Static Analysis of Lumbar Spine Compression Load Imposed by Olympic-Style Weightlifting in Female College Athletes

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RESULTS

- Analysis of back squat ascent failed to identify any meaningful associations between loads and low back dysfunction
  - None of 21 participants exceeded NIOSH L5-S1 3400 N Lower Limit during ascent
  - 88% (23/26) of participants exceeded NIOSH L5-S1 Lower Limit during the power clean pull stage
  - 8% (2/26) of participants exceeded NIOSH L5-S1 Lower Limit during the power clean catch phase
  - None of 26 participants exceeded NIOSH L5-S1 Maximum Permissible Limit
- Analysis of power clean "catch" identified possible thresholds associated with elevated risk for low back dysfunction
  - ≥ 2591 N (583 lbs) L5-S1 load identified as threshold associated with ODI score ≥ 2 (Figure 4)
  - ≥ 50 kg (110 lbs) bar weight identified as threshold for avoidance of low back dysfunction (Figure 5)
  - ≥ 118 cm (70 in) height identified as threshold at which L5-S1 compression load may increase risk (Figure 6)
- Combination of height and bar weight identified as "catch" threshold for ≥ 2591 N (583 lbs) L5-S1 load (Figure 8)
- ≥ 7878 cm*kg associated with 24 X increase in odds for L5-S1 load corresponding to low back dysfunction
- Regression equation calculated to estimate bar weight for a given height to minimize risk (Figure 9, Table 1)

PARTICIPANTS AND PROCEDURES

- 28 NCAA Division I female athletes (20.0 ±1.1 years of age; 170.6±8.8cm; 69.8 ±14.5kg)
- Survey for quantification of low back disability (0-100 score) administered: Oswestry Disability Index (ODI)5
- 3D Static Strength Prediction Program™ (3DSSPP; Center for Ergonomics, University of Michigan, Ann Arbor, MI)6
- 73 still images (back squat ascent: 21; power clean: 26 pull, 26 catch) uploaded (Figure 4)
- Compressive forces on L4-L5 and L5-S1 motion segments estimated
- NIOSH back compression limits for injury avoidance based on general working population
  - Lower Limit for maximum safety = 3400 N (770 lbs); Maximum Permissible Limit = 6400 N (1430 lbs)
- ODI score used to categorize athletes as free from low back dysfunction (0) or having low back dysfunction (≥ 2)
- Receiver operating characteristic (ROC) analyses identified thresholds for low back dysfunction risk

CLINICAL RELEVANCE

- A strong association appears to exist between intervertebral compression level and low back dysfunction
  - Both height and bar weight appear to be important determinants of the potential for degenerative changes
  - For a given height, the recommended maximum bar weight may reduce risk for gradual or sudden injury
  - A high core strength level and proper lifting technique may allow for safe use of greater bar weight
  - An association between a low level of low back dysfunction and lower extremity injuries has been established7

REFERENCES