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Adjustment of beam-specific physical training of juniors according to the new code of points in female artistic gymnastics

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Abstract
The paper has the **purpose** of improving technical executions and developing the psychomotor qualities specific to this event. **Hypothesis:** we assume that a specific program of physical training – using the means executed in conditions of balance – contributes to increased productivity and efficiency of balance beam training. **Methods.** The experiment concerned 8 third-category junior female gymnasts to whom the independent variable was applied, (i.e. a system of means addressed to the development of motor qualities on the beam, in balance conditions). The tests used were the following: Matorin, Fleishman, movement speed, speed strength of leg muscles and explosive power. **Results.** The values of arithmetic mean and standard deviation in the tests increased as follows: Matorin: 71°±2.9 on the dominant side, 76°±3.1 on the non-dominant side; Fleishman: 1.69±0.39 s on the dominant side, 1.87±0.07 s on the non-dominant side; movement speed: 1.63±0.27 s; muscle strength 2.62±0.44 on the dominant leg, 2.25±0.16 on the non-dominant leg; explosive power 1.87±0.55. **Conclusion**. Consequently, we posit that the means of physical training applied in balance conditions contributed to more effective balance beam training.

Keywords: artistic gymnastics, physical training, balance beam

1. Introduction

Although artistic gymnastics is still performed on the same apparatus as about 50 years ago, it has undergone great changes: increased competition, growth in rates of participation, the development of sport science in general and biomechanics in particular, and development of the creative forces of gymnasts themselves (Kirialanis et. al., 2003).

Artistic gymnastics is one of the sports (along with diving, figure skating and synchronized swimming) in which competition results (scoring and ranking of athlete's performance) heavily depend on the judges' evaluation. This is in contrast to some other sports, e.g. athletics, where results are recorded by precise technical instruments, or sports like basketball, where scoring is formally confirmed by the judge, but usually is not perceived as problematic by experts or spectators (Leskošek et al., 2012).

The sport comprises several activities in which female athletes perform routines on four apparatuses (vault, uneven bars, balance beam, and floor), while male gymnasts perform routines on six apparatuses: floor, pommel horse, rings, vault, parallel bars, and high bar (Prassas et al, 2006). Elite female and male gymnasts may initiate training for their sport as early as age 6 and 9 years, respectively, and peak performance is reached at least 10 years later. The primary determinant of success is the ability to perform a high-difficulty exercise with a high execution score. During a highlevel competition, the performance scores on uneven bars and balance beam for women and on pommel horse for men have been shown to be the strongest predictors of final standing in the competition (Massidda & Calo, 2012; Massida et al., 2015).

In the Code of Points it is emphasized that the exercise presentation is the most important part and it should never be compromised for difficulty. In the practice of competitions we often see exactly the opposite philosophy from gymnasts and their coaches (Čuk et. al., 2012).

The beam, specific event of women's artistic gymnastics, can be characterized as a balance apparatus par excellence both physically and mentally. From biomechanical point of view, the mastery and adjustment of balance throughout the exercises on beam can be achieved by respecting the law principle of the permanent projection of body centre of gravity on the support surface so narrow (Potop et al., 2014).

As it is mentioned before, balance beam is one of the four apparatus in Women Artistic Gymnastics on which gymnasts perform elements from different groups during a routine, in atime that may not exceed 1.30 minutes. Every routine begins with a mount (taken-off from the board or the mat). During the routine on the balance beam, gymnasts perform gymnastic leaps, jumps and hops, gymnastic turns, holds and acrobatic elements with or without flight phase and hand support (Delas, 2011).

The maximum of 8 highest difficulties including the dismount are counted for difficulty value (DV) score (maximum 5 acrobatic elements, minimum 3 dance elements) (FIG, 2013). Regarding the fact that landings and dismounts are the most common causes of injuries in artistic gymnastics (Marshall et al., 2007; Lund & Myklebust, 2011), we are mainly interested in jumping elements.

Regarding the fact that motor abilities are a direct limiting factor of performance, the level of lateral asymmetry of extremities may determine the gymnast's performance as well (Pajek et. al., 2016). Control of balance requires communication and integration across the nervous system. Preventing and recovering from loss of balance requires an integration of visual, vestibular, proprioceptive, and other sensory feedback mechanisms (Faraldo-Garcia et al., 2012; Sozzi et al., 2012).Visual system provides very important information about where the body is located with respect to the environment in which it moves; eventually it provides information about the speed of the movement (Shumway-Cook & Woollacott, 2007). The quality if visual system, mainly visual acuity and stereoscopic vision, in other words the depth of vision may influence the quality of performance of a balancing element (Hedbávný et. al., 2013).

Anxiety may be also important in gymnastics, particularly during balance beam performance, where elements of high difficulty are performed on a 10 cm wide beam at a height of 125 cm. (Cottyn et al., 2006).

Therefore, balance beam is a difficult event within women's artistic gymnastics, where points are lost very easily, (by losing balance or falling off the apparatus) considering the difficult conditions of the gymnasts' routine. The height and narrowness of the beam requires a thorough improvement of all senses, a good capacity to focus attention and to self-regulate emotions. Furthermore, this event requires an optimal level of motor qualities development. All of the aforementioned goals may be attained by training extensively and by spending ever more time on the balance beam.

2. Material and method

The paper had the *purpose* of improving technical executions and developing the psychomotor qualities specific to this event.

Hypothesis: we assume that a specific program of physical training – using the means executed in conditions of balance – contributes to increased productivity and efficiency of balance beam training.

The experiment concerned 8 third-category junior female gymnasts to whom the independent variable was applied for a year. The initial testing was conducted in September 2015, while the final testing in September 2016.

We have used the following tests: *the Matorin test*, conducted for both the dominant and the non-dominant side; *the Fleishman test*, consisting of timing the duration of maintaining one-leg balance, eyes closed, on a reversed-T equipment, (height of 4 cm, width of 2 cm and length of 60 cm) – the test was conducted for both legs; *the testing of movement speed* consisted of timing the duration necessary for a female athlete to move from one end of the balance beam to the other, by running forward and walking upon return – we recorded the seconds necessary for covering this distance; *the testing of speed and balance strength of leg muscles*: timing the execution and recording the time necessary to execute 10 one-leg squats on the balance beam, (the free leg outstretched above the floor); *testing balance explosive power:* executing a long jump on the small balance beam and measuring the take-off in centimetres.

The independent variable comprised a system of means addressed to the development of motor qualities in conditions of maintaining balance on the beam, namely: *means for developing repetition speed:* types of sprints, types of jumps and leg swings up to 90 degrees, executed in all directions; *means for developing the strength of muscle legs, executed on the balance beam:* standing on the balance beam, legs apart, squats executed transversely; duck walks; squat-jumps; standing, legs apart, sagittal semi-squat jumps; longitudinal squat-jumps on the balance beam; one-leg squats; knee-to-chest jumps executed transversely on the balance beam; and long jumps executed transversely on the balance beam*; means for developing the strength of abdominal muscles, executed on the balance beam:* sitting tuck position, legs raised at 45°, execute vertical criss-cross movements; laying longitudinally on the balance beam, flexed arms raised grasp the balance beam; raising outstretched legs from the balance beam; straddle-sitting on the beam, rising to pike and maintaining the position; from a supine position on the beam, arms to the sides, raising the trunk and the legs simultaneously; performing horizontal criss-cross movements, underneath the beam.

3. Results

Table 1. Values obtained by subjects in the two tests

Statistical indicators	Test	Matorin Test (degrees)		Fleischman Test (sec.)		Squats (sec.)		Explosive power (cm)	Movement speed (sec.)
	Testing	D	NonD	D	NonD	D	NonD		
Mean	T.I.	597,5	429	6,99	5,45	15,62	17,37	22,13	11,14
	T.F.	668	505	8,68	7,32	13	15,12	24	9,51
Standard deviation	T.I.	43,9	38	0,87	0,47	1,5	1,4	3,35	0,93
	T.F.	41	41,1	0,48	0,54	1,06	1,24	2,8	0,66
Variability coefficient	T.I.	7%	9%	12%	9%	10%	8%	15%	8%
	T.F.	6%	8%	6%	8%	8%	8%	11%	7%

The table above shows that the values of arithmetic mean and standard deviation in these tests improved as follows: in the Matorin test, by 71°±2.9 on the dominant side and by 76°±3.1 on the non-dominant side. In the Fleishman test, we noted an increase by 1.69±0.39 seconds on the dominant side and by 1.87±0.07 seconds on the non-dominant side. Concerning the testing of movement speed, we mention an increase by 1.63±0.27 seconds; as for leg muscle strength, we highlight an improvement by 2.62±0.44 seconds for the dominant leg and by 2.25±0.16 seconds for the non-dominant leg. As for explosive power, we also note a progress of 1.87±0.55 cm between the two tests.

Discussion

The training process in artistic gymnastics – like in any other sports – involves arduous, systematic, continuous, and scheduled work. Efforts are sometimes hard to imagine and to endure by both coaches and athletes.

A competent coach will always know to put the athlete first and the victory second. This belief will enable the coach to obtain the desired victory, if he perseveres and trusts his profession.

Furthermore, the coach must systematize and rationalize his entire array of training means and methods; he must adjust them to the individual particularities of athletes, in order to make each lesson as effective as possible.

We started from the assumption that specialized beam training will entail an improvement of both the level of motor qualities and the level of execution technique, which determined us to conduct this experiment.

The gymnastics-specific physical training with general contents is no longer enough and it is not as effective as it used to be. Gymnastics has evolved continually and the training process must be updated. For these reasons, we believe that physical and artistic training (if applicable) must be performed by focusing on the specific event. We must use both the means specific to physical and artistic training and the means of technical training, to be performed in conditions specific to the respective event.

Conclusion

This research shows that – based on the results – the means of physical training applied in balance conditions made the beam training process more effective by improving technical executions qualitatively and by developing the motor qualities specific to the event, which confirms the research hypothesis.

The progress recorded by the experimental group had proven the importance and necessity of approaching the instruction process for gymnasts on the balance beam from the perspective of all sports training components, according to the principle of great insight into training specialization.

The practical *recommendations* we provide are listed below: the use of means specific to physical training in balance conditions and their introduction into the training program of beam gymnasts, for all categories; the adjustment of training means to the evolution trends of the event and their corresponding updating whenever necessary; adequate focus on specialized training in all events, starting from early childhood; the judicious scheduling of the most effective sports training means, in order to ensure high efficiency in all practice sessions; the time spent on the balance beam will increase by age, by the individual needs of female gymnasts and by the demands specific to this event.

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