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Approach speed and performance in the horizontal jumps: What do Brazilian athletes do?

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ABSTRACT

Take-off velocity is an important factor determining performance in the long jump and triple jump, and it is influenced by approach velocity. The objectives of this study were: a) to determine the relationship between approach velocity and jumping performance, b) to verify if approach velocity is different when we compare the long jump and triple jump, and c) to discuss individual relationships, in comparison with values achieved by the group of athletes studied. Thirty-two male athletes competing in Troféu Brasil de Atletismo 2003 were studied. The official results and the mean velocity measured in the last 5m of the approach run were investigated. High correlation values were found between approach velocity and long jump performance (r = 0.72), but this relationship was not as high for the triple jump (r = 0.58). Approach velocity shows a tendency to be higher in the long jump than at the triple jump, even though the difference is not statistically significant. Individual relationships show a tendency to be lower than the group relationship. In some cases, they are negative.

AUTHORS

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Introduction

The long jump and triple jump are athletic events known as the "horizontal jumps", whose goal is – after a preparatory approach run - to cover the furthest horizontal distance by means of a single jump (long jump) or a sequence of three jumps (triple jump). To facilitate the study of these events, it has been proposed to split the total distance jumped into partial distances, and then to identify the determining factors for each. For the long jump, HAY (1981) classifies the following partial distances as shown in Figure 1.

D1 Take-off distance: the horizontal distance between the anterior edge of the take-off board and the vertical projection of the centre of gravity (CG) at the instant of take-off.

D2 Flight distance: the horizontal distance covered by the CG while the athlete is free in the air.

D3 Landing distance: the horizontal distance between the vertical projection of the centre of gravity at the instant the heels touch the sand and the mark from where the jump will be measured.

For the triple jump, each partial distance is repeated three times as shown in Figure 2.

The distance D2 represents more than 85% of the total distance of a jump and thus has the highest relationship with the final result (HAY, 1986). We can say that D2, and thus performance in the horizontal jumping events, is determined by the same four factors affecting movement of all projectiles (HAY, 1981): take-off height, angle and velocity, and air resistance (Figure 3).

It seems take-off velocity is the most important factor affecting D2 (HAY and REID, 1985), and it has a very high relationship with the velocity at the touchdown of the take-off foot at take-off (r = 0.87; p <

Figure 1: Partial distances in the long jump

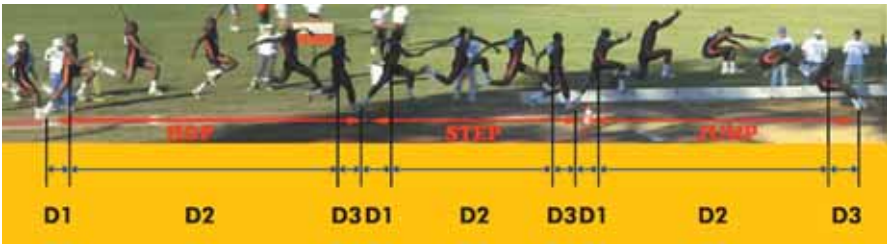

Figure 2: Partial distances in the triple jump

Figure 3: Factors that determine flight distance in the long jump

0.0001), which in turn is dependent on the approach velocity ($r = 0.81$; $p < 0.001$), according to data from FUKUCHI et al. (2003). In other words, the faster the athlete runs, the greater the horizontal velocity at the instant he/she touches the take-off board and the greater the take-off velocity. We can easily monitor approach velocity using photoelectric cells.

This study had the following goals: a) to determine the relationship between approach velocity and performance in the horizontal jumps at the 2003 Brazilian national championships; b) to verify if approach velocity differs between long jumpers and triple jumpers when we consider national elite athletes; and c) to discuss individual relationships, in comparison with values achieved by the group studied.

Methods

Thirty-two male athletes participants at the "Troféu Brasil de Atletismo 2003" were studied, 23 competing in the long jump and 16 in the triple jump (seven competed in both events). Official result and approach velocity were the variables studied. Brower Inc.® wireless photocells were placed beside the runway, 6m and 1m before the take-off board (Figure 4), allowing us to calculate the mean approach velocity (m/s^{-1}). Pearson linear relationship and the Mann-Whitney test were used to analyse the results.

Figure 4: Photocells placed 6m and 1m before the take-off board, to measure the approach velocity

Results and Discussion

The results are shown in Tables 1 to 4. Tables 1 and 2 show descriptive values for age (years), result (metres), time for the 5m interval (seconds) and velocity in this interval (metres per second), for the long jump and triple jump, respectively.

Table 1: Descriptive measures for age, result, time and velocity for the long jump

Descriptive measures	Age (years)	Result (m)	Time (s)	Velocity (m/s^{-1})
Minimum	17.00	6.52	0.48	9.09
Maximum	31.00	7.99	0.55	10.42
Mean	23.26	7.32	0.51	9.90
Standard deviation	4.31	0.41	0.02	0.38

Table 2: Descriptive measures for age, result, time and velocity for the triple jump

Descriptive measures	Age (years)	Result (m)	Time (s)	Velocity (m/s^{-1})
Minimum	19.00	14.29	0.48	8.62
Maximum	35.00	17.05	0.58	10.42
Mean	24.94	15.83	0.52	9.66
Standard deviation	5.11	0.77	0.02	0.41

Table 3 shows the correlation between approach velocity and performance, with higher values for the long jump

Since 2003, a database has been developed with results from different competitions. The aim is to store a significant amount of information regarding different athletes in order to determine individual relationships between approach velocity and performance. A preliminary analysis of the available data shows that these individual relationships tend to be smaller than that found in the group (Table 4). In other words, although we can generically affirm that faster athletes are able to jump further, we cannot always say that when a particular athlete runs faster he will perform better.

There is another question to be discussed: do long jumpers approach the board faster than triple jumpers? Data shown in Tables 1 and 2 indicate that this is the tendency, although the difference is not statistically

Table 3: Correlation coefficients and significance levels of the relationships between approach velocity and performance in the long jump and triple jump

Event	Correlation coefficient	Significance level
Long jump	0.72	$P < 0.0001$
Triple jump	0.58	$P < 0.02$

Table 4: Individual correlation coefficients between approach velocity and performance in the long jump and triple jump for selected cases

Events	Correlation coefficient
Long jump	
Athlete A	0.05
Athlete B	0.98
Triple jump	
Athlete C	- 0.35
Athlete D	0.21
Athlete E	0.49
Athlete B	0.82

significant. The Mann-Whitney test was used, and it is worth mentioning that the calculated P value (0.0516) is very close to the level of significance adopted for this study ($P < 0.05$).

High correlation values between approach velocity and performance were expected, particularly in the long jump. Many authors believe that approach velocity is the most important factor determining results in the long jump (JARVER & BOASE, 1984; MOURA & MENDES, 1983; POPOV, 1982; WALTERS, 1986; ZOTKO & PAPANOV, 1984), and correlation coefficients between 0.7 and 0.9 have been found frequently (HAY, 1993). We have to remember that the closer to 1.0 the stronger the relationship. The lower correlation values found in triple jump may indicate that more factors influence performance in this event. This weaker relationship has been reported before by HUTT (1989).

It is usual to see coaches telling their athletes to approach the board faster. This can be justifiable during practice, but it is questionable if this advice will always bring positive results in competition. We have seen that the individual relationships between approach velocity and performance may in some cases be low or even negative (the athlete jumps a lesser distance when he/she runs faster).

This apparent contradiction can be easily explained. For a long time, we have been aware that approach velocity must be optimal rather than maximal. HAY (1993) affirms that the athlete has three goals to accomplish during the approach run (Figure 5), and often the search for a higher velocity negatively affects the other goals. SMITH & LEES (2003) believe the balance between velocity, strength and technique is of utmost importance. When running velocity is increased, ground reaction forces (GRF) also increase, demanding higher levels of special strength.

We cannot forget that vertical GRF produced during triple jump represents the highest values measured during sports activities (AMADIO, 1985; HAY, 1993). Development of specific strength is a prerequisite for the effi-

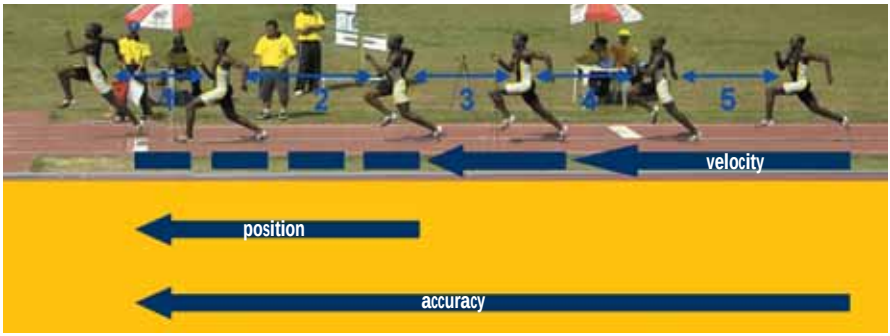

Figure 5: Tasks to be accomplished during the last strides of the approach: velocity, position and accuracy. Based on HAY (1993)

cient use of a higher approach velocity. In addition, when the condition to generate force and velocity changes, timing (technique) must be adjusted. Nowadays, there is no agreement on whether special physical conditioning and technique should be developed in parallel or sequentially (VERCHOSHANSKY, 1990; RITZDORF, 1998). In any case, it is important that, the velocity, strength and technique present a balanced development during the competitive period.

Conclusion

This study has shown that approach velocity is highly related to performance in the horizontal jumping events. This relationship is greater in the long jump, probably indicating that performance in the triple jump is determined by a larger number of factors. Individual relationships usually show lower values in comparison to the group. Approach velocity has the tendency to be greater in the long jump, even though the differences found in this study were not statistically significant. The tendency towards lower approach velocities in the triple jump remains intriguing, and deserves more investigation. New studies are also necessary to determine the factors that guarantee optimal use of approach velocity.

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