Introduction

Biomechanics of sprint running has long been the subject of scientific interest. Although a number of studies have described various aspects of ground reaction forces (GRF) and kinematics during sprinting, there is little information available concerning the variability or repeatability of biomechanical parameters of sprint running. Furthermore, no data exist about reproducibility for older runners. The goal of the present study was to investigate step-to-step variability in GRF parameters of maximum-speed sprinting in young and older runners.

Methods

Seventeen young adult (YA, 24±4 yr) and 23 older (OA, 70±4 yr) male athletes were examined. The athletes had a long-term sprint training background and success in international or national championships in sprinting events. After the warm-up the subjects ran two times maximal 60m sprints on an indoor synthetic track with spiked running shoes. Vertical and horizontal GRF were measured during the maximal speed phase (from 30m) using a 10m long force platform. Maximal and average values of the vertical (Fz), horizontal (Fy) and resultant (Fr) GRF, vertical impact peak (Fz-impact), maximal and average impact loading rates (LR-max, LR-ave), and contact time were calculated. The transition point from negative to positive value in the horizontal force-time curve was used to divide the force components into the braking and propulsion phases. The coefficient of variation (CV %) was used to determine the step-to-step variability of the selected parameters. The CV was calculated from 4 steps for the dominant and non-dominant side separately. Acceptable level of variance was considered a CV of <10%. The group differences in CVs were assessed by ANOVA. A paired t-test was used to determine side-to-side differences.

Results

There were wide-ranging levels of variability in the GRF parameters, with CVs ranging from 3.0 to 17.4% in YA and from 3.2 to 21.1% in OA group. In both YA and OA the CV was highest in the LR parameters (13.2-21.1%) and lowest in the parameters of Fz (4.1-5.3%), Fr (3.7-8.5%) and contact time (3.0-3.5%). A moderate variability was observed in the Fz-impact (7.4-11.7%) and Fy (6.4-12.9%) parameters. There were no significant differences in the CVs between dominant and non-dominant side for any of the variables in either group. The CVs of the LR-max, LR-ave and Fy-max of the braking phase and Fy-ave and Fy-max of the propulsion phase showed higher values in OA than in YA (p<0.05-0.01).

Conclusions

Our study showed that maximal and average vertical and resultant forces as well as contact time were the most consistent force platform measures of sprint running in young and older runners. In contrast, vertical loading rate and some horizontal force parameters did not show acceptable reproducibility and may require several trials to produce representative data. Age was found to increase variability in certain GRF variables and should be considered when using these parameters.

Keywords: Running, Ground Reaction Forces, Variability

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