Biomechanical Analysis of Hurdling

Kale Hintz, Ericka Fischer, Jenny Suing

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Biomechanical Analysis of Hurdling

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Skill Objectives

- Clear the hurdle with the smallest decrease in horizontal velocity as possible
Special Considerations

- Height of athlete
  - stride length

- Height of hurdles

- Flexibility of athlete
  - specifically at the hip joint
Keys to Successful Hurdling

- Spending as much time as possible sprinting
- Spending as little time in the air as possible (a perfected clearance technique)

(Pierre Beaulieu, 2012)
Center of Mass

- Raise just above the hurdle to allow for clearance
- Lean forward while clearing hurdle to minimize center of mass elevation
  - Leaning forward allows for more aerodynamic posture

(Pierre Beaulieu, 2012)
**Projectile Motion**

- Minimize potential energy by reducing elevation
- Maximize kinetic energy by spending as much time as possible sprinting
- Vertical height directly affects time
- By keeping the center of mass low as possible the runner is able to decrease time
- By lowering the center of mass less initial velocity is required to clear the hurdle

(Pierre Beaulieu, 2012)
Momentum

Momentum is lost when:

- stutter-stepping occurs
- the hurdle is hit

*Hitting the hurdle is an inelastic collision*
Anatomy/ Function of Hurdling (Leg)

**Mono-articulating**
- Short head of Bicep Femoris
- Vastus muscles
- *Gluteus Maximus
- *Tensor Fasciae Latae
- Adductors
- Soleus

**These muscles provide**
- Stability and leverage
- Force & work generators
- Lose tension in quick movements
Anatomy/ Function of Hurdling (Leg)

**Bi-articulating**
- Psoas Major
- Hamstrings
- Bicep Femoris
- Semimembranosus
- Semitendinosus
- Rectus Femoris
- Gracilis
- Gastrocnemius

**These muscles provide**
- High speed movements
- Saves energy by allowing concentric work to be done on one end and eccentric on the other
- Transfers energy while resisting moments across adjacent joints (isometric function)
- Effects timing of muscle activation on vertical jump
Phases
Hurdling Phases

- Take-off Phase
- Flight Phase
  - Splitting
  - Clearance
  - Landing Preparation
- Landing Phase
Take-off phase

- *Aggressive* run at the hurdle
- Stay of ball’s of feet
  - allows for less braking effect which would otherwise lead to slower horizontal velocity
- Avoid sinking center of mass
- Shifting of lead leg, arms, and trunk must be performed simultaneously
Take-off phase

- Pelvic orientation
- Minimizing loss in velocity
- Athlete must maintain a high position of center of mass during take-off
- Lead knee is driven up and at the hurdle
Biomechanical errors

- Taking too long of a stride before take-off
- Last stride is too close to the hurdle
- Lead leg is brought out to the side
Flight Phase

- Three different phases
  - Splitting phase
  - Clearance phase
  - Landing Preparation

*The key to this phase is spending as little time as possible in the air*
Splitting Phase

- Hurdler assumes split position
- Opposite arm reaches for opposite leg
Clearance Phase

- Keep center of mass as low as possible
  - Leaning forward allows for easier movement of the trail leg
- Keeping vertical velocity low allows for less time in the air
Biomechanical Errors

- Vertical velocity is too high
- Trail leg is not brought high enough or is brought under the body
Landing Preparation

- The main characteristic is the opposed movement behavior of trail and lead leg
- Forward trunk lean is kept to continue momentum
Biomechanical Errors

- Shoulders are not lined up with hips
Landing Phase

- Landing in plantar flexion of the lead leg allows for minimal loss in horizontal velocity
- High knee rotation allows for better clearance of the hurdle
References

https://www.youtube.com/watch?v=qveS_0sF0mw&list=PLYhTif3-2kJBBTLd4fC7QL3uliAWsvvyZH&index=34


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