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Abstract

Predicting the risk of anterior cruciate ligament rupture using muscle strength and flexibility in female football players

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Female football players are up to six times more likely to rupture their anterior cruciate ligament (ACL-rupture) than their male counterparts (Arendt & Dick, 1995; Junge & Dvorak, 2004). A very high incidence of anterior cruciate ligament (ACL) injuries has also been observed, ranging from 1 to 7 per 1,000 hours of play (Schiffner et al., 2018; Del Coso, Herrero, & Salinero, 2018; Larruskain et al., 2018). ACL-rupture in female competitive football (FCF) players also causes personal and professional impairments, which are associated with high economic costs for both players and the football clubs (Mather et al., 2013; Swart et al., 2014). Therefore, the prevention of non-contact ACL injuries is of great importance in sports traumatology. Therefore, the aims of the present research study were: 1) to predict risk factors for ACL-rupture based on muscle lower-limb strength and flexibility, and 2) to establish a diagnostic cut-off for factors related to ACL-rupture in FCF players. A prospective cohort study was conducted to predict risk

factors for ACL-rupture in 121 FCF players (aged 14-33 years). The independent variables such as age, anthropometric data, lower limb range of motion (ROM) and hip maximum isometric strength were measured. The model summary (Enter method) showed a significant relationship between the outcome variable (ACL-rupture) and the predictor variables (leg length, HAD-NH [hip adduction with neutral hip] maximal isometric strength, asymmetric ROM [AD-KE (ankle dorsiflexion with knee extended), AD-KF (ankle dorsiflexion with knee flexed) and HE (hip extension)], hip ROM [HIR (hip internal rotation with knee flexed) and HAB (hip abduction with knee extended)]) for H1 ($\chi^2(93) = 30.531$, $p < 0.001$). The Akaike Information Criteria and Bayesian Information Criteria for model fit were 30.24 and 51.79, respectively. The statistical value R_2 showed good model fit, 76.5% for Nagelkerke´s R2, 71.4% for McFadden´s R2 and 67.5% for Tjur´s R^2. The leg length (OR 2.689e+70 95%IC –54.831 to 379.171; p=0.143), HAD-NH maximal isometric strength (OR 1.029 95%IC –0.073 to 0.130; p=0.584), asymmetric ROM (AD-KE [OR 2.453 95%IC –0.006 to 1.800; p=0.051], AD-KF ([OR 0.356 95%IC –2.679 to 0.614; p=0.219] and HE [OR 2.669 95%IC –0.360 to 2.324; p=0.152]) and hip ROM (HIR [OR 0.418 95%IC –2.051 to 0.305; p=0.146] and HAB [OR 2.326 95%IC –0.226 to 1.914; p=0.122]) are not the predictor variables in FCF players. For ACL-rupture, the ROC curve analysis showed an AUC acceptable for the leg length (cut-off = 0.40 m, AUC = 0.771), HIR ROM (cut-off = 44º, AUC = 0.755) and asymmetric HE ROM (cut-off = 44º, AUC = 0.700). However, HAD-NH maximal isometric strength, asymmetric ROM (AD-KE and AD-KF) and hip ROM (HAD-HF and HAB) showed AUC values equal to or lower than 0.698, which indicates poor specificity and sensitivity. In conclusion, the predictor variables (leg length, HAD-NH maximal isometric strength, asymmetric ROM [AD-KE, AD-KF and HE] and hip ROM [HIR and HAB]) suggest a good-fitting model to explain future ACL-rupture. However, these individually evaluated tests are not in themselves a sufficient screening tool for the risk of future ACL-rupture. Future studies could predict the risk of ACL rupture by increasing the sample size of the ACL-rupture group.

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