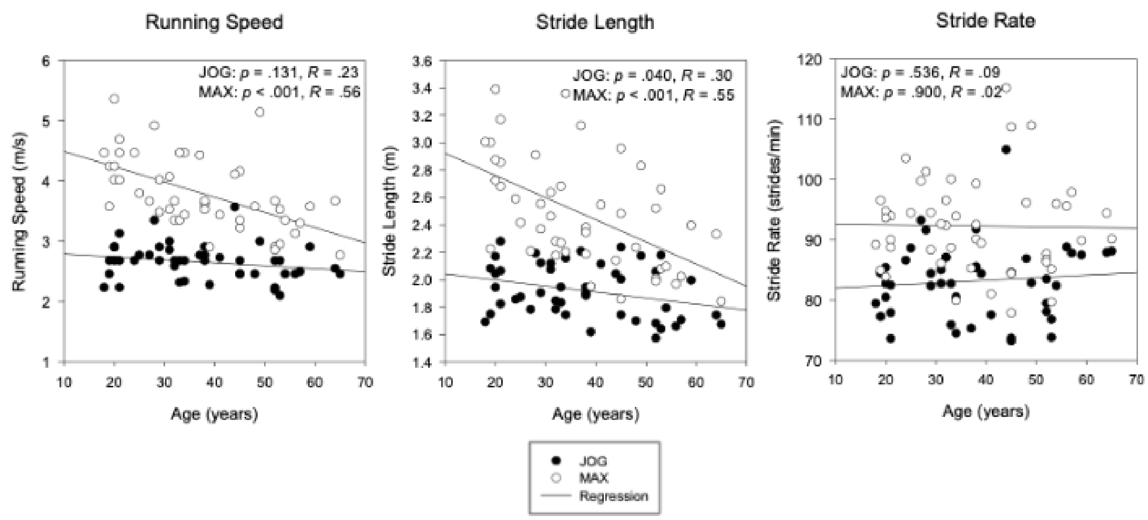
Figure 1. Correlations between age and running speed, stride length, and stride rate.



456

Exercise Selection And Fastball Velocity: Relationships In Collegiate Pitchers

Jesse D. Howell[1], Nathaniel J. Holmgren[1], Eric M. Cressey[2], J. Mark VanNess[1], John O'Neil[2], Jordan Kraus[2], Courtney D. Jensen[1]. [1]*University of the Pacific, Stockton, CA.* [2]*Cressey Sports Performance, Hudson, MA.*

In collegiate and professional baseball, fastball velocity is inversely correlated with opposing batting average. Although the importance of velocity is widely accepted, there is no consensus on the exercises that most accurately predict it.

PURPOSE: To examine relationships between fastball velocity and isotonic power output in diverse exercise motions.

METHODS: We recorded fastball velocity in 13 collegiate baseball pitchers using Rapsodo (Rapsodo Inc., USA) and conducted comprehensive biomechanical testing with Proteus (Proteus Motion Inc., USA). Players underwent baseline testing, followed by a 6-week training intervention, and were then retested. At both assessments, players completed 6 repetitions at 12 lb of magnetic resistance on 8 upper limb exercises (unilateral and bilateral biceps curl, triceps extension, horizontal row, and horizontal press) and 3 trunk and lower limb exercises (straight-arm trunk rotation, lateral bound, and vertical jump). Mean peak power (watts) across all repetitions was tabulated for each movement. Simple linear regressions evaluated associations between fastball velocity and power output for each movement at both time points.

RESULTS: Subjects were 20.3 ± 1.3 years of age and had a mean fastball velocity of 85.4 ± 4.2 mph. At baseline, the only exercise that significantly predicted velocity was lateral bound (p = 0.033). Mean lateral bound power was 165.1 ± 20.0 watts, and each additional watt predicted a 0.1 mph increase in velocity (R^2 = 0.164; 95% CI of β: 0.008 to 0.171). At follow-up, other positive relationships emerged. Each additional watt of power in lateral bound (p = 0.003; R^2 = 0.313; 95% CI of β = 0.016 to 0.071), two-handed triceps extension (p = 0.012; R^2 = 0.453; 95% CI of β = 0.013 to 0.082), two-handed horizontal press (p = 0.029; R^2 = 0.363; 95% CI of β = 0.009 to 0.140), and straight-arm trunk rotation (p = 0.013; R^2 = 0.232; β = 0.008 to 0.060) associated with increased fastball velocity.

CONCLUSIONS: At baseline, lateral leg power appeared to be the dominant contributor to pitching velocity. Following a training intervention, variability in upper limb power output exhibited relationships with performance. Coaches and training staff may consider focusing on these exercises in training prescriptions for collegiate pitchers.

457

Shock Attenuation Wavelet Transform Of Dominant Leg During A Fatiguing Run

Robbert P. van Middelaar[1], Marit A. Zandbergen[1], Allison H. Gruber, FACSM[2], Jasper Reenalda[1]. [1]*University of Twente, Enschede, Netherlands.* [2]*Indiana University Bloomington, Bloomington, IN.*

Running is associated with a high incidence of knee injuries. Neuromuscular fatigue is considered as main risk factor, suggesting that the body in a fatigued state is less able to attenuate impact forces sufficiently. This could lead to overloading and eventually injuries.

PURPOSE: Analyse vertical accelerations frequencies at the tibia (vTA) and sternum (vSA) with a Wavelet Transform to get insight in shock attenuation (SA) strategy of the body during a fatiguing run.

METHODS: 6 recreational runners (3F/3M, age 29.2 ± 12.8 years, height 182.8 ± 8.0 cm, weight 74.5 ± 7.5 kg , running >10 km per week for >1 year; uninjured in last 6 months; heel strikers) ran until exhaustion on a treadmill at 103% of their average 8 km race speed. Data were obtained overground on a 10-meter runway before and after the fatigue protocol with IMUs and an embedded 3D force plate. vTA and vSA were analyzed during stance with a Wavelet Transform (fig. 1), focusing on lower (0-9 Hz) - mid (10-25 Hz) - high (26-50 Hz) pseudo-frequency ranges, and impact (initial contact to first vTA peak instant times two) and active phase in time domain. SA was calculated in decibels (dB) from the vTA and vSA coefficient magnitudes.

RESULTS: Mean SA significantly decreased between non-fatigued and fatigued state in the lower pseudo-frequency range for both impact phase (-3.58 ± 0.89 to -2.52 ± 1.17 dB, p = 0.009) and active phase (-3.75 ± 0.93 to -2.73 ± 1.18 dB, p = 0.007). Other pseudo-frequency ranges showed no significant change (p > 0.05).

CONCLUSIONS: The body seems less able to attenuate low frequencies in fatigued state in both impact and active phase, indicating less attenuation by active attenuation mechanisms (joint motion with eccentric muscular contraction). This may be caused by a smaller range of motion or greater knee stiffness in fatigued state, possibly leading to future injuries. High frequencies are still well attenuated, SA by passive structures seem minimally affected by fatigue.