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Original article

THE INFLUENCE OF RUNNING SPEED AS DETERMING FACTOR OF PERFORMANCE IN LONG JUMP EVENT TO ATHLETES, 14-15 YEARS OLD

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Abstract*

Objective. The long jump is defined as an athletic event in which the jumper combines three motor qualities - strength, speed and agility. The increasing of speed during the run-up, until to an optimal level at take-off, will induce an ideal ascent angle, as outcome of the combination between horizontal and vertical vectors at take-off. The hypothesis from which we started in realizing this study was that a small difference between the running speed on an equivalent distance to the length of the approach run and the speed in the run-up with a high leap off the board, determines the increase of individual's performances in athletes.

Methods. This study has been developed on 12 subjects, 14-15 years old. The validity of the analysis highlights the qualitative component despite of the quantitative component, due to a low incidence of the pursued phenomenon, more precisely: improving the long jump technique and increasing individual performance in terms of running speed.

Results. We could observe that the subjects with low differences have a higher performance in the long jump in boys subgroup, as we can see in subject K.A. (5.55m long jump performance, Δ_1=0.07, Δ_2=0.11, Δ_3=0.18) and subject C.Z. (4.74m long jump performance, Δ_1=0.04, Δ_2=0.02, Δ_3=0.06). In the girl's subgroup, on the contrary, this hypothesis is not confirmed.

Conclusions. The main goal in our research was creating the possibility to intervene in the optimization of the training process, which has the purpose of increasing individual performance. We can interpret the presence of the take-off board as a disturbing factor in running speed.

Keywords: long jump; running speed; take-off vectors.

Introduction

The long jump event is one of the most natural events in track and field athletics, in which the natural ability of the athlete plays a large role and technique is of secondary importance, (Tan & Zumerchik, 2000). The two most important factors in the long jump are speed and elevation. Fast saltatory movements such as human running or jumping are characterized by alternating flight and contact phases, (Seyfarth et al., 2000).

Athletic performance training develops, to a high level, a series of motor skills and psycho-behavioural attitudes. In the permanent combat with timer and roulette, besides developing speed, strength, detention, resistance and specific skills, the athlete develops a number of moral and willful qualities, such as skills of communication, listening, argumentation, observance of sports ethics, empathy, tolerance, team support, fair play, all of them having a consistent influence through topokinetic components such as speed and strength (Neagu, 2012b).

The used basic technique in long jump event has remained unchanged since the beginning of modern athletics competitions in the mid-nineteenth century, (Hong & Barlett, 2008). The long jump can be divided into four phases. These phases include the run up, the take-off, the flight and the landing, (Guiman & Burcă, 2015). Firstly, a jumper runs on the ground and after the take-off he launches himself into the air, continuing to fly with a peculiar technique toward the landing point. The approach starts with the athlete being stationary and ends as the athlete begins to transition into take-off with a specific rhythm of the last two strides preparing the body for take-off in order to conserve as much speed as possible, (Mihăilă et al, 2008). This is a very important phase in continuing and developing the velocity that is going to launch forward the jumper as long distance as possible. The objectives in every phase are the same, regardless of the athlete's age, level of experience, gender or ability.

After the approach, the athlete enters the take-off phase. This second phase consists in controlling the last three or two strides before the take-off board, where the athlete leaves the ground and this moment

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is probably the most important part of the long jump, because the controlled movements that occur at take-off are ultimately responsible for generating the longest distance that the jumper will get, (Muraki et al., 2008). During the transition from the run up to take-off, the athlete begins to gradually lowering his center of body mass or gravity center, which, by decreasing the take-off height, prepares the optimal launching angle, around 20-22^{O}, (Ashby & Heegaard, 2002). It has also been proven that the motion of the trunk during the last stride before take-off plays an important role, (Jaitner et al., 2001).

The flight phase is following the approach and take off phases and finishes with the landing of the athlete. The jump is measured from the take-off board to the jumper's closest mark in the sand.

Therefore, a successful long jumper must be a fast sprinter, having very strong legs and must be highly coordinated to perform the complex motor action chain including the approach, the take-off, the flight and finally, the landing, (Hong & Bartlett, 2008). Paradoxically, we can interpret the presence of the take-off board as both a disturbing or motivational factors in the running speed. The first one must be expelled and the second fully developed and exploited.

When analyzing the velocity of the jumper, we must separate it into a horizontal and vertical component and consider each with their own magnitude and direction, (Allen et al., 2016). Approaching the speed run sounds fairly simple, but it actually is a challenge for jumpers to make sure they haven't hit their maximum speed but the optimal one during the take-off moment. While running, the jumper must be aware, that the optimal speed is not always the maximal speed, when reaching the take-off board. In that moment he must keep a very good balance between those two levels of running speed, (Bridgett & Linthorne, 2006; Graham-Smith & Lees, 2005). It will also play a role in the creation of vertical velocity. The vertical velocity is a combination of the speed carried in from the run, as well as the height gained from the push off the ground, (Wu, 2016; Knudson, 2007).

A properly relationship between horizontal and vertical vectors will generate a third important factor - the resulted vector - inducing the optimal launching angle, thus the jumper reaching a high level of velocity, (Rebutini et al., 2016).

The appropriate length of the strides and height of body vertical oscillations performed by the jumper during the approach is going to have an impact not only on the vertical force created by pushing off the ground, but also on the angle at which take-off occurs, (Zhang, 2013). The take-off angle varies on the athlete because not all the athletes have the same height, weight, and therefore engage different forces in a very short time, while take-off. The optimal angle is decreased for a higher approach speed and increased for higher leg stiffness, (Wakai & Linthorne, 2005). Through reciprocal potentiation even though all of these variables function independently to ensure a maximal jump, they also have a great relevance to one another, (Linthorne et al., 2005). It is a combination of all of these variables that is going to allow our jumper to maximize his distance, (Morriss et al., 2001).

The approach time, the running speed, the height and launching angle are playing a very important role in the overall distance of the jump and they all depend on one another, (Neagu, 2012b). Many other external factors - disruptive or favouring - can be made on the athlete's technique in all four phases that could alter these variables in different ways – positively or negatively. Most of these factorial influences occur during the run up and take-off phases.

There are a lot of variables that play a role in generating the longest possible jump. Some of the limiting factors for attaining a greater jumping performance are the ability of increasing running speed (Hay, 1993) and the ability to develop strongest and powerful of lower limb muscles (Alexander, 1990). A causal understanding of the contribution of different variables to jumping distance requires a biomechanical model during the final phase before take-off, (Seyfarth et al., 2000). Therefore, speed is one of the most important factors for success in the long jump. Other factors such as power, coordination, jumping ability, and strength are also vital to maximize an athlete's performance in the long jump.

The level of motor aptitudes, in the context of individual growth and development, but also through a directed and continuous intervention and practice, can become stable, inducing high performances. We can appreciate that, at least in terms of sports performance, the results obtained by the so-called young talent are not predictive for the future, (Neagu, 2012b). In terms of the training assessment process, we can follow the interdependence between the specific characteristic and the efficiency and quality of the evaluation process, generating the concept of mutual potentiation, (Neagu, 2012a).

The hypothesis from which we started in realizing this study was that a small difference between the running speed on an equivalent distance to the length of the approach run and the speed in the run-up with a high leap off the board, determines the increase of individual's performances in athletes. The main goal in our research was creating further possibilities to intervene in the optimization of the training process, which has the purpose of increasing individual performance.

Methods

The *hypothesis* of this study was that a small difference between the running speed in three different situations, respectively: the first one - running speed / 20 m; the second one - an equivalent distance to the length of the approach of the long jump and the last one, the running speed with long jump, determines the increase of individual's performances in athletes.

A further goal in our research was creating several possibilities to intervene in the optimization of the junior athletes training process, which has as main training objective the increasing of individual performance in long jump event.

Twelve subjects were included in our research, 6 girls and 6 boys, long jump oriented athletes with the age between 14 to 15 years old. The *Microgate Racetime System 2* - with photocells three gates - has provided a very accurate measurement. All the running speed data was recorded during the long jump practice lessons. No involvements of human errors were involved. A pair of photocells was placed at the starting line and the second one at finish line of measured involved distances. The obtained values of each three running times were analyzed and compared.

For every subject we performed three running tests. The surface of the running track was the same for all three tests. They were individually tested, chronologically performing. Firstly – it was the 20 meters speed running test - on a flat surface, in the absence of a take-off board or any other disturbing factor.

Secondly, 20 m distance, subjects were run at the highest speed, facing the take-off board, without performing the long jump.

The last speed measurement was realized with the subject running at his highest speed, facing the take-off board, performing the long jump.

After calculating the differences between the three obtained speed values, all the results were correlated to the greatest individual achieved performance.

The used methods in realizing this study have been: the observation method, the measurements and recording method and the statistic-mathematical method.

Results

Following the application of our three speed tests, the differences on girl's subgroup are presented in Fig. 1, and on boy's subgroup in Fig. 2. We found that two girls (B.K., N.V.) recorded the best individual values of 5.93 m/s speed on 20 linear meters, a greater value being achieved by the subject V.A., boy's subgroup → 6.35 m/s. When referred to the speed on track with take-off, the best result was achieved by N.V., (girl's subgroup) → 5.61, 6.11 being obtained by the subject V.A. (boys subgroup).

If girls achieved an average of 5.62 m/s in 20m linear speed test, boy's subgroup achieved 5.97. Also, the average of the speed on track without take-off is 5.46 for girls and 5.88 for boys. When take-off is included, the speed on track reduces to 5.19 for girls and 5.73 for boys.

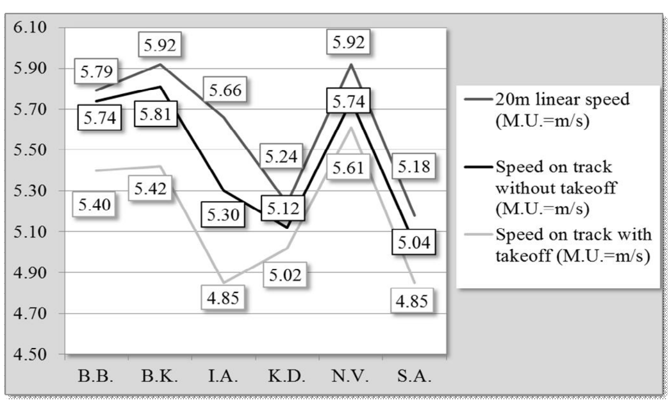

Figure 1 - The differences of individual results between the three types of speed tested, on girl's subgroup

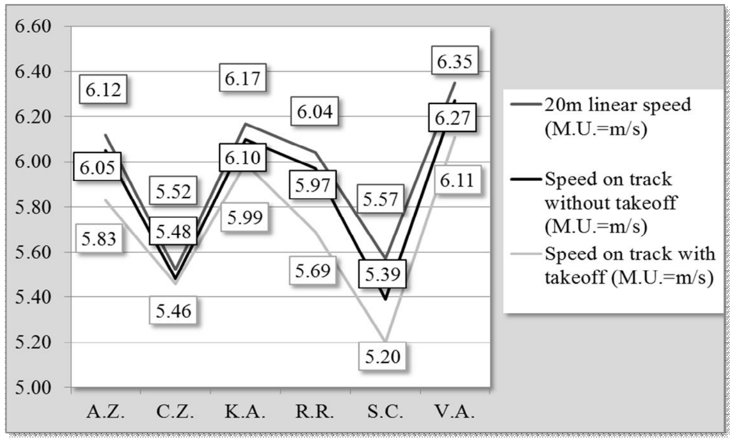

Figure 2 - The differences of individual results between the three types of speed tested on boy's subgroup

Looking at the best personal performance, a significant difference occurred between the smallest result → 3.55m, achieved by subject K.D. (girls subgroup), and the greatest result → 5.55m, achieved by subject K.A. (boys subgroup) Averages were calculated, as it follows: 4.05m for girls and 4.07m for boys. All the results are presented bellow, in Fig. 3.

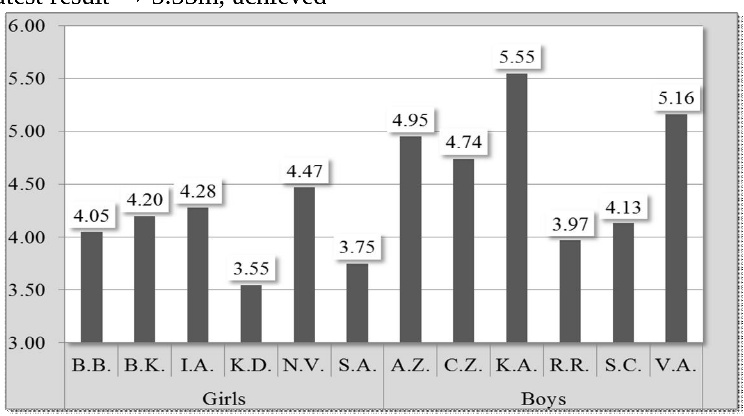

Figure 3 - Achieved performance in long jump event, boys and girls

Moreover, we present the differences between the three types of speed that we tested. From the result obtained in 20 meters linear speed test we subtracted the obtained result of speed on track without take-off. In girls subgroup, best result was obtained by the subject B.B. (0.05m/s), (Fig. 4.) 0.02m/s being the value obtained by the subject C.Z. (boys subgroup), (Fig. 5.). We did the same thing with the purpose of calculating "Δ" between the speed on track without take-off and the speed on track with take-off, 0.10m/s being achieved by the subject K.D. (girls subgroup) and 0.02 by the subject C.Z. (boys subgroup). With a very important purpose, the difference between the speed on a linear surface (20 meters) and the speed on track with take is presented. Best values were found at subject K.D. (0.22m/s → girl's subgroup) and subject C.Z. (0.06m/s → boys' subgroup), worst being found at subject I.A. (0.81m/s → girls subgroup) and subject S.C. (0.37m/s → boy's subgroup).

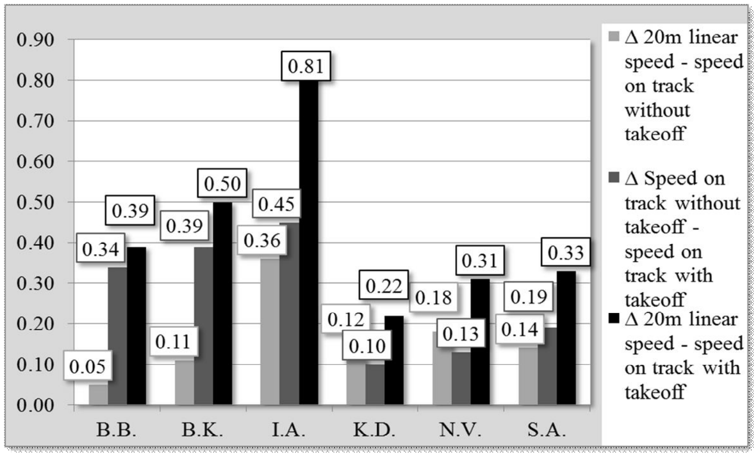

Figure 4 - A comparison of the differences (Δ) between the three types of speed, tested on girls

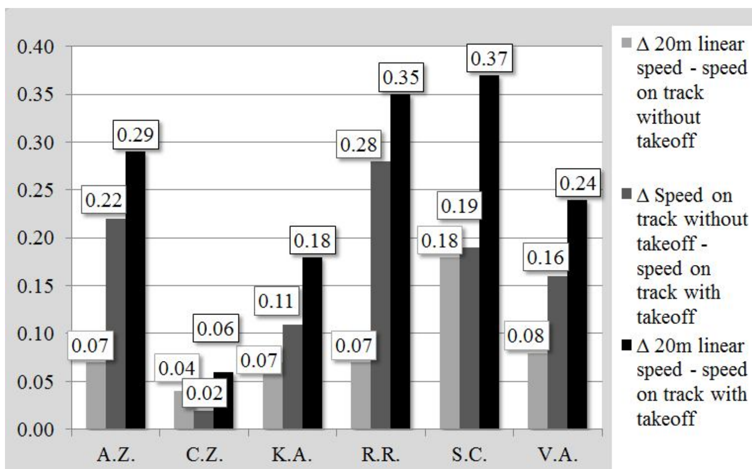

Figure 5 - A comparison of the differences (Δ) between the three types of speed, tested on boys

Discussion

The differences between the three speed runs become an important parameter in the evaluation of the maximal momentum capacity, but also in creating a specific individual training program. After performing this research, we could observe that the subjects with low differences have a higher performance in the long jump in boy's subgroup, as we can see in subject K.A's results (5.55m long jump performance, Δ_1=0.07, Δ_2=0.11, Δ_3=0.18) and subject C.Z's results (4.74m long jump performance, Δ_1=0.04, Δ_2=0.02, Δ_3=0.06). In the girls subgroup, on the contrary, this hypothesis is not confirmed, as we can see in subject K.D's results. (3.55m long jump performance, Δ1=0.12, Δ2=0.10, Δ3=0.22), compared to the subject with the second individual performance, I.A. (4.28m long jump performance, Δ1=0.36, Δ2=0.45, Δ3=0.81).

We consider that there are several possibilities to optimize the training process in long jump event, through speed training specific exercises, action which will be reflected in athlete's performances, (Kamnardsiria et al., 2015).

A correct interpretation of the recorded results must be contextualized to the dynamic and biomechanical requirements of the long jump event.

Testing with *Microgate Racetime 2* could become an mean objective of recording individual values, during the continuous evaluation process.

We can interpret the presence of the take-off board as a disturbing factor, (Bartlett & Bussey, 2012). none of the athlete's values being better when facing it, with or without performing the long jump.

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