

### Values of physical preparation in female gymnasts

Edison Ikonomi<sup>1</sup>, Ferdinand Mara<sup>2</sup>, Arben Bozaxhiu<sup>1</sup>, Xheni Kozi<sup>3</sup>, Entela Ikonomi<sup>4</sup>,  
 Eglantina Daulle<sup>5</sup>

<sup>1</sup>Department of Sports.Sport University Tirana, Albania

<sup>2</sup>Department Health, Sports and Recreation. Sport University Tirana, Albania

<sup>3</sup>Phd student. Sport University Tirana, Albania

<sup>4</sup> Coach female gymnastics sport club Tomorri

<sup>5</sup> Coach female gymnastics sport club Tirana

Correspondence: Edison Ikonomi (e-mail: edisikon@yahoo.com)

#### Abstract

Artistic gymnastic is one of the components of competitive gymnastics and is divided in men's and women's artistic gymnastics. There are four events in the women's artistic gymnastics: vault, uneven bars, balance beam and the floor. Strength training in artistic gymnastic is closely linked to the gymnastic skills, so we can talk about the development of specific strength that is comparable to other sports. Taking into consideration the predetermined role of the muscular preparation in defining the physical training for female gymnasts. In this study, were obtained analysis twenty-one female gymnasts from four sports clubs in different cities of Albania, who are members of national gymnastics competitions. Tests realized in the beginning and final are as follows: SJ (cm), CMJ (cm), TF SJ (ml/s}, T F CMJ (ml/s}, SJBW (cm), CMJ 15 sec. (cm), HP (cm), HPWB (cm). Gymnasts have level average in SJ and CMJ. Low ratio indicates optimal condition strength to gymnasts. Referring tests shows that 16 gymnasts have high value flight times jumps SJ and CMJ. A different tableau is observed to 5 gymnasts, where look lower values of flight times jumps in SJ and CMJ. From the measurements of the tests, it resulted that those gymnasts that were involved in the study had an average level of strength of their lower limbs and a lower level of power of their upper limbs.

*Keyword:* Artistic Gymnastics, Physical Training, Strength, Performance.

## Introduction

Artistic gymnastic is one of the components of competitive gymnastics and is divided in men's and women's artistic gymnastics. There are four events in the women's artistic gymnastics: vault, uneven bars, balance beam and the floor. On the each of apparatus, except on vault, where is performed only one jump, gymnasts do links between the series of gymnastic elements which merge into one routine of 30 to 90 seconds duration. (*Meta A., 2019*)

Strength training in artistic gymnastic is closely linked to the gymnastic skills, so we can talk about the development of specific strength that is comparable to other sports. When we look at children's artistic gymnastic, considering definitions of strength and power, we cannot talk about strength, we can, only, talk about power, especially explosive. (*Jorgoni A., 2007*)

Jumps take an important part of gymnastics daily routines. Gymnasts' ability to transmit their impulse from their feet to their upper bodies following rebounds is crucial, allowing acrobatic skills such somersaulting and twisting. Artistic gymnastics has seen amazing evolution throughout the last five decades (*Kosova et al., 2022*).

Exhibited strength, power, flexibility and spatial awareness via the incredible complicated aerial skills have contributed in shaping a new profile of the modern gymnast (*Jemni, 2018 & Ramirez-Campillo R et al., 2013*).

Vertical jumps are used in a plenty of sports. Their primary goal is usually to reach the greatest possible height (*Feeney et al., 2016*). Gymnasts' jumping ability is often linked to successful performance (especially in floor routines and vault).

Gymnasts have incredible neuromuscular connections and they are also characterized by very high levels of strength, power, flexibility, and muscular endurance, combined with speed and coordination (*Asadi et al., 2017*).

The gymnasts differ from each other in motor abilities which are reflected in the performing quality of gymnastic movements, or accuracy of the techniques, levels of the elements, compositional possibilities of the realization of gymnastic exercises. (*Bogdanis C et al., 2019*).

From the perspective of child development, gymnastics is one of the key sports as any physical exercise on the floor or apparatus that offers a great range of locomotive, stability and body control movements which are highly important for the development of children (*Romero C et al., 2021*).

### Measurements and methods

In this study, were obtained analysis twenty-one female gymnasts from four sports clubs in different cities of Albania, who are members of the national gymnastics competitions. Experimentation and comparison of data from different measurements, occupies an important place in the study, which enable testing of explosive strength and modeling training her.

To measure these important indicators, the Leonardo Mechanography (GRFP) certified apparatus was used, which is a platform connected to the computer that measures the power, jumpiness, balance of the legs in various tests, which are presented in its manual. Specific data for the performed tests were obtained from this apparatus.

To measure important indicator of explosive strength of upper limbs, was used Ergo-jump Bosco System, Made by Globus equipment, which were taken from specific data.

Tests with gymnasts were conducted in the laboratory of the Scientific Research Centre of Sports in UST during the period March 2023 (first measurement), May 2023 (second measurement).

#### Statistic

Descriptive statistics were performed for the entire group and the homogeneity of the distribution was investigated. Measurement pairs were compared by nonparametric Wilcoxon Test. The relations between variables were examined by Correlation test. The data was analyses with the help of Microsoft Excel, 2010. Significance was set to  $p < 0.05$  and  $p < 0.01$  levels. Software was used in all the statistical procedures.

#### *Apparatus used*

Lengthmeter; scales; Leonardo Mechanography (GRFP); Ergo-jump Bosco System, Made by Globus. computer.

#### *Calculations*

Indicators measure the sportsmen by Bosco P. (*Marina M, Jemni M. 2014*). were:

- ◆ Height, weight measurements of study group were taken.

Body Mass Index (BMI) was determined by the following equation:  $(\text{BMI}) = \text{weight} / \text{height (cm)}^2$

All anthropometric measurements were applied according to Anhtropometric Standardization Manuel (*Wang 2000 & Timothy et al., 1988*).

- ◆ Was measured height flight in both types of CMJ and SJ jumps and flight time.
- ◆ Based on the difference of the two types of jumps CMJ & SJ, muscular elasticity was determined in cm.

- ◆ In test 15 seconds jumps, knowing the time average flight, defined the average height of flight.
- ◆ Decided to report the average height of flight for 15 seconds with to jump (CMJ).
- ◆ The evidence of 15 seconds is measured, the average time of flight and the average time of contact with the ground.
- ◆ In three tests thrust with hands in the vertical, was calculated the average.  
Environment temperature was 23<sup>0</sup>C place was soft.

### ***Methods standard jumps***

Standard jump (fig. 1a) starts from the stand at attention with their hands in the middle, sportsman makes leg flexion and quickly jumps up. This jump is called CMJ (Mouvement Jump Counter).

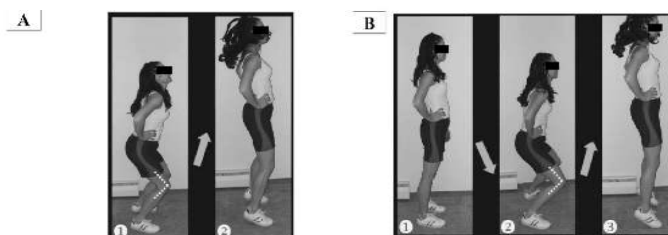
In Figure 1b, is shown jumping out of position with knees bent at 90 ° angle. This jump is called SJ (squat Jump).

### ***Vertical thrust technique***

Vertical thrust is one specific exercises necessary thrust his hands in gymnastics. She realized with extended arms, which reached a jump with shift down-up and return again to vertical position.

### **Figure 1**

SJ and CMJ jump .



### ***Methodology development of physical qualities of gymnasts***

Gymnasts competing at the highest levels, should be "light" weight. For this reason, coaches are very careful in strength training because it is an important skill motors in artistic gymnastics.

Exercises preparation physical and special place three times a week alternating, a physical preparation day, another special day. They were carried at the end of the preparatory part training.

### Exercises physical preparation

Exercises physical preparation were made to ten weeks presented in tables 1 as follows:

**Table 1**

*Plyometric training program (6 weeks) (Slimani et al., 2016)*

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Week Plyometric training program

number of sets × number of rebounds  
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Standing vertical hops 2 × 10

Single foot hops 4 × 8

1–2

Counter movement jumps 3 × 5

Multiple two-foot hurdle jumps (hurdle height 0.55 m) 6 × 6

Depth jumps (drop box height 0.20 m) 3 × 6  
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Lateral two-foot jumps 2 × 10

Two-foot jumps 4 × 8

3–4 Counter movement jumps 3 × 5

Multiple two-foot hurdle jumps (hurdle height 0.65 m) 6 × 6

Depth jumps (drop box height 0.30 m) 3 × 6  
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Two-foot jumps forward and backward: 2 × 10

Single foot jumps 2 × 8 on each foot

5–6 Counter movement jumps 3 × 5

Multiple two-foot hurdle jumps (hurdle height 0.76 m) 6 × 6

Depth jumps (drop box height 0.40 m) 3 × 6  
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### *Exercises special preparation*

Special preparation is exceptional value in the acquisition of gymnastic techniques, as exercises selected for this purpose, not only are similar from the standpoint of neuro-muscular strain, but above all, with technique self of performing elements in kind different many gymnastic competitions. (A.G.F. a. g. 2020)

Exercises special preparation were for ten weeks: Dosage load calculated by the amount of tools in part basic to training.

**Table 2**

*Methodology of special exercises. (A.G.F., a. g. 2020)*

Floor exercises: <ul style="list-style-type: none"> <li>• Run combined with jumps in diagonal.</li> <li>• Rondat flic row.</li> <li>• Back somersault, flic, back somersault.</li> <li>• Flic, back somersault, flic.</li> <li>• Tempo row.</li> <li>• Front somersault row.</li> </ul>	Beem: <ul style="list-style-type: none"> <li>• Transportation, front and back, lengthwise.</li> <li>• Combination with the more simple elements.</li> </ul>
Vault: <ul style="list-style-type: none"> <li>• Run 20-30m sprint.</li> <li>• Push the feet and hands from different positions.</li> </ul>	Parallel bar: <ul style="list-style-type: none"> <li>• All press to handstand. (stradle. piked. swing)</li> <li>• Handstand up and down.</li> <li>• Uprise with swinging front (back) row.</li> <li>• Swinging over row times.</li> </ul>

Exercises special preparation were included at half preparatory training by developing motor qualities to gymnasts at high level until the execution of gymnastic exercises as well.



## Results

To obtain exact data on the realization of our goals in the study, conducted anthropometric measurements. Measurements served to calculate body mass index (BMI), which helped us to take important conclusions over actual status of functional indicators, seeing the relationship between body weight and height.

**Table 3**

*Gymnasts anthropometric indicators.*

n=21	Min	Max	M $\pm$ SD
AGE (years)	16.32	18.24	17.04 $\pm$ 3.28
WEIGHT(kg)	35.2	49.8	42.71 $\pm$ 7.90
HEIGHT(cm)	141	158	150.13 $\pm$ 6.90
BMI (kg/m <sup>2</sup> )	17.03	20.16	18.495 $\pm$ 2.21

### Tests in two standard jumps

Two standard jumps were performed, Squa Jump (SJ) and the Counter Movement Jump (CMJ). In both jumps, gymnasts performed each three proofs of which were registered average results. Results SJ and CMJ were: SJ, IT 38.2cm. sd  $\pm$ 3:24, TF 40.7cm. sd  $\pm$  4. 61. Ratio between two jumps CMJ / SJ was: IT 1.131 sd  $\pm$ 0.01, TF 1.143 sd  $\pm$  0.01 and fast muscle fibers, IT 87% sd  $\pm$  11, TF 94% sd  $\pm$  9.

### Testing of jumps in 15 second

Gymnasts were tested, doing as much jumps, hanging within a maximum time of 15 seconds, where was measured: the number of jumps in 15 seconds TI 16 sd  $\pm$  2, TF 18 sd  $\pm$  3. The average height of these jumps: TI 26.6cm sd  $\pm$  6.4, TF 30.1cm sd  $\pm$  5.1 and calculation of the ratio between the average height of CMJ / CMJ jumps for 15 seconds: IT 1798 sd  $\pm$  0.11, TF 1737 sd  $\pm$  0.12.

### Handstand push testing

Handstand push without and with busily. gymnasts were tested by performed three proofs in both cases. Average results were: HP, IT 3.4cm sd  $\pm$  1.2, TF 4.2cm sd  $\pm$  1.5 and HPWB, IT 6.9 cm sd  $\pm$  2.3, TF 8.1cm sd  $\pm$  1.8.

### Testing of time flight in jumps CMJ and SJ



Flight time, measured in milliseconds, is an additional parameter of neuro-muscular skills of gymnastics. Time flying in SJ was: IT 545 milliseconds  $sd \pm 106$ , TF 581 milliseconds  $sd \pm 134$  and CMJ was: TI 427 milliseconds  $sd \pm 57$ , TF 466 milliseconds  $sd \pm 48$ .

### Testing jump with load to equal body weight

Gymnasts tested also jump SJ load placed on the neck, to equal the body weight. From this test (SJBW), issued the following data: IT 20.6 cm  $sd \pm 4.12$ , TF 22.9cm  $sd \pm 3.9$  and report SJBW / SJ: IT 0354  $sd \pm 0.15$ , TF 0377  $sd \pm 0.24$ .

**Table 4**

*Supplied data tests described above.*

LEGEND	TI s/d	TF s/d	DIF	MEAN	SD
SJ (cm)	38.2 $\pm 3.24$	40.7 $\pm 4.61$	2.5	39.45	$\pm 3.925$
CMJ (cm)	45.8 $\pm 6.05$	49.4 $\pm 2.93$	3.6	47.6	$\pm 4.49$
T F SJ (ml/s)	545 $\pm 106$	581 $\pm 134$	36	563	$\pm 120$
T F CMJ (ml/s)	427 $\pm 57$	466 $\pm 48$	39	446.5	$\pm 52.5$
R CMJ / SJ	1.131 $\pm 0.01$	1.143 $\pm 0.01$	0.012	1.137	$\pm 0.01$
F M F (%)	87 $\pm 11$	94 $\pm 9$	5	91.5	$\pm 10$
SJBW (cm)	20.6 $\pm 4.12$	22.9 $\pm 3.9$	1.7	23.75	$\pm 4.01$
R SJBW/ SJ	0.354 $\pm 0.15$	0.377 $\pm 0.24$	0.023	0.3655	$\pm 0.195$
N CM.J 15 sec	16 $\pm 2$	18 $\pm 3$	2	17	$\pm 2.5$
CMJ 15 sek (cm)	26.6 $\pm 6.4$	30.1 $\pm 5.1$	3.5	28.35	$\pm 5.75$
R CMJ/ CMJ 15sec	1.798 $\pm 0.11$	1.737 $\pm 0.12$	-0.061	1.7675	$\pm 0.115$
HP (cm)	3.4 $\pm 1.2$	4.2 $\pm 1.5$	0.8	3.8	$\pm 1.35$
HPWB (cm)	6.9 $\pm 2.3$	8.1 $\pm 1.8$	1.2	7.5	$\pm 2.05$

### Discussion

The data in table five, we see that gymnasts generally have BMI normal values and underweight. The speed of the explosive force of these is optimal, where seen a good performance in the execution of gymnastic elements. A small part of the gymnasts are overweight. This shows the main deficiencies in intramuscular coordination, lowering of capacity motor and physical. The important for us is to observe if they sportswoman overweight have in favor muscle mass of greater or fat mass BMI based on data of literature given in table 6.

**Table 5.**

*(Wang et al., 2000)*

<b>Classification</b>	<b>Female</b>
<b>Normal</b>	16.5-21.99
<b>Overweight</b>	22 -26.99
<b>More overweight</b>	27 high

Links between SJ and CMJ are very strong. This shows that the two tests are similar and valid for determining the strength fast of the lower bias. Table 6 shows that gymnasts have level average in SJ and CMJ. Low ratio indicates optimal condition strength to gymnasts. BMI is in normal situation, are good indicators that represents predominance of speed. Some gymnasts with high elasticity, strength is insufficient, low percentage of fast fibers and no balance of forces, it shows deficiencies in speed.

By comparing these data, we see that the level of our gymnasts CMJ is high indicator. At CMJ, for 15 sec concluded that gymnasts have the average level. This level is not evidenced in the report CMJ / CMJ 15 seconds where the great value of this ratio indicates sustainability anaerobic lesser of gymnasts.

Handstand push without and with busily. gymnasts were tested presented in the lower levels. After final testing results show an increase from exercises methodology used, the situation is still low level.

Referring tests shows that 16 gymnasts have high value flight times jumps SJ and CMJ. This ability to levels relatively high reflect even in poor motor coordination in different floor

exercises and vault. A different tableau is observed to 5 gymnasts, where look lower values of flight times jumps in SJ and CMJ. This indicates a better motor coordination by them.

The data in Table 6 in the jump test load equal to the weight of the body shows that 11 gymnasts have a total strength of relatively small compared to others, but have good balance between strength and speed. The 7 gymnasts, strength predominates, while the 3 gymnasts lack strength.

Report strength / speed comes from the jump SJ to load the body weight and jump SJ, If this report is 0.33, have a balancing situation, larger values indicate the predominance of force, while values lower level insufficient strength. The literature data presented in the table 10 helped us to calculate the level of gymnasts tested SJBW / SJ where their status is 0.3655, balancing.

**Table 6**

*Rapport speed / strength (Petrigna et al., 2019)*

<b>Strength</b>	<b>Speed</b>	<b>Boscoss</b>	<b>Level</b>
		<b>indicators</b>	
SJ to load the body weight	SJ	Rapport speed / strength	
<b>15 cm</b>	45 cm	15 / 45 = 0.33	<b>Balanc</b>
<b>13 cm</b>	45 cm	13 / 45 = 0.28	<b>Insufficient strength</b>
<b>18 cm</b>	<b>45 cm</b>	<b>18 / 45 = 0.40</b>	<b>Predominance stre.</b>

### Conclusions

Based on content of our study, we arrived at some basic conclusions, which we are listing as follows:

- The results of our study showed that in artistic gymnastics among gymnasts, strength (especially relative) with forms of its manifestation, without underestimating other movement and coordination skills, is one of most important physical skills.
- Physical preparation is the basis for high results. Its preparation and progressive development are evaluated as a special component in the annual training macro cycle, and it is accompanied by complex tests, through which level of training is determined, for achieving satisfactory results in various activities (Bacciotti, S., et al., 2017).
- To our subjects conclude average level of strength in the lower limbs.
- The effects of physical preparation derive from the time and preoccupation devoted to it. Skills of gymnasts obtained in our study were found in this order: 4 were at a good level, other 12 were at an average level and 6 were poor.
- Physical preparation is a necessary component for preparation of quality sportsman in artistic gymnastics. (Sands, W. 2017).

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