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Is there a relationship between flexibility ability and the selected long jump performance components of teenage athletes?

Există o relație între capacitatea de flexibilitate și componentele de performanță selectate ale sariturii in lungime la tinerii sportivi?

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Abstract

Background. The long jump is technically divided into four stages: run-up, jump, flight and landing. The total measured distance of the long jump consists of the sum of these three lengths: take-off distance (L1), flight distance (L2) and landing distance (L3). The parts of the long jump were examined to determine by analyzing the various kinematic variables such as the percentage of L1, L2 and L3 rates in previous studies.

Aims. The aim of this study was to determine whether there is a relationship between flexibility ability and selected variables of long jump performance components, particularly the landing distance (L3) for teenage athletes.

Methods. The research group comprised 32 male athletes, age 16.2 ± 0.6 years, who participated in the qualification round in the Turkey Youth Indoor Championships. All trials of the athletes were recorded and a two-dimensional analysis of their best performances was made. Velocity values (V10) of the last 10 meters of the approach run of the athletes, contact time at take-off, take-off angle, and long jump performance component (L1, L2, L3) values were calculated.

Result. When the relationship between the flexibility ability and other performance components of the athletes was examined, only a weak statistically significant correlation was found between the approach run velocity and flexibility (r=0.45). Various studies have been conducted in different events, examining the effects of flexibility on sprint and jumping ability.

Conclusions. Due to the L3 similarity of the body position in landing with the sit & reach test, the anticipated relationships were not found except for V10.

Keywords: flexibility, long jump, L3, teenage athlete.

Rezumat

Premize. Săritura in lungime este tehnic împărțită în patru etape: elanul, desprinderea, zborul și aterizarea. Distanța totală măsurată a săriturii în lungime reprezintă suma a trei lungimi: distanța de elan (L1), distanța de zbor (L2) și distanța de aterizare (L3). În studii anterioare, fazele săriturii în lungime au fost examinate pentru a determina valorile procentuale ale ratelor L1, L2 și L3 prin analizarea diferitelor variabile cinematice.

Obiective. Scopul acestui studiu a fost de a determina dacă există o relație între capacitatea de flexibilitate și variabilele selectate ale componentelor de performanță ale săriturii în lungime, în special distanța de aterizare (L3) pentru sportivii tineri.

Metode. Grupul de cercetare a fost format din 32 de sportivi de sex masculin, cu vârsta 16,2 ± 0,6 ani, care au participat la runda de calificare a Campionatului Indoor de Tineret, Turcia. Toate încercările sportivilor au fost înregistrate și a fost făcută o analiză bidimensională a celor mai bune performanțe. Au fost calculate valorile vitezelor (V10) pe ultimii 10 metri de abordare a săriturii în lungime, timpul de contact la bătaie, unghiul de desprindere și valorile componentelor de performanță pentru săritura în lungime (L1, L2, L3).

Rezultate. Atunci când s-au examinat relațiile dintre capacitatea de flexibilitate și celelalte componente ale performanței sportivilor, s-a constatat o corelație semnificativă statistic între viteza de deplasare și flexibilitate (r = 0,45). Diverse studii au fost realizate cu ocazia diferitelor evenimente, examinând efectele flexibilității asupra abilităților de sprint și săritură.

Concluzii. Datorită asemănării L3 a poziției corpului în aterizare cu testul sit & reach, relațiile așteptate nu au fost găsite decât în cazul V10.

Cuvinte cheie: flexibilitate, săritura în lungime, L3, viteza de deplasare.

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Introduction

The long jump is one of the natural but technically complex disciplines of athletics. It primarily consists of an approach run at maximum speed and a flight phase starting as close as possible to the jump line. To be successful in this event, the long jumper must have the ability of a sprinter so that it can reach a sufficient speed in the approach run. One of the most important factors affecting performance in the long jump is the speed of the approach run (Theodorou et al., 2017). Another important factor determining the jump distance in a long jump is the vertical movement of the horizontal velocity of the center of gravity of the body via the approach run applied at high speed, at the instant of touchdown at the take-off board (Koyama et al., 2006). After Bob Beamon's record in Mexico in 1968, a lot of work has been done on the biomechanics of the long jump. These studies have shown that good long jump performance can be described as a fast approach run and a skill of vertical transfer of the horizontally achieved velocity. However, arm movements also play an important role in the effectiveness of the vertical jump (Pradon et al., 2014). There are different techniques for transferring horizontal velocity to the vertical axis (Bridgett & Linthorne, 2006).

The long jump is technically divided into 4 phases: 1) Approach Run, 2) Jump, 3) Flight and 4) Landing. In a study investigating the ratio of total distance performance to jump phases for the long jump, 5.4% for jump (L1), 92.9% for flight (L2) and 8.0% for landing (L3) were found (Hay et al., 1986). The landing phase of the long jump technique (L3) recalls the movement in the sit and reach test, which is often used for flexibility in athletic performance tests.

The sit and reach test is one of the most commonly used tests of flexibility in determining physical fitness parameters. It was designed in 1952 to measure back and lower extremity flexibility. In 2008, flexibility was defined as the ability to move smoothly in the range of motion of the joint. Studies have shown that the sit and reach test can be used to measure the strength of the agonist muscle group and to determine the flexibility resistance of antagonist muscles. In 1966, it was reported that the sit and reach test was the most valid test compared to others for determining the folding flexibility of the torso (Carrasco et al., 2013).

The relationship between the level of flexibility and performance has always been the subject of research. In general, flexibility exercises are evaluated as a very important exercise that is applied with warming movements before training, providing many benefits such as protection from injury and increase of performance by increasing body heat and nerve conduction. For this reason, it is necessary for athletes to perform flexibility exercises at the beginning of training. Although the effects of static and dynamic flexibility exercises have been discussed, many studies have demonstrated the positive contributions of flexibility exercises to performance (Paradisis et al., 2014). Dynamic flexibility exercises particularly have a great contribution to the development of power, speed and jumping abilities. In the development of the level of flexibility in general, static flexibility exercises were found to be more successful than dynamic flexibility exercises, based on the results of the sit and reach test (Samso et al., 2012).

The relationship between flexibility and performance has been constantly researched and the positive impact of flexibility on performance, especially the positive impact on speed and jumping, has been explained. Technically, there is a similarity between the positions of long jumpers in the landing phase and the body position in the sit-and-reach flexibility test. The purpose of this study was to determine whether there is a relationship between the flexibility ability and selected variables of long jump performance components, particularly the landing distance (L3), for young athletes.

Hypothesis

In the long jump, due to the L3 similarity of the body position in landing with the sit & reach test (L3), there may be a relationship between the flexibility ability of athletes and L3 percentage. Also, there may be a relationship between flexibility and the other long jump components such as run-up, contact time at take-off, take-off angle and percentage of jump phases.

Material and methods

Research protocol

All trials of the athletes in the research group were recorded during the Turkish Indoor Youth Championship. All trials of the athletes were recorded and two-dimensional analysis of their best performances was done.

a) Period and place of the research

The study included 32 male long jumpers competing in the Turkish Indoor Youth Championship organized in January 2015.

b) Subjects and groups

The subjects of the study, 32 male long jumpers, participated as volunteers in this study. They were informed in detail about the test procedures and benefits of the results. The study was performed in accordance with the Declaration of Helsinki. The data collection process started after the approval of the Turkish Athletic Federation was obtained. The general characteristics of the participants are shown in Table I.

Table I

Athletes' age, body mass, height, and sitting height variables

Variables	n	Mean	SD
Age (years)	32	16.2	0.6
BM (kg)		62.8	7.2
BH (cm)		173.4	6.3
SH (cm)		90.41	3.60

Legend

BM: body mass, BH: body height, SH: sitting height

c) Tests applied

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 were used to determine the running times of athletes, were placed at 1m and 11m distance from the take-off board (Smart Speed, Fusion Sport, Australia). Velocities for the 11m-1m sections 10m (V10) were calculated for each jump. The official jump distances were recorded. The best performances of the athletes were

analyzed by two-dimensional analysis software (Tracker, v4.90-95). Thus, values of kinematic variables, which are loss of take-off (TO), 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) were obtained. Furthermore, the actual distance (sum of official distance and loss of TO) and percentages of L1, L2, and L3 were calculated.

d) Statistical processing

Pearson's correlation coefficients (r) were used to express the relationships between parameters. Interpretation of correlation coefficients was as follows: $r \leq 0.49$ weak relationship; $0.50 \leq r \leq 0.74$ moderate relationship; and $r \geq 0.75$ strong relationship. For the statistical procedure, the IBM-SPSS 20.0 pocket software was used and statistical significance was set at $p<0.05$. The general characteristics of the participants were presented as means and standard deviations (±SD).

Results

The demographic and anthropometric features of the athletes are presented in Table II.

Table II

Descriptive values (mean ± SD) of the long jumpers

Variables	n	Mean	SD
Official distance	32	5.44	0.67
Actual distance		5.58	0.63
Loss of TO		0.14	0.12
Flexibility (cm)		43.94	5.64
V10 (m/s)		8.25	0.51
CT-TO (s)		0.14	0.02
TO-angle (°)		19.02	3.73
L1 (%)		6.81	1.78
L2 (%)		83.23	3.82
L3 (%)		9.97	2.86

Pearson's correlation coefficients were used to express the relationships between the flexibility ability and the selected variables of the long jumpers. These results are presented in Table III. According to these findings, there is a weak significant relationship between flexibility and V10 ($r=0.45$; $p<0.05$). No statistically significant relationship was found between flexibility and other variables, especially the landing distance (L3) ($p>0.05$).

Discussion

In the study, the relationships between the athletes' flexibility and the running speed (V10), the contact time (CT-TO), the take-off (L1), the flight (L2) and the landing (L3) sections among the selected long jump performance components were investigated.

Many studies have looked at the relationship between flexibility characteristics and performance of athletes. In a study conducted to investigate the effect of static and dynamic flexibility exercises on the jump height, both flexibility exercises were found to improve the jump height (Samson et al., 2012).

In a study investigating the relationship between flexibility and reaction time, it was shown that although there is no significant difference between static and dynamic flexibility exercises, the increase in the level of flexibility results in a statistically significant difference of the reaction time when compared to the group that did not do any flexibility exercises (Perrier et al., 2011).

In a study conducted on long distance runners, an inverse relationship between the sit and reach flexibility test and running economy was found. That is, less flexible runners had higher running economies and this was statistically significant (Jones, 2002; Trehearn & Buresh, 2009). In another study on female runners with a mean age of 30 (± 9) years, it was found that the level of flexibility did not contribute to running economy (Mojock et al., 2011).

In a study on high-level footballers with a mean age of 16.1 (± 0.6), the relationship between flexibility development and performance was examined. In this study, it was found that the development of flexibility resulted in a significant improvement in footballers' 35m sprint values, explosiveness and agility (Hadjicharalambous, 2016). The 7-week flexibility exercise program applied to football players with a mean age of 16.5 (± 0.7) years resulted in a significant improvement in sprint values regardless of the position of the players (Fernandez et al., 2016).

In a study on the acute effect of static and dynamic flexibility exercises on the vertical jump performance of footballers, it was demonstrated that dynamic flexibility exercises had a more acute positive impact on vertical jump performance (Ferreira et al., 2013).

In a study on wrestlers, the effects of four weeks of dynamic flexibility exercises on performance were examined and significant improvements in anaerobic capacity and strength characteristics were obtained (Herman & Smith, 2008).

In a study on basketball players with a mean age of 20 (± 2) years, it was shown that the application of ballistic flexibility exercises and consequently, the development of flexibility provide a significant improvement in vertical jump performance (Woolstenhulme et al., 2006).

In a study on the flexibility level of footballers' hamstring muscles and its effect on football skills, it was found that less flexibility of back group muscles of the legs had an adverse effect on characteristics such as jump and speed. Based on this result, it was suggested that footballers should perform flexibility exercises at an early age (García-Pinillo et al., 2015).

Various studies have demonstrated that an increase

Table III

The relationships between the flexibility ability and the selected variables of the long jumpers.

Variables		Actual distance	V10	CT-TO	TO-angle	L1 (%)	L2 (%)	L3 (%)
Flexibility	r	0.34	0.45*	-0.14	-0.11	-0.04	0.05	-0.04
	p	0.55	0.01	0.46	0.56	0.82	0.80	.84

* $p<0.05$

in the flexibility of athletes results in an improvement of jumping and speed values. In this study, a statistically significant relationship between the approach run up speed, which is one of the long jump performance components, and the flexibility of the athletes was found, while there was no statistically significant relationship between the landing stage (L3) values of the athletes (due to the L3 similarity of the body position in the sit and reach flexibility test) and flexibility.

Conclusions

1. Due to the L3 similarity of the body position in landing with the sit & reach test, the anticipated relationships were not found except for V10.

2. A statistically significant weak positive correlation was found between the flexibility ability of the long jumpers in the study group and the approach run velocity (V10).

3. No statistically significant relationship was found between flexibility and other selected parameters. In the literature survey that was conducted, no other study examining the relationship between long jump performance components and flexibility was found.

Conflicts of interests

The authors confirm that there are no known conflicts of interest associated with this publication.

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