SELECTION PROCEDURE Of MEASUREMENT MOST OBJECTIVE METHODS OF LEVEL JUMPING ABILITY IN SPORTSMEN

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Abstract
Objective: A high level of jumping ability is a prerequisite of success in many sports.
Method: The study aimed at comparing two methods of measuring jumping ability - a simple, direct test and another one by tensometric platform.
Discussions and Conclusion: The results were compared to selected anthropometric variables. In a group of 39 athletes representing 5 sports a high correlation between the results obtained by those 2 methods was found ($r=0.93$, $P<0.001$). However, the results obtained by the direct method-Starosta's test were about 15.8% higher ($P<0.001$) than those obtained by tensometric method.
Key words:

INTRODUCTION

A high level of jumping ability is a prerequisite of success in many sports, e.g. track and field jumps, volleyball, basketball, handball, ice figure skating, rhythmic gymnastics. Thus, determining jumping ability is of paramount importance for assessing the athlete's motor potential. The height of vertical jump is associated with a large number of degrees of freedom, due to the involvement of many joints, thus being a task of a complex coordination (3). The height of a vertical jump depends on its performance (1,4,8,9), as well as on the knee flexion angle and swing range (2,7).

The methods used for measuring of jumping ability vary regarding their objectiveness and reliability as reported by many authors (2,6,9,10) who pointed out weak points in some of them which resulted in a decreased reliability (table 1). The reports comparing various methods of measuring of the jumping ability are rather scarce. Fidelus and Gradowska (6) studied the displacements of the centre of body mass in the jump tests of Sargent and Abalakov (9, 10) and found the results to diverge considerably, differences between both methods ranging from - 5 to 6 cm. Those methods were compared with a modified test of Starosta (9, 10) and the latter was found to be more precise than the other two tests.

No published, comparative study has been found in the available literature, concerning the jumping ability. The aim of this work was thus to compare the results of measuring the jumping ability by two methods - a simple, direct method – Starosta's test (9, 10) and another one employing the Kistler's tensometric platform.

MATERIAL AND METHODS

A total of 39 athletes - 34 male and female ones, engaged in various sports (track and field jumps, volleyball, soccer, rowing and ice hockey), volunteered to participate in the study. Their training experience ranged from 3 to 14 years and their sport class - from the national (Class 2) to international elite. Basic characteristics of the subjects studied are presented in Table 2.

Every subject performed 3 jumps on a recording device mounted on Kistler's tensometric platform. This enabled simultaneous recording of results by both methods. The mode of the jumping abilities test: wooden square platform (the jumping-meter) with each side 1m long, a leather belt with a centimetre tape placed on the cord. In the middle of the platform there was an opening with a tape passed through it. The tape was connected by a thin cord with a belt which was put on round the hips of the individual examined. A slack connection of the tape with the belt made impossible overstating of measurement results because of hips motion forward or back during the jump.

The test and the measurements: after mounting the belt with the tape, the individual examined stood barefoot on the jumping-meter with their ankles in a line with the opening for the tape. Then jumped upwards with a swing of arms, pulling out the tape from the opening. The result of the jump was the remainder between the numerical value of the tape after and before the jump. The place of landing was limited by two concentric circles (larger with 62cm in diameter for the youths and adults, smaller with 42cm in diameter for children). Crossing the limit of the appropriate circle made impossible to recognition of the test. In the opening for the tape there was the tape transport limiter fitted to eliminate pulling it out by force of inertia. Measurements were repeated three times and the best result was taken into consideration

RESULTS

The results of jump tests obtained by the direct method – Starosta's test and from the tensometric platform are presented in Table 3. Individual results obtained by those 2 methods were highly correlated ($r=0.93$; $P<0.001$) although the direct method rendered systematical higher results (by 15.8% on the average; $P<0.001$). Individual differences ranged from 3.8 to 16.4 cm, mean values for groups - from 7.7 to 11.1 cm ($x = 8.8+2.3$ cm). The following interrelationship was observed: the higher was result of jumping ability, the greater was difference of both methods results.

DISCUSSION

A high correlation (r=0.93) between the measurements of jumping ability obtained from tensometric platform and by a direct method evidences that both methods provide measures of the same trait. However, all individual results obtained by the direct method were considerably higher than those obtained from the tensometric platform due, probably, to different execution of the measurements. Namely, in the tensometric method, the moment of full take-off was recorded and thus the rise of heels and metatarsal support before the take-off did not affect the final result. That latter phase considerably improved the jump height (by 15.8%) measured by the direct method. The length of foot is probably another contributing factor. This rises the question whether the tensometric platform method, not taking into account the displacement of the center of gravity until the take-off adequately reflects the jumping ability.

There is also a question of applying jumping ability measurements in practice in view of the differences between tensometric measurements and those obtained by simpler techniques, e.g. that of Sargent or of Starosta (9,10). Tensometric platform produces accurate results but difficult to employ due to its high cost (cf. Table 1). For that reason, the test of Starosta (9,10) may be easily adopted, especially for screening purposes, monitoring the sport training, at schools, etc, owing to its simplicity, accuracy and low cost of the device.

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Table 3: Mean values (SD) of basic characteristics of jump tests recorded in male (M) and female (F) athletes

Variable	Track & Field		Volleyball	Rowing	Soccer	Ice Hockey	All athletes X (n=39)
	M(n=10)	F(n=5)	M(n=5)	M(n=5)	M(n=6)	M(n=8)	
Age (years)	23,2±2,3	22,8±3,4	23,4±2,2	23,6±2,7	18,2±4,2	15±0,2	20,7±4,2
Body height (cm)	181,1±3,4	171,0±5,2	176,8±8,6	190,2±4,1	177,2±5,2	173,0±5,5	178,3±7,7
Body mass (kg)	72,5±4,0	59,6±6,4	71,8±10,6	84,6±1,8	62,7±5,9	59,4±6,5	68,1±10,3
Athletes experience (years)	6,1±2,4	8,4±1,1	6,6±1,3	8,0±2,6	4,7±3,6	4,7±0,7	6,2±2,5
Direct test - Starosta's test (cm)	60,2±9,4	51,0±4,2	57,2±9,3	58,8±7,7	51,7±4,5	51,5±4,8	55,3±7,8
Kistlers's platform (cm)	50,5±9,1	42,9±3,4	49,1±9,3	47,7±6,0	43,2±4,6	43,8±6,3	46,5±7,4
Difference (cm)*	9,7±2,0	8,1±2,3	8,1±2,0	11,1±2,0	8,5±2,9	7,7±2,2	8,8±2,3
Correlation significant	**0,944**	**0,921**	**0,921**	**0,928**	**0,937**	**0,934**	**0,931***

Table 1: Methods of measuring jumping ability – an overview

Sargent	Abalakov	Starosta	Tensometric platform
	Disadvantages		
-Impsecision of initial measurement (rising the shoulder worsens the jump results (6) -Fear of hitting the wall -Touching the board too late or too early (increases measurement error (6) -Fixed board is of some disadvantage	-Subject's feet set in position relative to the tape -Indeterminate jump-down point (9,10) -Raised shoulder at jump may increase the result -Pelvic motions forwards or backwards may improve the result (9,10)	-Frequent replacement of the tape - Frequent control of the tape fastening point and fastening belt -Subject has to be instructed in detail as to the jump technique (9,10)	-Unavailable for screening purpose -Expensive equipment -Heat-and moisture-sensitive -Erroneous results after prolonged use (5) -Not simple in use
	Advantages		
-Simple and easy in use -Inexpensive equipment -Enables screening measurements	-Simple and easy in use -Inexpensive equipment -Enables screening measurements	-Simple and easy in use -Equipment inexpensive and easy to set up -Enables screening measurements in diverse, even primitive conditions -Fixed place and position of feet before and after jump -Fixedorientation of feet to one another -Belt and tape fixed to subject's hips -Tape protected against pulling out by hip motions (9,10)	-High reliability -Universal power supply and amplifiers -Optional remote control -Simultaneous recording of many variables (5)

Table 1: The basic characteristics of the studies subjects (n = 39)

n	Discipline of sport	Sport Class	Training experience(years)
15	Track and Field	First and second	6-10
5	Volleyball	First	7-13
5	Rowing	Master (National Team)	8-14
6	Soccer	Second	4-10
8	Ice hockey	First (Junior National Team)	3-5

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	M(n=10)	F(n=5)	M(n=5)	M(n=5)	M(n=6)	M(n=8)	(n=39)
Age (years)	23,2±2,3	22,8±3,4	23,4±2,2	23,6±2,7	18,2±4,2	15±0,2	20,7±4,2
Body height (cm)	181,1±3,4	171,0±5,2	176,8±8,6	190,2±4,1	177,2±5,2	173,0±5,5	178,3±7,7
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Correlation significant	**0,944**	**0,921**	**0,921**	**0,928**	**0,937**	**0,934**	**0,931***

*All differences between results of jump tests was significant (P≤0,001)

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8	Ice hockey	First (Junior National Team)	3-5