Physiological and Neuromuscular Risk Factors of Preventable Musculoskeletal Injuries in the Army 101st Airborne Division (Air Assault) Soldiers: A Prospective Study

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Context: Musculoskeletal injuries have negatively impacted tactical readiness. The identification of prospective and modifiable risk factors of preventable musculoskeletal injuries can guide specific injury prevention strategies for Soldiers and health care providers. Objective: To analyze physiological and neuromuscular characteristics as predictors of preventable musculoskeletal injuries. It was hypothesized that Soldiers with prospective injuries would have reduced physiological and neuromuscular characteristics as measured at baseline. Design: Descriptive prospective-cohort study. Setting: Warrior Human Performance Research Laboratory. Patients or Other Participants: Initially, medical charts from 491 Soldiers were reviewed by certified athletic trainers. A total of 179 Soldiers (age: 26.8±5.9yrs, height: 69.1±3.0in, weight: 174.9±30.0lbs) had no injuries (NOI) and 129 Soldiers (age: 27.1±6.0yrs, height: 68.9±3.5in, weight: 177.2±30.3lbs) had at least one preventable musculoskeletal injuries (INJ). The rest of Soldiers were excluded from this analysis due to their medical records of traumatic injuries or other medical conditions. Interventions: All Soldiers participated in laboratory testing to examine their physiological characteristics, strength, flexibility, balance, and landing biomechanics. Injuries were tracked for 12 months following laboratory testing utilizing medical-chart document injury data. Soldiers were then divided into two groups (NOI and INJ) for group comparisons on physiological and neuromuscular characteristics. Main Outcome Measures: The following variables were collected at baseline: physiological characteristics (body composition using air-displacement-plethysmography, aerobic capacity during a graded treadmill running protocol, and anaerobic peak/mean power (Watts/kg) during the Wingate test), muscular strength (isokinetic knee flexion-extension and trunk rotation strength (%BW) and ratio), flexibility (hamstring and trunk rotation active range-of-motion), balance (single-leg eyes-open/closed balance on a force plate), and landing biomechanics (hip/knee flexion angles at initial contact and maximum during a double-leg stop-jump). Independent t-tests or Mann-Whitney U-tests were used for statistical analyses (p<0.05). Results: There were 157 preventable musculoskeletal injuries identified among the INJ group. The most commonly injured locations were ankle (17.8%), low-back (15.9%), knee (12.1%), and shoulder (10.8%). The INJ group had significantly less anaerobic peak power (INJ: 12.1Watts/kg, NOI: 13.1Watts/kg, p=0.002), mean power (INJ: 7.2Watts/kg, NOI: 7.6Watts/kg, p=0.019), knee flexion/extension strength ratio (INJ: 0.47, NOI: 0.50, p=0.001), and trunk rotation strength (INJ: 138.9%BW, NOI: 147.6%BW, p=0.040). Additionally, the INJ group had significantly poor balance (higher values) in the medial-lateral (INJ: 11.9N, NOI: 9.7N, p=0.046) and vertical directions (INJ: 18.0N, NOI: 12.3N, p=0.004) during the eyes-closed condition. There were no significant differences in body composition, flexibility, and landing biomechanics. Conclusions: Soldiers who later sustained preventable musculoskeletal injuries had worse anaerobic peak/mean power, strength, and eyes-closed balance.
Athletic trainers and other health care providers should be aware of those risk factors when working with Soldiers. Future analyses should be conducted to investigate the effectiveness of targeted intervention exercises (based on risk factors) on preventing new or recurrent musculoskeletal injuries. **Word Count:** 449.

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