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# Differences in selected long jump components according to the results of Turkish youth boys

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## Abstract

The purpose of this study was to determine differences between the groups which have two different performance levels in the long jump for youth athletes. The technique of long jump consists from the run-up, jump, flight and landing stages. Each stage has been deeply investigated by analysing various kinematic variables such as velocity, length, duration, angle, jump percentages in previous studies. The recent study has found differences between two different performance levels athletes according to the velocity variables, take-off angle and percentage of the take-off distance. Considering the run-up speed of long jump is priority indicator of the jump distance, the athletic coaches should give more attention for the speed ability of athlete when the processes of talent identification and selection in the long jump event.

**Keywords:** Long jump, kinematic, velocity, take-off

## INTRODUCTION

As one of the oldest Olympic sport event, the long jump has a relatively simple technique in terms of teaching and learning. It is technically divided into four stages: run-up, jump, flight and landing. (Jonath, Krempel, Haag, & Müller, 1995). The total measured distance of long jump consists the sum of these three lengths: take-off distance (L1), flight distance (L2) and landing distance (L3) (Hay & Miller, 1985). The parts of the long jump have been examined to determine by analysing various kinematic variables such as velocity of last ten meters and last strides, length of last strides, duration of take-off support phase, distance lost on the board, angle of take-off, the percentage of L1, L2 and L3 rates in previous studies (Hay, 1988; Hay & Koh, 1988; Hay & Miller, 1985; Hay, Miller, & Canterna, 1986; Letzelter, 2011; Linthorne, 2008; Schulek, 2002).

It has been reported that the run-up speed of long jump is priority indicator of the jump distance (Bridgett, Galloway, & Linthorne, 2002; Bridgett & Linthorne, 2006; Hay, 1993; Hay et al., 1986; Lees, Graham-Smith, & Fowler, 1994). Some of the researchers found that the jump distance increases at range from 6 cm to 12.8 cm per 0.1 m/s increase in the velocity of the run-up (Bridgett & Linthorne, 2006; Hay, 1993). Besides, Bridgett and Linthorne (2006) have described the strong relationship between horizontal velocity and jump distance as 96 percent. The horizontal velocity at the end of the run-up should be peak within the last two strides. The most obvious characteristics of last two strides is that the penultimate step (last-but-one) slightly is longer than the last step of the approach in terms of flight time and stride lengths (Lees et al., 1994). The effective run-up is evaluated by many coaches as looking at the position of take-off foot on the take-off board. Although the aim of the run-up is to place athlete's jumping foot close to the front edge of the board (zero-in), Hay (1988) has identified for distance lost –it is known as 'loss of take-off'- (toe-board distance) of 20 cm or less is very good, and the loss of 25 cm or more is poor.

One of the crucial points in long jump performance are take-off features: take-off angle and support phase of take-off. It is known that they have relationship with the run-up speed, in the other words, the take-off angle and the take-off contact time depend on the horizontal velocity of the approach run. A study has revealed the fact that the run up velocity increased the take-off angle and duration of take-off decreased (Bridgett & Linthorne, 2006). The optimum take-off angle should be under $45^o$ since the vertical and horizontal velocity are not equal in magnitude. The most appropriate instance for this issue is the world-class athletes coherently perform $21^o$ for take-off angles according to the study of Linthorne (2008). The author has also reported the typical values of some parameters for elite male long jumpers in his study. He describes that a long jumper who can jump eight meters should have 10.6 m/s for horizontal velocity, 1.8 m/s for loss of horizontal velocity during take-off and 0.11 s for duration of take-off. As the distance of long jump is the sum of L1, L2 and L3, L2 has approximately 90 percent of the total jump distance as the most important part (Linthorne, 2008).

Most of the above explained relations and values are variables which obtained from technical analyses during major championships. As the biomechanical reports of championships analyses are important for the athletes and their coaches, it is also important for sports scientists to understand the performance of the elite athletes in the real condition, competition, rather than experimental studies (Campos, Gámez, Encarnación, Gutiérrez-dávila, & Rojas, 2013; Fukasiro & Wakavama, 1992; Hay & Miller, 1985; Hommel, 2009; Panoutsakopoulos, Papaiakovou, Katsikas, & Kollias, 2010; Seo & Kim, 2011). Nevertheless, most of the studies have focused on senior level athletes rather than youth or novice athletes. There are few studies involving youth and junior athletes in which they have been examined of their technical skills like elite senior athletes (Berg & Greer, 1995; Huremovi, Biberovi, Pojski, & Original, 2005; Makaruk, Mastalerz, Starzak, & Buszta, 2015; Panteli, Theodorou, Pilianidis, & Smirniotou, 2014) . A study which is deeply examined technical component of novice jumpers is the study of Berg and Greer (1995). They have emphasised that kinematic variables which has affected the long jump performance have not similar relationship with performance for the novice athletes as expert jumpers according to their findings.

The purpose of this study was to determine differences between groups which have two different performance levels.

## METHODS

Research Group

A total first thirty two youth long jumpers were selected as participants during the qualification round of the Turkish Youth Indoor Championship in January 2015. This competition has covered between 15 and 17 years old athletes. The participants have divided in two groups as the best 16 athletes and the others.

**Table 1**. Descriptive values (mean ± SD) of the groups.

| | Group A (n=16) | | Group B (n=16) | |
|---|---|---|---|---|
| | Mean | SD | Mean | SD |
| Age (year) | 16.0 | 0.6 | 16.4 | 0.5 |
| BM (kg) | 59.7 | 6.6 | 65.9 | 6.5 |
| BH (cm) | 170.9 | 6.0 | 175.9 | 5.7 |

Data Collection Instruments

All trials of the athletes in the research group were recorded by a camcorder at 100 fps (Panasonic HC-w850). The camera was placed perpendicular to the take-off board. The photocells which are used to determine running times of athletes have been established 1m, 6m and 11m distance from the take-off board (SmartSpeed, FusionSport, Australia).

Data Collection

Velocities for 11m-6m section (V1), 6m-1m section (V2), total 10m (V10) and difference between V2 and V1 (Vloss) were calculated for each jump. The official jump distances were recorded. Best performance of the athletes was analysed by the two dimensional analysis software (Tracker, v4.90-95). Thus it was obtained values of kinematic variables which are loss of take-off (TO), length and duration of last two steps (2last, 1last), duration of the contact of take-off (CT-TO), angle of take-off (TO-Angle), take-off distance (L1), flight distance (L2) and landing distance (L3). Further, it was calculated actual distance (sum of official distance and loss of TO), last step velocity (VLS) and the range of last two steps (RL=[1last/2last]x100).

Data Analysis

General characteristics of the participants were presented as means and standard deviations (±SD). Statistical comparison of the groups was carried out using Mann Whitney-U test. For the statistical procedure IBM-SPSS 20.0 pocket program was applied and statistical significance was set at $p<0.05$.

## RESULTS

The long jump kinematic variables of the two groups are presented in Table 2. No significant differences were found between Group A and Group B in terms of the loss of TO, Vloss, last two steps length (2last and 1last), range of last two steps (RL), support phase of the TO and percentages of flight distance (L2) as well as landing distance (L3). Whereas there are statistically significant differences with regard to official distance and actual distance, values of the velocity variables (V1, V2, V10, VLS), angle of TO as well as distance of TO (L1). This expected differences of the official and actual distances are due to the composition of the groups by jump distances. The Group B jumpers have significantly shown better long jump performance than Group A jumpers (GroupA=4.90m, GroupB=5.98, $p<0.05$). The Group B athletes were faster than Group A athletes considering the all velocity variables of the study. When the athletes' take-off angle values were compared, it was observed significantly difference between the groups ($p<0.005$) that the Group A athletes have jumped by 17.5 degree, while Group B jumpers mean value is 20.5 degree. There is likewise a significant difference for the percentage of take-off distance (L1%) between the two groups ($p<0.005$). The mean range of take-off distance (L1) in Group A was observed to have more value than Group B (7.8%, 5.8%, GroupA, GroupB, respectively; $p<0.005$).

**Table 2.** The values of long jump kinematic variables (mean ± SD) and differences between the groups.

| | Group A (n=16) | | Group B (n=16) | | Significance |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Official distance (m) | 4.90 | 0.45 | 5.98 | 0.32 | *0.00** |
| Loss of TO (m) | 0.17 | 0.13 | 0.11 | 0.09 | 0.32 |
| Actual distance (m) | 5.07 | 0.43 | 6.09 | 0.28 | *0.00** |
| V1 (m/s) | 7.76 | 0.41 | 8.51 | 0.46 | *0.00** |
| V2 (m/s) | 8.03 | 0.51 | 8.72 | 0.25 | *0.00** |
| V10 (m/s) | 7.89 | 0.45 | 8.61 | 0.27 | *0.00** |
| VLS (m/s) | 9.08 | 0.55 | 9.88 | 0.51 | *0.00** |
| Vloss (m/s) | 0.27 | 0.22 | 0.21 | 0.53 | 0.71 |
| 2last (m) | 2.04 | 0.28 | 2.20 | 0.22 | 0.08 |
| 1last (m) | 1.96 | 0.25 | 2.10 | 0.18 | 0.09 |
| RL (%) | 96.7 | 7.3 | 96.0 | 9.0 | 0.76 |
| CT-TO (s) | 0.15 | 0.02 | 0.14 | 0.02 | 0.35 |
| TO-Angle ($^o$) | 17.5 | 4.0 | 20.5 | 2.8 | *0.03** |
| L1 (%) | 7.78 | 1.66 | 5.84 | 1.34 | *0.00** |
| L2 (%) | 81.93 | 4.48 | 84.53 | 2.56 | 0.10 |
| L3 (%) | 10.31 | 3.71 | 9.63 | 1.69 | 0.42 |

* $p<0.05$

## DISCUSSION

In the long jump, the athlete's intention is to jump as far as possible in a horizontal direction with a perfect landing phase. Therefore the athlete should run maximum speed which is a controllable manner in the approach run combined with a minimum speed loss in take-off (Hay, 1985). Even if the long jump has many factors effecting the jump distance, the most component of jump length is the run-up speed. The strong relationship between horizontal velocity and jump distance has been described as 96 percent by Bridgett and Linthorne (2006). They have announced that the jump distance have increased when their run-up speed also increased for experienced male long jumpers. Another study in which the run-up speed of athletes was artificially increased (with the towing method), the researcher has discovered great improvement in the term of the increase in jump distance when the speed increases without create any technical problems (Schulek, 2002). This study has an importance because the analyse was applied while each athlete was jumping by normal run and with towing method run. Thus it was found a positive effect of run-up speed on the jump distance for high level long jumpers. Even if there are abundant studies about the correlation between run-up velocity and jump distance, most of them have been done with high level athletes or adult athletes rather than novice or young athletes. One of the few studies is Berg and Greer's (1995) research about novice long jumpers. They have also found good relation between run-up velocity and jump distance for the study group athletes who have jumped mean 5.55 m. Besides that the run-up velocity was being a determinative factor to explain the differences between male and female as an example for different performance level athletes (Akl, 2014; Hussain, Khan, Mohammad, Bari, & Ahmad, 2011). In the present study, the velocity variables of long jump approach have been one of the determinative factors of the differentiation between the two diverse performance level jumpers (GroupA= 4.90 m, GroupB=5.98 m).

Linthorne (2008) reported that the typical mean value of the horizontal velocity is 10.6 m/s for elite long jumper who jumped 8 meters. According to the result of Berlin 2009 IAAF World CH, the mean value of jump distance is 8.03 m and velocity of last ten meters is 10.4 m/s (Hommel, 2009). Further, Bridget and Linthorne (2006) were found 10.4 m/s run-up velocity for experienced athletes jumped 7.89 m. The mean horizontal velocity is 9.82 m/s in the study of Panoutsakopoulos et al. (2010). The mean jump distance of this athletes is 7.40 m. The researchers, who have examined some kinematic parameters, noticed that the horizontal velocity of the athletes is 9.17 m/s and mean jump distance is 6.79 m (Hussain et al., 2011). In the study of novice athletes, Berg and Greer (1995) have reported that the long jumpers have 8.14 m/s horizontal velocity value and their mean jump distance is 5.55 m. In the current study groups have 7.89 m/s and 8.61 m/s for the values of last 10 meters horizontal velocity (GroupA and GroupB, respectively). In other words, the faster athletes have shown better long jump performance than the others. Thus, it may be said that those who has shown better long jump performance were faster than others, according to these findings.

The run-up speed of athlete decreases associated with the adjustments made in preparation for take-off, but the aim is minimum loss of speed (Hay, 1985). The current study has found the loss of velocity for each group. There is a similarity between the groups in terms of the loss of run-up speed. The adjustment in take-off preparation determines the athlete's take-off angle. As reported in previously studies, once the approach speed increases the take-off angle and duration of take-off contact decreases (Bridgett & Linthorne, 2006; Hay, 1985; Huremovi et al., 2005; Linthorne, 2008; Linthorne, Guzman, & Bridgett, 2005). In the recent study, the take-off angle has been a decisive variable to the difference between the groups, as well. Whereas, it was not found any difference between the research groups according to the duration of take-off support phase.

Hay (Hay, 1985) addressed that the long jump distance may be considered to be sum of the take-off distance, the flight distance and the landing distance. These three lesser distances have been expressed as percentages of the jump distance which are 4% (L1), 89% (L2) and 8% (L3). But the percentages of jump distance have shown differences in the several studies according to the review (Hay, 1986). In any case the flight distance is overwhelmingly influential in point of the contribution percentage of jump distance. The current study has found a likewise dominant finding for L2% to each group. Also there is a similarity between the groups (GroupA=82%, GroupB=85%, $p>0.05$). But the percentage of take-off distance (L1%) differed between the study groups, which are GroupA=8% and GroupB=6% ($p<0.05$).

It is possible that this difference may occur because of the athlete is not able to do an active jump during the take-off. The presumption is probable when considering low take-off angle of the GroupA ($17.5^o$) from GroupB ($20.5^o$).

In conclusion, it was observed that the only a few parameters which the velocity variables, take-off angle and take-off distance from the performance components of jump distance determining differences between the groups in this study.

## CONCLUSION

There are many components of jump distance in the long jump. However, it was observed that velocity variables, take-off angle and take-off distance are a few parameters from the components determining differences between the groups in this study. The speed ability of the athletes has been seen the dominant variables in order to explain the differentiation between groups, as it is for youth athletes in the current study. Because of that, it may be said that the coaches should give more attention for the speed ability of athlete when the processes of talent identification and selection in the long jump event.

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