

BARRIER CLEARANCE IN THE 3000M STEEPLECHASE

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INTRODUCTION

The steeplechase is a 3000 meter track race consisting of 28 barriers and 7 barriers followed by a water pit. The water pit is 3.66m long. Each lap the runners hurdle four barriers followed by a water jump. Barrier heights for men are 0.914m (36 in) and barrier heights for women are 0.762m (30in).

One of the goals for steeplechase athletes is to minimize the loss of running speed while hurdling the barriers. Many coaches believe this can be accomplished by accelerating during the approach and minimizing jump height while still safely clearing the barrier [1]. Men should take off between 1.2 and 1.5 meters before the barrier. The landing should be around 1 meter past the barrier [2]. These values differ for women due in part to slower running speeds and lower barrier heights [3]. It has also been suggested that body clearance of 3 to 6 cm, keeping the lead leg slightly bent and leaning forward with the trunk at the point of hurdle clearance will help decrease time spent over the hurdle [1].

Previous studies have looked at speed but not body positioning in steeplechase hurdling. For the water jump, accelerating during the approach to the barrier resulting in a relatively long landing distance helps maintain race pace [3]. As the steeplechase race progresses, men and women hurdle the barriers with greater step lengths and speeds while race pace remains the same [3].

In order to effectively coach steeplechase hurdling, the optimal body positioning and movement must be determined. This study investigated how barrier clearance related to the percent loss of horizontal velocity during steeplechase hurdling between men

and women. Other characteristics of technique were measured to help explain barrier clearance findings.

METHODS

Two Canon Elura 60 digital video cameras were placed around the third barrier at the 2007 USA Track and Field Nationals men's and women's steeplechase finals. A survey pole calibration was performed to obtain three-dimensional body positioning for every lap of the top 8 finishers. We were unable to digitize every lap due to other athletes or photographers blocking camera views. However, a total of 20 jumps for the women and 33 for the men were analyzed. Barrier clearance was defined as the height of the center of mass relative to barrier height when the athlete was at the high point of the jump. Two linear regressions were performed (one each gender) of clearance height relative to the percent loss of velocity from the penultimate step to the first step after landing.



Figure 1: Step definitions.

RESULTS AND DISCUSSION

Barrier clearance was closely related to the percent of velocity lost among men ($R^2 = 0.57$, $p < 0.01$), but not among women ($R^2 = 0.08$, $p < 0.25$) (Figure 2).

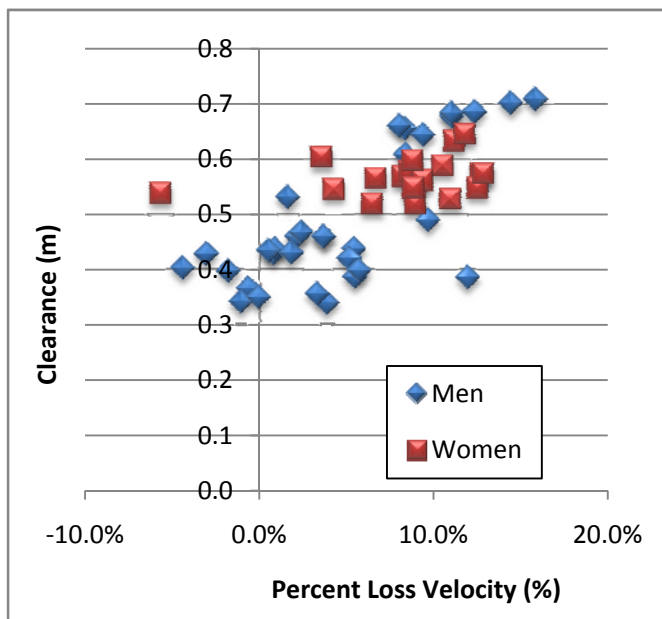


Figure 2: Results of the regression analyses ($R^2 = 0.57, p < 0.01$ for men; $R^2 = 0.08, p < 0.25$ for women).

Men jump higher, relative to the ground, but have a lower clearance, due to the greater barrier height. During the take-off, horizontal kinetic energy is partly transferred into vertical kinetic energy. Greater jump heights require more horizontal energy to be transferred, resulting in a greater loss of horizontal velocity.

To help minimize the need to jump higher, the vertical separation between the hip and knee of the trail leg when the center of mass is at its peak height is less among men (0.25m for men, 0.32m for women, $p < 0.01$).

Women can safely clear the barrier without the need to jump as high off the ground as men do since the barriers are 0.152 m (6 in) lower. Figure 2 shows a small range of clearance heights among women, which shows there are other factors relating to the percent loss of velocity. When considering characteristics such as: take-off and landing

distance, hip and knee angles, and heights of trail and lead legs, the high variability made any meaningful conclusions difficult to make.

When coaching steeplechase athletes, it is important to take into consideration the differences between men and women. In order to minimize loss of running speed, men should be taught to minimize clearance height. This can be accomplished by leveling out their trail leg when it is directly above the hurdle. This will bring the trail leg closer to the height of the center of mass, minimizing hurdle clearance. More research needs to be done in order to determine what causes women to lose speed over the hurdles.

SUMMARY/CONCLUSIONS

Men lose horizontal velocity when they hurdle with a greater clearance. So, they must work on movement patterns and takeoff distances that will help minimize hurdle clearance. However, a similar relationship was not observed among women. There are other factors not measured in this study that relate to what leads to lost velocity among women. This study only focused on velocity. The effect of various techniques on economy must also be considered as coaches and athletes modify technique.

REFERENCES

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