

THE RELATIONSHIP BETWEEN BIOLOGICAL MATURITY AND ASYMMETRIES IN BIOMECHANICAL PARAMETERS AMONG YOUTH HANDBALL PLAYERS

*Gergo Simon¹, Peter Bakonyi¹, Tamas Dobronyi¹, Bettina Beres¹, Fanny Zselyke Ratz-
Sulyok^{1,2,3}, Csilla Jang-Kapuy^{1,2,3}, Marton Ferenc Izso², Annamaria Zsakai^{1,2} and
Tamas Szabo¹*

¹Hungarian Handball Federation, Directorate of Sport Science and Diagnostics, Budapest, Hungary; ²Eotvos Lorand University, Faculty of Science, Department of Anthropology, Budapest, Hungary; ³Eotvos Lorand University, Faculty of Science, Doctoral School of Biology, Budapest, Hungary

Background: Rapid growth and changes in body proportions during puberty may cause a transient decline in motor coordination and increase injury risk. Force parameters measured during the landing phase of countermovement jumps (CMJ) may serve as sensitive biomechanical indicators of neuromuscular control. Trunk muscle strength and stabilizing capacity are essential for coordinated segmental movement.

Objective: This study aims to examine how biological maturity status and trunk strength jointly influence landing force mechanics during vertical jumping. It also investigates how landing asymmetries change over time in more mature athletes in relation to the optimization of movement coordination.

Subjects and methods: The analysis included data from 407 male and female youth handball players aged 14–17 years. Biological maturation was categorized by peak height velocity status in boys and age at menarche in girls. Vertical jumps were recorded using a Vald ForceDecks force platform at 1000 Hz. The analysis focused on biomechanically relevant asymmetry parameters during the landing phase. Trunk muscle strength was measured using a BioniX isokinetic trunk dynamometer in rotation, flexion–extension, and lateral flexion at an angular velocity of 30°/s, based on mean work values. Data processing is currently ongoing.

Results: We hypothesize that peak force asymmetry during the CMJ landing phase may temporarily increase around peak height velocity and menarche, particularly in athletes with lower trunk strength. This asymmetry is expected to decrease in later stages of biological maturation.

Conclusions: The study is expected to clarify changes in adolescent movement of coordination and to support the importance of technical retraining of sport-specific movements in youth handball players.

Keywords: Biomechanics; Biological maturation; Bone age; Peak height velocity; Trunk strength; CMJ; Asymmetry.