

MULTIMODAL ASSESSMENT OF BODY STRUCTURE IN YOUNG ELITE HANDBALL PLAYERS USING DEXA, 3D BODY SCANNING AND ANTHROPOMETRY

*Csilla Jang-Kapuy^{1,2,3}, Fanny Zselyke Ratz-Sulyok^{1,2,3}, Peter Bakonyi¹, Bettina Beres¹,
Tamas Dobronyi¹, Gergo Simon¹, 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: Accurate body composition assessment is essential in elite sports for athlete monitoring and performance optimization. Dual-energy X-ray absorptiometry (DEXA) is considered a reference method, however, its routine application is limited by cost, time requirements and the need for specialized equipment. Three-dimensional (3D) body scanning has emerged as a rapid, non-invasive and radiation-free alternative but its validity in adolescent elite athletes remains underinvestigated.

Objective: This study aimed to compare body structure parameters measured by DEXA, 3D body scanning and traditional anthropometry in young elite handball players, and to assess the potential of 3D body scanning as a tool for body structure evaluation in elite sports.

Subjects and methods: A total of 144 adolescent elite handball players participated in the study. Body composition was assessed using DEXA and a 3D body scanner using a standardized protocol. DEXA-derived variables included regional total mass and lean soft tissue mass of the upper limbs, lower limbs and trunk. The 3D scanner provided segmental body volumes and circumferential measurements. Dominant and non-dominant limbs were analysed separately. Pearson correlation analyses and linear regression models were used to evaluate relationships between measurements obtained by the methods.

Results: Very strong correlations were found between 3D-derived segmental volumes and DEXA-derived regional total mass values ($r = 0.936\text{--}0.983$). Strong associations were also observed between segmental volumes and lean soft tissue mass ($r = 0.836\text{--}0.952$). Significant correlations were identified between conventional anthropometric circumferences and corresponding 3D-derived measurements ($r = 0.855\text{--}0.942$).

Conclusions: As a rapid, non-invasive, radiation-free method, 3D body scanning may represent a practical tool for routine athlete monitoring and large-scale field assessments in elite youth sports.

Keywords: Body composition; DEXA; 3D body scanner; Handball; Adolescent athletes.