Sex Differences in Anthropometrics and Heading Kinematics Among Division I Soccer Players
Bretzin AC*, Mansell JL*, Tierney RT*, McDevitt J*: *Temple University, Philadelphia

Context: A direct or indirect blow to the head or body transmitting resultant acceleration, deceleration and possibly rotational forces to the brain may cause a concussion. In soccer, heading to redirect the ball is inherent to the sport and has been identified as a potential mechanism of injury for concussion. It is theorized that stronger neck musculature may reduce such kinematics, by co-activating opposing muscle groups. Objective: To evaluate the relationship between anthropometrics and soccer heading, with an emphasis on differences between male and female collegiate soccer players. Design: Cross-sectional. Setting: Laboratory. Patients or Other Participants: A total of 5 male (age = 19.2 ±1.09 years, height = 177.40±8.79 cm, mass = 70.45±3.96 kg) and 8 female (age = 20.25±0.70 years, height = 158.73±36.12 cm, mass = 66.98±5.25 kg) Division I soccer players with at least five years of soccer heading experience, with no history of head or neck injury in the last six months. Interventions: Anthropometric and neck strength measurements were taken in six directions (i.e., flexion, extension, right and left lateral flexion and lateral rotation). Participants headed the ball ten times while wearing an accelerometer secured to the back of their head. Soccer balls were projected from a JUGS machine at varying speeds (i.e., 25 mph, 40 mph). Kinematic measurements were recorded for each header using a GForce tracker. Data were analyzed using descriptive and inferential statistics. T-tests were used to identify differences in anthropometrics, strength, and head impact kinematics between sexes. Pearson correlations were used to assess associations between ball speed, anthropometrics, and kinematic measures. All analyses were evaluated using SPSS (version 22; SPSS Inc., Chicago, IL), with a significance level set at an alpha level of \( p \leq .05 \) for all analyses. Main Outcome Measures: Dependent variables included anthropometric measurements and head impact kinematics (i.e., linear acceleration, rotational velocity) at two ball speeds. Results: Sex differences existed in neck girth (\( t = 5.09, p < .001 \)), strength (\( t = 3.006, p = .012; t = 4.182, p = .002 \)), and kinematic measurements (\( t = -2.628, p = .024; t = -2.227, p = .048 \)). Neck girth had negative correlations with both linear acceleration (\( r = -.599, p = .031 \)) and rotational velocity (\( r = -.551, p = .012; r = -.652, p = .016 \)). Also, stronger muscle groups had lower linear accelerations at both speeds (\( p < .05 \)). Conclusions: These findings deepen the understanding of the role of the head-neck segment during a head impact. For this subject demographic, sex differences existed between isometric neck strength, neck girth, and head impact kinematics. Neck girth and neck strength are factors that may limit head impact kinematics. Word Count: 442.