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Gymnasts' Special Quickness-Force Abilities and the Indicators of Jump from a Springboard

Adam Koperski

Department of Gymnastics, Jędrzej Sniadecki Academy of Physical Education and Sport in Gdansk, Poland,
koperskia@wp.pl

Andrzej Kochanowski

Jędrzej Sniadecki Academy of Physical Education and Sport in Gdansk, Poland, andrzej.kochanowicz@awf.gda.pl

Czesław Słodkowski

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Abstract

Background: The aim of this research is to find a relation between one's special quickness-force abilities, recorded in laboratory conditions, and physical values, revealed during a gymnastic jump in a real sports contest. **Material/Methods:** The tests were made on gymnasts, aged 15–18 years, from the Academic Sports Association (AZS) in Gdansk. The gymnasts were a selected group of 8 people who had already practised sport for 9–12 years as contestants. The project was carried out in the Physical Effort Laboratory at the Academy of Physical Education and Sport (AWFiS) in Gdansk, using of the Kistler tensometric platform to measure and analyse the ground reaction forces. The strength of leg muscles and pelvic girdle were checked. The measurements of quickness and force abilities of sportsmen were based on the assessment of power of their take-off and the time in which they contacted the ground. The results were compared with the result analysis of jumps achieved by the contestants in the Individual Polish Championships (Iława 2005). The measurement of the mechanical quantities during the take-off at the springboard was done using the photogrammetric method. **Results:** The statistically highest and important correlation between the results of gymnasts in the quantity of the take-off power, checked on the tensometric platform and at the springboard was with the value being $r=0.916$ for $p \leq 0.05$. A crucial correlation was also observed for the time of the contestant's contact with the ground in laboratory tests and the same parameter measured during the contestant's taking off the springboard ($r = 0.668$). **Conclusions:** The analysis of test results reveals a strict correlation between the level of one's abilities in quickness and force in laboratory conditions and physical values revealed during the take-off from a springboard in an actual contest. The measurement of the quickness-force abilities (the power of take-off) in laboratory conditions can be used as the measurement of the sportsmen's preparation for the gymnastic jump.

Keywords

artistic gymnastics, quickness and force abilities, take-off power, vault

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A – Study Design
 B – Data Collection
 C – Statistical Analysis
 D – Data Interpretation
 E – Manuscript Preparation
 F – Literature Search
 G – Funds Collection

Adam Koperski ^(A,B,C,F), **Andrzej Kochanowicz** ^(D,E,F),
Czesław Słodkowski ^(D,E)

Jedrzej Sniadecki Academy of Physical Education and Sport in Gdansk,
 Poland

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Abstract

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Material/Methods: The tests were made on gymnasts, aged 15–18 years, from the Academic Sports Association (AZS) in Gdansk. The gymnasts were a selected group of 8 people who had already practised sport for 9–12 years as contestants. The project was carried out in the Physical Effort Laboratory at the Academy of Physical Education and Sport (AWFiS) in Gdansk, using of the Kistler tensometric platform to measure and analyse the ground reaction forces. The strength of leg muscles and pelvic girdle were checked. The measurements of quickness and force abilities of sportsmen were based on the assessment of power of their take-off and the time in which they contacted the ground. The results were compared with the result analysis of jumps achieved by the contestants in the Individual Polish Championships (Iława 2005). The measurement of the mechanical quantities during the take-off at the springboard was done using the photogrammetric method.

Results: The statistically highest and important correlation between the results of gymnasts in the quantity of the take-off power, checked on the tensometric platform and at the springboard was with the value being $r=0.916$ for $p \leq 0.05$. A crucial correlation was also observed for the time of the contestant's contact with the ground in laboratory tests and the same parameter measured during the contestant's taking off the springboard ($r = 0.668$).

Conclusions: The analysis of test results reveals a strict correlation between the level of one's abilities in quickness and force in laboratory conditions and physical values revealed during the take-off from a springboard in an actual contest. The measurement of the quickness-force abilities (the power of take-off) in laboratory conditions can be used as the measurement of the sportsmen's preparation for the gymnastic jump.

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Address for correspondence:

Mgr Adam Koperski

Academy of Physical Education and Sport, Department of Gymnastics, 80-336 Gdańsk, Poland, ul. K. Górskiego 1

Phone: +4858 554-73-21, e-mail: koperskia@wp.pl

Introduction

The demonstration of the power of muscles, being one of the most important motor skills in artistic gymnastics, requires multi-directional research which will help to locate important points in the training process of gymnasts at various stages of their advancement [1,2,3,4,5]. Because of the specificity of this sport discipline, determination of one's quickness and force is a rich source of information on one's potential and it is an important indicator of the effectiveness of his/her training process [6,7,8,9,10,11]. There is a close relation between one's quickness and force abilities and the way in which one performs a given motion task, receiving a specific result in sport [12,13,14,15,16].

In artistic gymnastic, the character of muscle work depends on the requirements in particular contests in all-around gymnastics. A gymnastic vault is characterised by a short time of performance with the optimum use of one's quickness-force as well as co-ordination skills in every phase of the jump [17,18].

The aim of this research is to find a relation between one's special quickness-force abilities, recorded in laboratory conditions, and physical values, revealed during a gymnastic jump in a real sports contest.

Material and method

The tests were made on gymnasts, aged 15–18 years, from the Academic Sports Association (AZS) in Gdansk. The gymnasts were a selected group of 8 people who had already practised sport for 9–12 years as contestants. The entire project was carried out in the Physical Effort Laboratory at the Academy of Physical Education and Sport (AWFiS) in Gdansk, using of the Kistler tensometric platform to measure and analyse the ground reaction forces. The following data were checked: the strength of leg muscles and pelvic girdle. The measurements of quickness and force abilities of sportsmen were based on the assessment of power of their take-off and the time in which they contacted the ground. The results were compared with the result analysis of jumps achieved by the contestants in the Individual Polish Championships (Iława 2005). The measurement of the mechanical quantities during the take-off at the springboard was done using the photogrammetric method. Next, the collected material was analysed statistically using the Excel and Statistica 7.0 PL software.

Results

The highest power was achieved in jumps on the tensometric pathway by Ł.M. (65.0), and the lowest one by S.P. (45.2 W). The mean result of the group was 56.2 W, against relatively low dissipation of the results (standard deviation – 6.5). The shortest time of contact with the ground was obtained by gymnast W.A. (0.117 s), and the longest one by J.P. (0.17 s). The mean time of contact with the ground in the research group was 0.15 s, with standard deviation at 0.02 (Tab. 1).

The extreme results recorded during the take-off at the springboard at the Polish Championships (Iława 2005) achieved by the same gymnasts as in the laboratory condition were Ł.M. 4987 W and S.P. 3228 W respectively, while the shortest time of contact with the springboard, 0.12 s, was obtained by gymnasts W.A. and R.B. and the longest one, 0.15 s, by J.P. and R.M. – 0.15 s. The mean contact with the springboard of the group was 0.13 s, and the standard deviation was 0.01 (Tab. 2).

The statistically highest and important correlation between the results of gymnasts in the quantity of the take-off power, checked on the tensometric platform and at the springboard was with the value being $r=0.916$ for $p\leq 0.05$ (Tab. 3). A crucial correlation was also observed for the time of the contestant's contact with the ground in laboratory tests and the same parameter measured during the contestant's taking off the springboard ($r = 0.668$).

Tab. 1. The results of gymnasts' take-off, considering the parameter of force and the contact time with the ground

Gymnasts' initials	Force of take-off [W]	Contact time with the ground [s]
D. M.	56.2	0.131
J. P.	49.7	0.170
W. A	57.7	0.117
R. M	62.2	0.166
Ł. M	65.0	0.152
T. K.	59.3	0.164
R. B	54.0	0.154
S. P.	45.2	0.147
Mean results	56.16	0.150
Standard deviation	6.47	0.02

Tab. 2. Physical values of the sportsmen's take-off on a springboard

Gymnasts' initials	Force of take-off [W]	Contact time with the springboard [s]
D. M.	4774	0.13
J. P.	3745	0.15
W. A	3984	0.12
R. M	4522	0.15
Ł. M	4987	0.13
T. K.	4310	0.13
R. B	3960	0.12
S. P.	3228	0.14
Mean results	4189	0.13
Standard deviation	576.7	0.01

Tab. 3. The correlation between laboratory results and physical values during the take-off from the springboard

Kind of research		Laboratory results		Take-off from the springboard	
	Parameters	Force of take-off	Contact time with the ground	Force of take-off	Contact time with the springboard
Laboratory results	Force of take-off	x			
	Contact time with the ground	-0.115	x		
Take-off from the springboard	Force of take-off	0.916	-0.124	x	
	Contact time with the springboard	-0.241	0.668	-0.205	x

Discussion

In special research attention was devoted to the relation between motor skills and technical preparation in the chosen all-around gymnastics [19,20]. In the opinion of Gaverdovskij and Smolevskij [1] quickness-force possibilities greatly decide about the quality and the effectiveness of learning gymnastic exercises. In the research conducted by Szot et al. [14] attention was paid to a high relation between the power of take-off from the springboard and from the gymnastic table with the height of the performed vaults. A. Kochanowicz et al. [17] define that the height level of technical preparation in gymnastic vaults depends, among others, on individual quickness-force abilities recorded in laboratory conditions.

The presented research has defined the level of quickness-force abilities of sportsmen and indicated the correlation between the take-off in laboratory conditions and the results during actual contests. The parameters of muscle work of the leg and hip area are strictly correlated with the power of the take-off on a springboard.

Similarly, a high interdependence was noted in laboratory tests, testing the time of a sportsman's contact with the ground. The above information can be used as a starting point for further search for more effective monitoring during training. Short laboratory tests of quickness-force abilities on a tensometric platform can broaden the scope of special training of sportsmen, preparing them to the vault on a gymnastic table. However, in this case, all remaining aspects must be taken into account, including a recording and analysis of the training load, the level of one's advancement in sport practice and other components of contestants' training process.

Conclusions

1. The analysis of test results reveals a strict correlation between the level of one's abilities in quickness and force in laboratory conditions and physical values revealed during the take-off from a springboard in an actual contest.
2. The measurement of the quickness-force abilities (the power of take-off) in laboratory conditions can be used as the measurement of the sportsmen's preparation for the gymnastic jump.

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