) with absolute shank angle at the instant of ground contact of a stride using 2D video analysis with 2 IPHONE 13 mobile cameras and KINOVEA 0.9.5 [4]. Five reflective markers had been placed on the bony land marks of lower body. For data collection, subjects were asked to perform 3 trials of running for 30 meters by placing either left or right foot according to the stride pattern on the embedded KISTLER 9287CAQ01 force plates were analyzed. The running speeds of the subjects were monitored in a range between 10 and 15 kilometers per hour with the verbal feedback provided by the researcher using calculation. The following variables have been measured and analyzed: Braking/propulsion time ratio, Peak braking force, Peak propulsive force, Ground contact time and Mass specific vertical stiffness measured with vertical displacement of COM using 2D video analysis [3]. IBM SPSS software was used to independent t-tests to compare the means at a significance level of 5%.

Results and Discussion

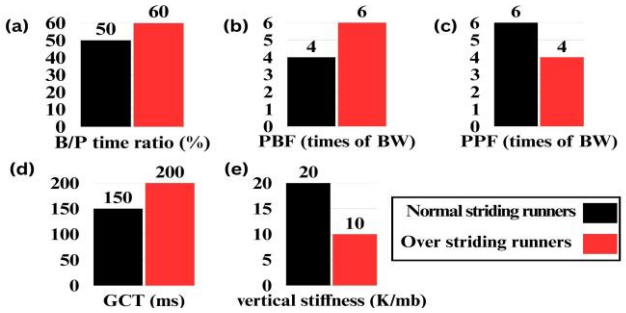

Figure 1: Graphs illustrates the difference on variables between the Normal striding and Over striding runners.

Conclusions

The finding shows that there was a significant difference between all variables among Normal striding and Over striding runners. B/P time ratio, PBF and GCT were greater in Over striding runners than Normal striding runners. Same way PPF and Mass specific vertical stiffness were lesser in Over striding runners than Normal striding runners. These difference shows that over striding running are mechanically inefficient and can lead to many musculoskeletal injuries.

References

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