Project Summary/Abstract

A large number of sports injury in minors (potentially over 1.75 million annually) are due to falls and collisions. In soccer, injuries from player collisions are most common, accounting for 57% of all injuries. Female soccer athletes are twice as likely as males to suffer serious musculoskeletal injury due to collisions, increasing their risk of debilitating long-term negative outcomes (i.e., osteoarthritis). Our pilot data indicate 59% of collisions in girls' soccer are unanticipated, that is, the athlete does not see it coming. Unanticipated collisions would, therefore, be preventable if specific training protocols can be designed to enhance mechanisms that support timely detection of upcoming collisions and drive appropriate motor responses. However, little is known about what these mechanisms might be and how they relate to collision risk. To fill this gap in knowledge, we propose a highly innovative approach that capitalizes on the biological concept of Phenotypic Plasticity (PP) to quantify an athlete's responsiveness to high risk collision scenarios. Here PP is computed based on measures of oculomotor dynamics and biomechanical responses and, therefore, reflect faulty perceptual-motor and neuromechanical mechanisms underlying increased collision risk. The overall objectives of this ancillary proposal are, therefore, to determine (a) how measures of PP related to unanticipated collision frequency and impact magnitude, and (b) how our augmented neuromuscular training (aNMT) intervention—the focus of the parent grant, U01 AR067997-01A1, to this application—affects such measures. Our central hypothesis, supported by our pilot data, is that lower PP relates to more unanticipated collisions and greater impact forces. We also hypothesize, based on published and pilot data, that aNMT is effective in promoting collision anticipation and the reduction of impact forces, through refinement of multimodal mechanisms that underlie PP. The proposed research will provide insight into mechanisms supporting adaptive sport behavior, and enhances the value of the parent project via the following expected outcomes: (1) identification of a highly sensitive PP-based risk profile for injuries related to unanticipated collisions, (2) identification of modifiable aspects of collision risk, and (3) expansion of the aNMT application to the prevention of contact injuries with identified mechanistic targets for eventual protocol enhancement. We will leverage the most applicable cohort from the parent grant (i.e., female soccer athletes) for the achievement of these outcomes: the critical first steps for improving detection of, and responses to, previously unanticipated collisions and the development of complete training protocols to optimize injury prevention efforts for contact sport athletes. This contribution will be significant for the prevention of collision-based musculoskeletal injury and associated long-term sequelae in young females.