NATIONAL SPORTS ACADEMY

„VASSIL LEVSKI

DEPARTMENT „GYMNASTICS“

EMIL NIKOLAEV STOIMENOV

Technique variation of gymnastics elements on floor exercise and improvement of the training methodology

ABSTRACT

SOFIA, 2021

The dissertation contains 194 standard typewritten pages. It is illustrated with 33 tables, 86 figures and 2 appendices. The bibliography includes 217 literary sources, of which 133 in Cyrillic and 84 in Latin.

The defense of the dissertation will take place on 21.12.2021. from 13.00 in hall A 3 of NSA "V. Levski ".

NATIONAL SPORTS ACADEMY

„VASSIL LEVSKI

DEPARTMENT „GYMNASTICS“

EMIL NIKOLAEV STOIMENOV

Technique variation of gymnastics elements on floor exercise and improvement of the training methodology

ABSTRACT

of a dissertation for award

of educational and scientific degree "doctor"

in the field of higher education 7. "Healthcare and sports", professional field 7.6. "Sport", doctoral program "Theory and methodology of sports science"

SUPERVISOR:

Assoc. Prof. Iliya Kiuchukov, Ph.D.

Official reviewers:

Prof. Bonka Mihaylova Dimitrova, Ph.D.

Prof. Kiril Atanosov Aladzhov, DSc

The dissertation was tested, discussed and proposed for official defense by the Department of Gymnastics at NSA "V. Levski ".

Introduction

Gymnastics is one of the sports with the most ancient traditions. It has undergone many-sided and diverse development to reach its modern form. Today, gymnastics is divided into seven disciplines: Artistic gymnastics (men and women), rhythmic gymnastics, trampoline gymnastics, acrobatic gymnastics, aerobic gymnastics, gymnastics for all and parkour.

Artistic gymnastics is a variety of man-made shapes called exercises. They, in turn, represent a coordinated system of movements for moving or holding, both individual parts of the body and the whole body in space for a fixed time. The movements and actions are performed in a strictly defined sequence and rhythm. The exercises are performed on gymnastics apparatus. For men they are six in number (floor exercise, pommel horse, still rings, vault, parallel bars and horizontal bar), and for women four (vault, uneven bars, balance beam and floor exercise). One of the most attractive devices for the spectators is the floor exercise.

We focused on the study of acrobatic exercises, which are prevalent in the gymnastic combinations of the apparatus, both for men and women. Of interest is the variation in the technique of acrobatic elements in floor exercise and training methods.

We believe that the methodology of teaching basic elements in gymnastics for both men and women can be optimized after studying the technique and variation in different elements.

I. Literature review

In gymnastics, one of the most important components is the difficulty, this is one of the criteria for the formation of sports results. On this basis, the first rules for evaluating the combinations of competitors were drawn up. In its development, gymnastics has more than once been considered to have reached its critical saturation threshold. Nowadays, we can say that any such statement is wrong, because with each passing year it reaches a higher level of complexity and virtuosity. In modern gymnastic performances, those who are able to perform complex and ultra-complex elements, who perform gymnastic elements without mistakes, succeed. This is the main pattern in the development of high-achievement sports (Turishteva, 1986; Terekhina and Burda-Andronova, 2008, etc.).

Sports technique is a set of interconnected and purposeful movements, with high efficiency with minimal energy loss. There are various definitions of technique that we will not dwell on, we will only present a short, clear and precise definition of sports technique by Gaverdovsky (2007), which reads: "The technique of exercise is a biomechanically determined way to individually solve the motor task".

In the system of training athletes, the role of technical training as a dominant component is indisputable. We fully share Verkhoshansky (1968) view that sports technique is not a state that can be achieved once, but an ongoing indicator of a continuous and endless process of movement from the slightly perfect to the more perfect.

Hadjiev (1978) also assigned a major role and a primary place to technology. He believes that technical training is one of the most important sections of sports training.

Mkaouer et al. (2013) focus their interest on the acrobatic series round-off,

back handspring, back layout salto and round-off back tempo salto. A strain gauge platform and a motion analysis system were used to provide the biomechanical data. Indicators such as take-off angle, body momentum, horizontal and vertical displacement of CG, vertical and horizontal velocity of CG were calculated. Although both series can be used successfully, the optimal series in this case, according to the researchers, is the series round-off, back handspring, back layout salto, which results in a higher height of the final salto.

Andonov (1988) researches the technique of complex gymnastic elements on horizontal bar and improves their teaching methodology through created corrective programs. A contribution to the development is the use of a video-computer system that provides information.

One of the optical systems for 3D biomechanical analysis is Ariel Performance Analysis System (APAS) of the American company Ariel Dynamics Inc. It has the ability to synchronize video from up to 9 different cameras (www.arielnet.com). It is widely used for the analysis of movements in sports (Ariel, G., 1973, 1973, 1973, 1973, 1996, 2006), as well as in gymnastics (in the parallel bars Prassas, 1994; Prassas and Ariel, 2005; Andreev, 2010 ; Veličković et al., 2011).

The method of modeling contributes greatly to the more complete study of complex gymnastic and acrobatic elements.

Modeling as a method has been widely used in gymnastics for more than 40-50 years. Nazarov (1969), Zinkovsky and team (1977), Walton and Kane (1977), Gaverdovsky and Mammadov (1980), Suchilin (1980), Gostev and Suchilin (1981), Evseev and Rykunov (1985), Yordanov and Petrov (1986)) and many others successfully apply this method in gymnastics.

Research hypothesis

We assume that the establishment of the kinematic indicators that have the greatest impact on the quality of performance of basic acrobatic elements in floor exercise, as well as the determination of those variants of performance technique that provide better conditions for the final elements, will help us. served in the construction of a rational and effective methodology for improving the level of technical mastery.

II. Aim, tasks, methodology and organization of the study

II.1. Aim of the study

Improving the kinematic indicators that reflect the level of technical mastery of basic acrobatic elements in floor exercise through an optimized training methodology.

II.2 Tasks of the study

1. Pedagogical monitoring of the combinations and elements on floor exercise, performed by elite gymnasts - finalists of world cups, European, World championships and Olympic Games, for the period 2006-2019;
2. Establishing variability in the performance of gymnastic elements on floor exercise;
3. Kinematic analysis of basic acrobatic elements on floor exercise;
4. Establishment of correlation between kinematic components and quality of performance of gymnastic elements on floor exercise;
5. Development of training methodology;
6. Conducting a pedagogical experiment to test the teaching methodology.

II.3 Object, Subject and contingent of the study

II.3.1 Object of the study

The object of the research are basic acrobatic elements on floor exercise (round-off, back handspring, back flip, handspring and flip).

II.3.2 Subject of the study

The subject of the study are the kinematic parameters of the gymnastic elements (horizontal and vertical speed, trajectory of the center of gravity, etc.).

II.3.3 Contingent of the study

The contingent of the research are men and women gymnast:

224 performers, participants in the finals of world championships and Olympic Games are included in the pedagogical observation;

12 gymnasts, performers of basic acrobatic elements on floor exercise were subjected to analysis;

22 gymnasts were included in a pedagogical experiment to test the proposed methodology for teaching basic acrobatic elements on floor exercise.

II.4 Organization of the study

Stage 1 (2016)

- Study of literature sources and outline the main directions of the research.

Stage 2 (2016-2019)

- Pedagogical observation of video recordings of the combinations and individual elements of floor exercise, performed by elite gymnasts - finalists of World championships and Olympic Games, for the period 2006-2019.

Stage 3 (2017-2019)

- Analysis of combinations of European and World championships;
- Video recording of basic acrobatic elements and series of floor exercise;
- Kinematic analysis acrobatic elements and series of floor exercise;
- Establishing variants of technique for different elements;
- Development of training methodology.

Stage 4 (2019)

- Conducting a pedagogical experiment to test the proposed experimental

methodology;

- Analysis of results from a pedagogical experiment.

Stage 5 (2020-2021)

- Forming the dissertation.

II.5 Methodology of the study

1. **Research and analysis of literature sources**

A total of 217 literature sources were studied and analyzed, of which 133 in Cyrillic and 84 in Latin, related to our research problem.

2. **Pedagogical observation**

Pedagogical observations were made to get into the essence of the researched problem. They are realized by watching videos of world cups, European and World championships, Olympic Games over 500 combinations and individual elements performed by highly qualified gymnasts.

3. **Expert evaluation**

The method of expert evaluation is realized by compiling a sports-technical commission of three experts, who evaluate the technical level of the performances of the selected basic acrobatic elements and series.

4. ***Video recording and video surveillance***

The shooting was realized with a Sony camera, with a frame rate of 50 fps, and all the necessary requirements for biomechanical analysis of movements are met.

5. ***Biomechanical analysis***

The method of biomechanical analysis can most accurately give us quantitative values of various indicators of the object of study, namely the

various acrobatic elements of floor exercise. Through this method, an error and deviation in the technique can be registered, and in addition, the objectively fixed parameters allow for a creative search for new effective options for improving the gymnastic technique.

Specialized motion analysis software was used to perform the biomechanical analysis. The software used are APAS and SkillSpector.

- Motion tracking - tracking the trajectory of 7 main points for body movement (ankle, knee, hip, shoulder, elbow, wrist, head);
- Calibration - 8 points were used, with previously known coordinates;
- Digitization - a digitization module built into the APAS and SkillSpector software is used;
- Automatic display of basic kinematic parameters (height, length and angular characteristics; speed characteristics, trajectory, displacement, positioning of CG, moment of momentum for individual segments, based on standard models built into the program).

6. Modeling method

- Position models. For each exercise in the training methodology we developed three-dimensional models for application in sports practice. We used Poser - a special program for 3D animation;
- Video modeling. We used the method of video modeling in combination with positional models to increase the effect of the training methodology.

7. Pedagogical testing

To determine the initial and final level of physical training, as well as to support the formation of two homogeneous groups for conducting a pedagogical experiment, sports pedagogical testing was conducted. For this purpose, tests

from the unified program in gymnastics - women (2019) were used, meeting the requirements for standardization, reliability, validity and objectivity.

Test battery to determine the level of physical training:

1. 15 jumps from the lying on his back
2. Climbing a rope
3. Handstand hold
4. Press to handstand
5. Kip to handstand on uneven bars
6. 20m. run
7. Jump from 0,5m. and jump high
8. From “L” position on bar lifting the legs to the grip

To determine the initial and final level of technical training, as well as to support the formation of two homogeneous groups for conducting a pedagogical experiment, testing was conducted. For this purpose, the kinematic indicators were used in the performance of the acrobatic series - round-off, back handspring and back flip. The choice of this acrobatic series as a test for the initial level and the final technical preparation is explained by the fact that they are fundamental for mastering more difficult elements.

Fig. 1 Round-off, back handspring and back flip

8. *Pedagogical experiment*

Based on the analysis, we prepared a sample training program. To prove its effectiveness, we conducted a pedagogical experiment.

The experiment was conducted from May 6, 2019 to December 1, 2019 with gymnasts from Bulgaria aged 11-12 years. The experiment involved 22 athletes divided into two groups of 11 girls.

At the beginning and at the end of the experiment, data were taken from tests for technical and physical training, which served as the initial and final level. Based on the initial data, two equivalent groups were formed - experimental (EG) and control (KG). At KG the training sessions were held according to the traditional methodology and program of the coach. For EG we applied an experimental methodology for teaching basic acrobatic exercises in ground gymnastics. During the 30-week experiment, the two groups conducted 180 training sessions of 3 astronomical hours each. In the weekly cycle, the trainings were held from Monday to Saturday, and on Sunday both groups rested. The two groups practiced floor exercise three times a week, in even weeks Monday, Wednesday and Friday, and in odd weeks Tuesday, Thursday and Saturday. Only on the days when floor exercise was practiced, EG performed the technical and physical training exercises from the experimental methodology. The complexes of exercises for physical and technical preparation in the period of the experiment were of different dosage.

The compiled experimental methodology includes the modules:

Physical training complexes

Physical training complex (PTC) 1

1. Jumps with stretched knees - 20 pcs.
2. Jumps on left leg with stretched knees - 20 pcs.
3. Jumps on right leg with stretched knees - 20 pcs.
4. Jumps with high knees - 20 pcs.
5. Jumps on left leg with high knees - 20 pcs.

6. Jumps on right leg with high knees - 20 pcs.
7. Half squat jumps - 20 pcs.
8. Half squat jumps on left leg - 20 pcs.
9. Half squat jumps on right leg - 20 pcs.

Physical training complex (PTC) 2

1. Jumps on gymnastics blocks 0,6m. - 10 pcs.

Technical training complexes

Technical training complex (TTC) 1

1. Round-off to knee on gymnastics mats - 10 pcs.
2. Round-off on gymnastics cylinder and falling on his back on gymnastics mat- 10 pcs.
3. Round-off and jump on his back on gymnastics mat- 10 pcs.

Technical training complex (TTC) 2

1. Jumps on his back on gymnastics mat - 10 pcs.
2. Back handspring on gymnastics cylinder to falling on the front of the body - 10 pcs.
3. Back handspring to falling on the front of the body - 10 pcs.

Technical training complex (TTC) 3

1. Round-off, back handspring and jump - 10 pcs.
2. Round-off, back handspring and high jump on gymnastics mat- 10 pcs.
3. Round-off, back handspring and back flip on gymnastics mat - 10 pcs.

9. Mathematical and statistical data processing

The data from the study were statistically processed with the specialized computer programs "SPSS-17" and "Excel". The following mathematical and statistical methods were used for objective analysis and evaluation of the research results:

- ***Variation analysis***
- Correlation analysis
- ***Comparative t-criterion of Student***

III. Results analysis

III.1 Trends in the Olympic cycle 2017-2020

98 combinations of floor exercise were registered and analyzed by video surveillance. A total of 268 forward and 380 backward were detected in their performance. For greater clarity in analyzing and illustrating the results, we will look at them by gender and direction of flips.

In the men in fig. 2 illustrates the rewinds. The most performed element is back-flip with 5/2 twist. It is present in 96% of the combinations of the finalists of floor exercise in the period 2017-2019. Back flip with 3/1 twist and double back in tuck position with 2/1 twist are the next most preferred elements by gymnasts. We analyzed the type of the previous exercise and in fig. 3 it can be seen that the back flip with 5/2 twist is performed 75% after a round-off and only 25% after a back handspring. The reason for this is mostly due to the limited space on the playing field for floor exercise. All gymnasts perform one more flip after performing a back flip with 5/2 twist. In a back flip with 3/1 twist, 53% of gymnasts perform only a round-off, and 47% do the acrobatic series of a ound-off and back handspring before performing it.

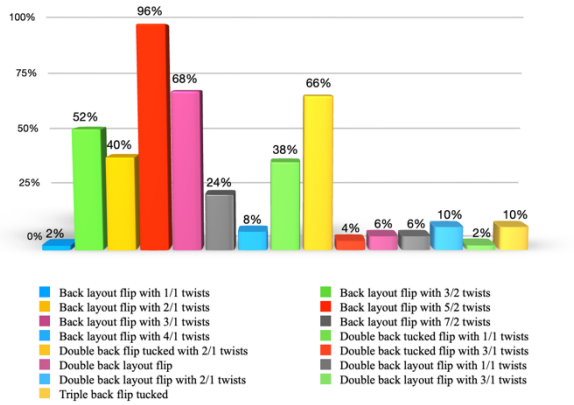


Fig. 2 Trends in back flips on floor exercise men

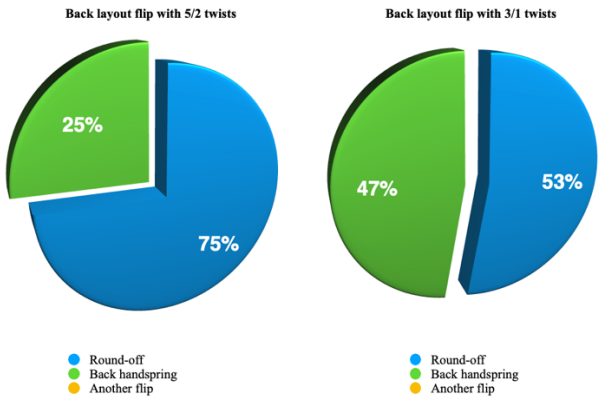


Fig. 3 Trends in Back layout flip with 5/2 twists and Back layout flip with 3/1 twists on floor exercise

In the women of fig. 4 shows the frequency in percentages of backward flips. The most performed element is a double back in pike position, it is present in 58% of the combinations of the finalists of floor exercise in the period 2017-2019. The figure shows that in women the most performed are different variants of posterior double flips. When registering the type of the previous elements before the acrobatic elemetns, the gymnasts prefer to perform a back handspring. Only in the case of a back layout with 3/2 twists do the gymnasts prefer to perform the element after a round-off. For women, there is no finalist to perform a double back from a round-off.

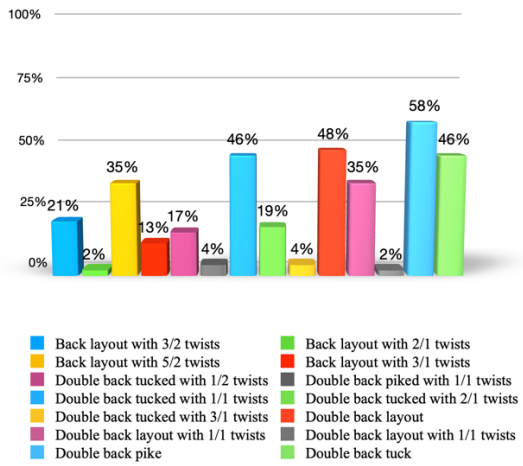


Fig. 4 Trends in back flips on floor exercise women

In women, we found a tendency for double back to be performed after back handspring. 100% of the cases of performing a double back with a tuck and pike body position are performed after a back handspring.

In the case of single flip in women, there is a tendency in which the use of back handspring increases with the increase of the twists along the longitudinal axis. When performing a back layout with 3/2 twists, only 10% of the performers used back handspring, and when performing a back layout with 3/1 twists, the percentage increased to 83% (Fig. 5).

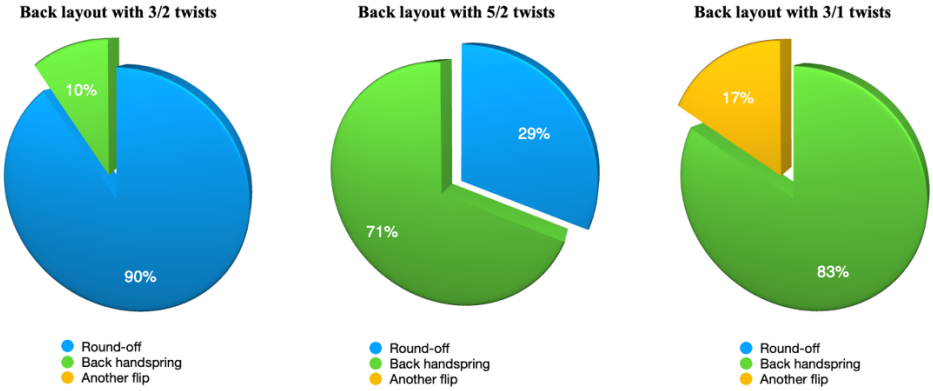


Fig. 5 Trends in Back layout flip with 3/2 twists, back layout with 5/2 twists and back layout with 3/1 twists on floor exercise

III.2 Kinematic analyzes of selected elements and acrobatic series

Through kinematic analysis of the basic (basic) acrobatic elements of floor exercise (round-off, back handspring, back flip, handspring and flip), we will gain more detailed information and knowledge about the kinematic parameters (joint angles and speed characteristics of joint units and CG) for the selected elements. Information about the movements during the performed elements is acquired by calculating the coordinates of the main joint centers

(ankle, hip, shoulder, wrist) in space. Data on the movement of the joint centers provide information on private movements, such as road, speed and time, but not on the movement of the body as a whole. Complex information about the total effect of the athlete's actions can be obtained if we study the movement of the body's CG. The calculation of the location of the CG of the body for each frame in the course of the movement is performed by a specialized software APAS. Through it we get detailed information and quantitative values of all indicators.

III.2.1 Variants and analysis of the handspring technique

Фиг. 6 Handspring

Handspring is a basic element. Gymnasts perform it in preparation for performing high difficult flips in the forward direction. We analyzed and subjected to expert evaluation 12 competitors who performed a handspring. The element in acrobatic series is performed after a "specific jump", which is a double jump on one leg and lifting the other forward, combined with lift the hands forward. The goal of gymnasts is to switch from running reinforcement to handspring without losing the horizontal speed accumulated by the reinforcement, which they subsequently transform into vertical. We found the highest values of horizontal speed, with which the gymnasts enter the handspring,

of 10.6 m / s. After the "specific jump", an attack is performed with the placement of the arms and a swing with the hind leg. In Fig. 7 shows the curve of the horizontal speed of the CG during tossing during the execution with the highest and lowest expert assessment. It shows two moments in which the horizontal speed decreases. The first is by stepping after the "specific jump", as the speed decreases to 6 m / s. The second moment is after the support of the arms.

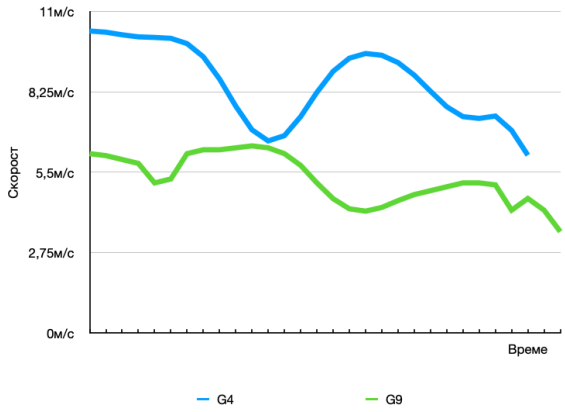


Fig. 7 Horizontal speed of the CG

The reason for the loss of speed can be the transition to rotational motion, but the trajectory of the CG in the vertical is also essential (Fig. 8). The vertical deviations of the CG lead to a loss of horizontal velocity. The initial level of CG in the group performed handspring is about 0.9 m. vertically (y) and in some embodiments there is an amplitude of 0.5 m, which has a strong influence on the horizontal speed. The goal in the first phase is to keep it long and the arms forward. The angle of rebound and the actions with the arms and the body are also a factor in determining the unsupported phase when do a handspring.

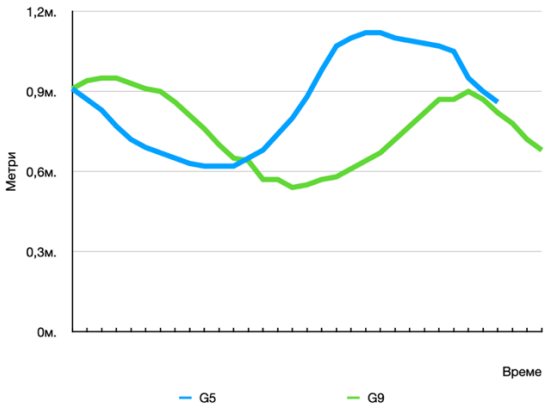


Fig.8 The vertical deviations of the CG

During the implementation of the element we registered two variants of implementation. The first option is to place the hands in the support at shoulder width, and in the second option they are placed wider. In Fig. 9 we have illustrated the two variants of placing the hands in the support when do a handspring. We believe that the first option is more suitable for adolescents and the initial study of the element, and the second option for high-class gymnasts, in order to reduce CG and achieve a smaller angle when meeting the floor.

Variation 1 Variation 2

Fig.9 Variant of hand position

When analyzing the two phases before the arm support and after it during the handspring, we found that the first phase is shorter than the second. The average length of the first phase is 1.15 m, and the second is 1.68 m.

III.2.2 Variants and analysis of the salto technique

Fig. 10 Salto

Saltos is a basic element. Present in any combination of floor exercise. We analyzed and subjected to expert evaluation 12 athletes who performed flips in an acrobatic series (handspring, flip) and from running. The element in acrobatic series is performed after handspring or after another flip. When performed without previous element, it is performed by running reinforcement.

For greater clarity of the analysis, we divided the exercise into three phases (phase of preparatory, main and final actions).

For the preparatory actions when do a salto from a running reinforcement, we consider the reinforcement and the preparatory jump to two legs. In these actions we registered three variants of technique when the element is performed without a previous element:

1. Lift hands up and holding in the up position until the jump (variation 1);
2. Lift hands front and downswing in jump (variation 2);
3. Lift hands back and downswing in jump (variation 3);

When performing after another previous element, we registered only a variant of the technique with lifting the hands up or to the side before jumping and holding them in this position when performed after another flip and holding the arms up or up to the side when flip is performed after handspring.

In the run-up versions, the version with the arms raised above and hold in the up position until the flip is most often used (variation 1). Performance with this technique received the highest expert rating of 10 points. on a ten-point scale. The execution was also with the highest horizontal speed in the preparatory actions of 5.4 m/s. and a ground attack angle of 69° concluded between the CG, the support and the ground surface (Fig. 11).

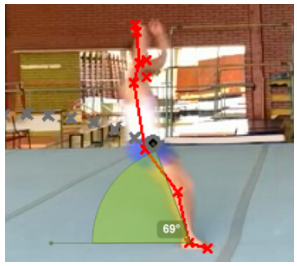


Fig. 11 Ground attack angle

The main action phase starts with the jump. In different variants of the technique, the hands perform different actions. In variation 1 they are taking down, in option 2 they are lift, and in option 3 they are lifted back.

After the jump, the body contracts and floor, which reduces the horizontal speed. The reduction in horizontal speed is due to the upward jump required to provide height for successful flip. In the main actions, gymnasts aim to transform the horizontal speed into a vertical one. In the analysis of the results we registered maximum values of vertical speed of 6.4 m/s. and 613°/s. angular velocity of the torso, which we consider to be the main components in the flip. Upon reaching the highest point of CG vertically (Fig. 12), the final actions begin.

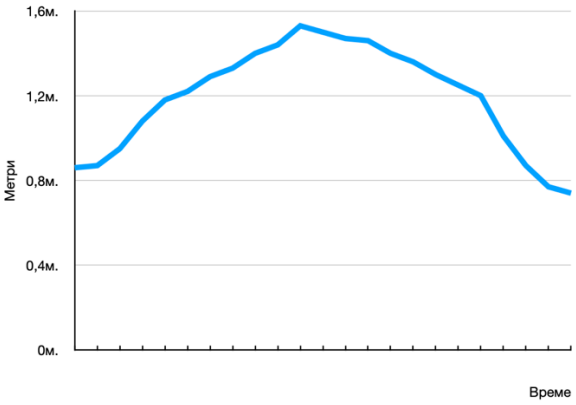


Fig. 12 Vertical trajectory of the center of gravity

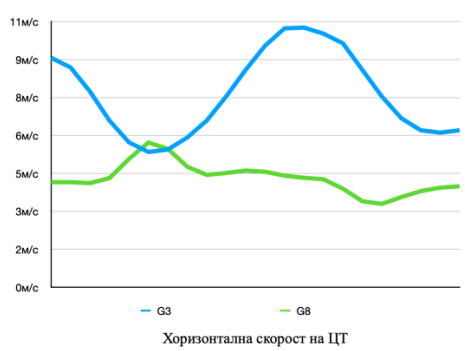
In the final steps, the body unfolds in all joints, the angular velocity decreases and the gymnasts prepare to land or perform a jump for the next element.

In conclusion of the analysis we can say that variation 1 (with hands up) gives the best prerequisites for developing the element in a more difficult. With variation 2 (by raising the arms back in the jump), gymnasts provide higher values of angular velocity, but at the expense of height and appropriate configuration of the implementation of flips along the longitudinal axis. In variation 3 (with arms lift in the jump) the advantage is the accumulation of more height, but at the expense of rotational movement. When analyzing the flight phase of the saltos, we registered that it has an average length of 1.36m.

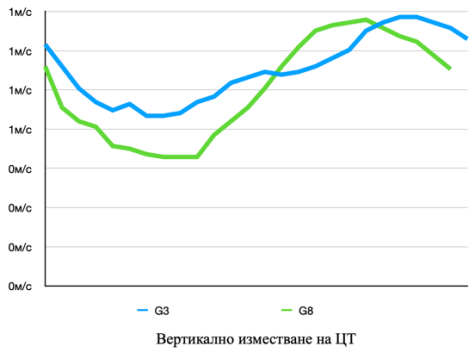
III.2.3 Variants and analysis of the round-off technique

Fig. 13 Round-off

Round-off is a basic element. Gymnasts perform it in preparation for performing difficult element backward. We analyzed 12 performances. The element in acrobatic series is performed after a "specific jump", which is a double jump on one leg and lifting the other forward, combined with lift the arms forward. The goal of gymnasts is to move from running strength to handspring. The accumulated value of the speed from the reinforcement, subsequently the gymnasts transform it into a vertical one for successful realization of the final flips in the series. After the "specific jump", an attack and inversion are performed by placing the hand of the same name on the front leg, combined with a swing of the back leg. In this phase we registered a maximum speed of 5.68 m/s. With the bounce from the front leg and the placement of the second arm, the speed increases, reaching 10.7 m/s. The body passes through the vertical and the support reaction takes place, with which the "kurbet" is performed (folding and rounding of the body after the support in preparation for attacking the floor for the next element). With the support there is a decrease in the horizontal speed to 6.4 m/s. Depending on the subsequent element, the legs are left behind or folded. All performances were subject to expert evaluation. In fig. 14 shows a performance curve with the highest and lowest horizontal CG speed and the vertical deflection of the CG during a circular toss in a situation where the next element is a back handspring.



Хоризонтална скорост на ЦТ



Вертикално изместване на ЦТ

Fig. 14 Horizontal velocity and vertical trajectory of the center of gravity

The analysis showed that after placing the hands there is a certain loss of horizontal speed. The reason for the loss of speed can be the support of the arms, but the trajectory of the CG in the vertical is also essential (fig. 14). The vertical deviations of the CG lead to a loss of horizontal velocity. In the unsupported phase, we registered a maximum value of the horizontal CG velocity of 8.5 m/s. In this phase, gymnasts configure their body in a position suitable for attacking the floor (the body is rounded).

When performing the element, we registered two variants of performance. The first option is to place the hands in the support after ¼ inversion and perform another ¼ inversion after it, and in the second option they are placed after ½ inversion. The first option with placing the hands is more suitable for initial study in children and when flips is performed after the round-off, because it allows for better countering of the horizontal speed and the transformation into a vertical one.

When analyzing the two phases before the arm support and after it in a circular throw, we found that the first phase is shorter than the second. The average length of the first phase is 1.08m, and the second is 1.24m.

III.2.4 Variants and analysis of the back handspring technique

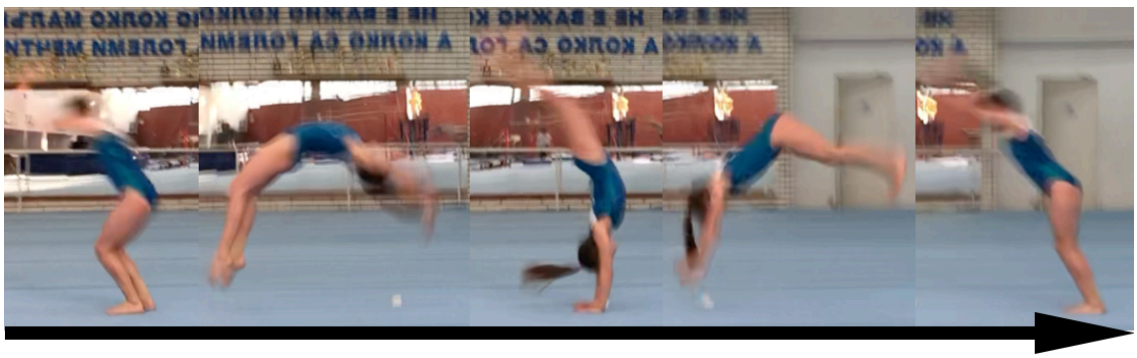


Fig. 15 Back handspring

Back handspring is a basic element. Gymnasts perform it in acrobatic series in preparation for performing high difficult back flips. We analyzed 12 performers who performed back handspring in an acrobatic series (und-off, back handspring, back flip). The element in acrobatic series is performed after a round-off, the goal of the gymnasts is to accumulate additional speed, which they subsequently use for the successful performance of the final flip. All performances were subject to expert evaluation. The element is performed with a jump back up combined with a wave of the arms. In the performance with the highest expert assessment, the highest output speed for the rear throw of 7.2m/s is observed at an angle (between the support and CG) of the rebound for the first unsupported phase of 105° (fig. 16).

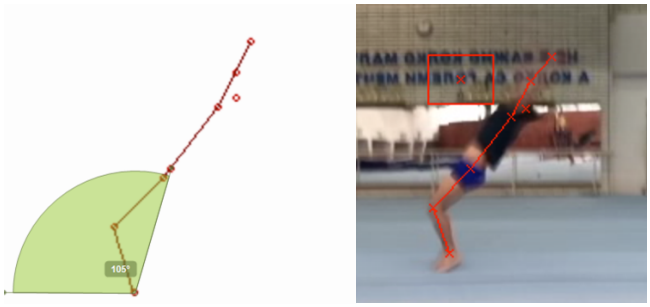


Fig. 16 Take-off angle

In the first flight phase, the body is stretched as in the most bent position, the angles that are concluded in the hip and shoulder joints are 210° in the hip and 190° in the shoulder, respectively. Immediately before placing the hands on the floor, the maximum speed in the whole version of 8.9 m/s is observed. when placing the hands, the angle that is concluded between the support and the CG is 71° (Fig. 17).

Fig. 17 Angle at the support of the hands on the floor

In fig. 18 shows a curve of the horizontal speed of the CG when performing a back handspring by the gymnasts with the best and worst result.

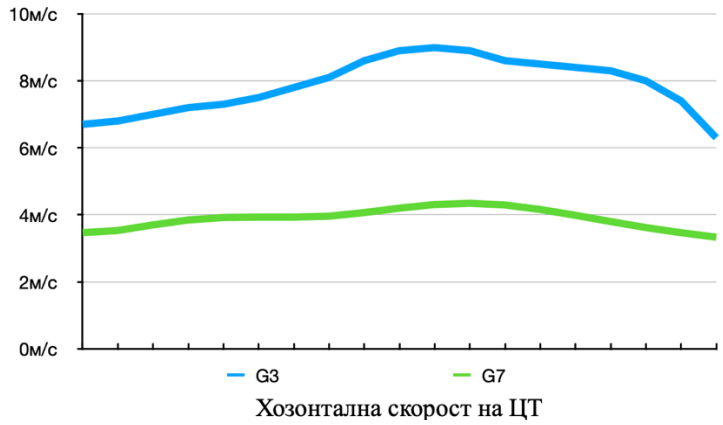


Fig. 18 Horizontal velocity of CG

The analysis showed that after placing the hands there is a certain loss of horizontal speed. The reason for the loss of speed can be the support of the arms, but the trajectory of the CG in the vertical is also essential (Fig. 19). The vertical deviations of the CG lead to a loss of horizontal velocity. The goal in the first flight phase is to be low and short, which is determined by the rebound angle and the actions with the arms and body.

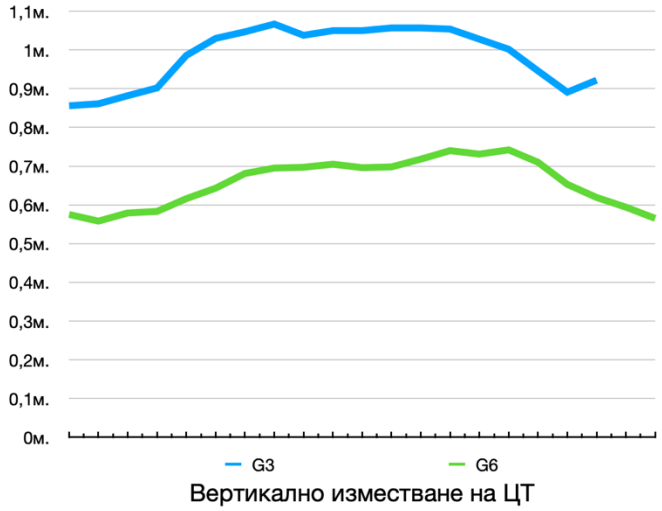
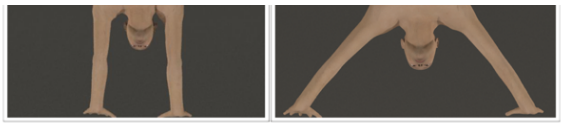


Fig. 19 Vertical trajectory of the center of gravity

In the second non-support phase, we registered a maximum value of CG speed along the horizontal of 8.6 m/s. In this phase, gymnastics configures the body with a posture suitable for attacking the floor (the body is rounded).

When performing the element, we registered two variants of performance. The first variant is to place the hands in the support at shoulder width, and in the second variant they are placed wider. In fig. 20 we have illustrated the two variants of placing the hands in the support when reversing. The first variant with placing the hands is basic and we recommend it in the initial study of acrobatic element, but when improving and improving the function of the preparatory series we recommend switching to the second variant with placing the hands wide, because thus CG is lower.



Variation 1 Variation 2

Fig.20 Variant of hand position

When analyzing the flight phases in the back handspring, we found that the first non-support phase is shorter than the second. The average length of the first flight phase is 0.87m, and the second is 1.12m.

III.2.5 Variants and analysis of the back flip technique

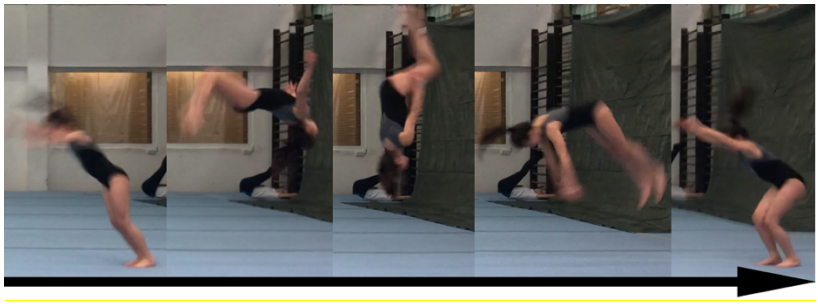


Fig. 15 Back flip

Back flip is a basic exercise in gymnastics. It is basic and has a long chain of development into a more difficult element. The variation for performance in acrobatic series are after a round-off, back handspring or other flip. We shot 12 rewind performances performed by round-off and back handspring. We made a kinematic analysis and comparison of the flips. All performances were subject to expert evaluation. The highest horizontal speed before the attack on the floor of 6.4 m/s was registered during the performance of a back flip after a round-off with the highest expert assessment. Again, when performing the same element, but after a back handspring we registered a higher value at a horizontal speed of 6.7 m/s. The average values of the horizontal speed before the attack of the floor for back flip after a round-off are 5.6m/s +/- 0.8m/s, and after the back handspring before the attack of the floor for back flip is 5.8m/s +/- 0.9m/s. This shows better prerequisites for back flip after back handspring than after round-off. In fig. 22 shows the horizontal speed curve of the CG during the rewind of the execution with the highest and lowest expert rating.

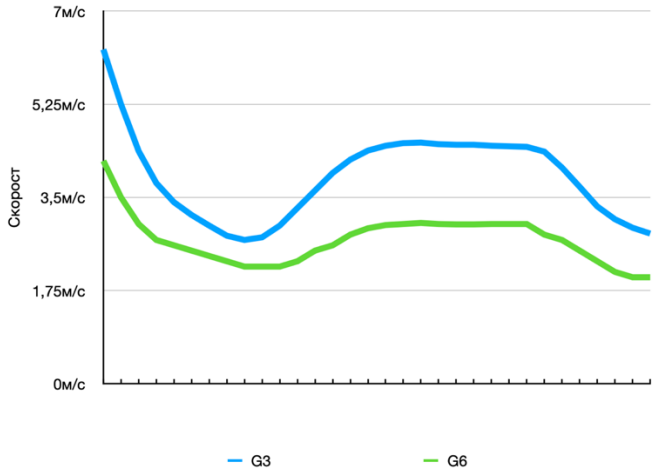


Fig. 22 Horizontal velocity of CG

We also made a comparison in the height of the flips performed after a round-off and after a back handspring, and they have an advantage of the somersaults performed after a back handspring. Regarding the vertical displacement of the CG during the rewinds during execution after a round-off, we registered the highest value of 202 cm. In the performances after back handspring, the highest registered value is 212 cm, which is 10 cm. difference in the height of the flips (Fig. 23).

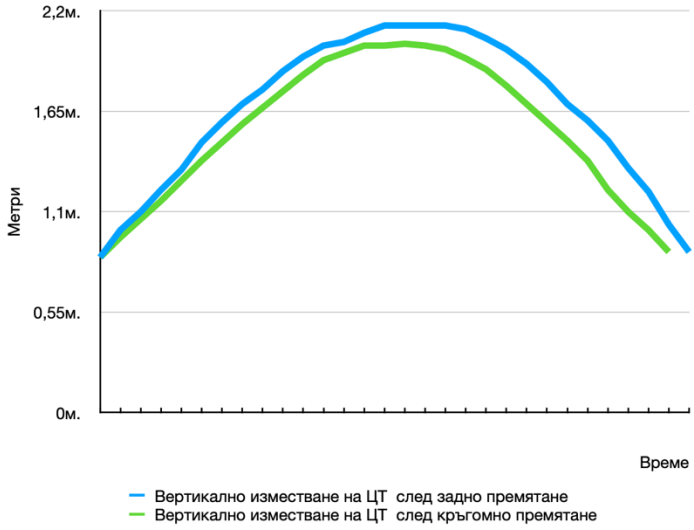


Fig. 23 Vertical trajectory of the center of gravity

From the analysis we can conclude that the performance of back flip after back handspring provides better conditions for its implementation. The kinematic indicator vertical displacement of CG can be defined as the main indicator determining the level of performance.

III.2.6 Kinematic model on acrobatic series handspring front flip

The acrobatic series handspring front flip is the basis for floor exercise. Gymnasts are required in their combinations to include an acrobatic series in the forward direction. This is the basic connection of two basic element in a series. Mastering and performing them at a high level provide a prerequisite for reaching

high difficult and ultra-high difficult final flips. Quantitative guidelines for the quality of acrobatic element would be very useful in the process of research and improvement. Creating a kinematic model can serve as a template for coaches and give them a quantitative assessment of the elements performed.

The indicators included in the kinematic model are derived from videos of the best performance of the acrobatic series among more than 50 analyzed recordings. The elements are digitized and with the help of specialized software for motion analysis APAS are presented kinematic values, such as horizontal and vertical velocity of CG and angular characteristics. After processing the derived data, a kinematic model was made for the standard of performance of the acrobatic series of handspring and front flip.

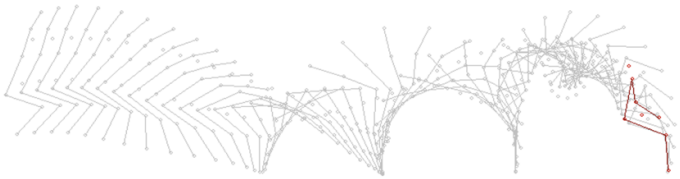


Fig. 24 Kinematic model from mechanic axis's on acrobatic series handspring front flip

The values of the indicator angle between the horizontal, the support and the CG are the following: 62° when meeting the support with the palms when handspring, 124° when leaving the arm support when handspring, 73° when meeting the floor after handspring and 94° when bouncing for the final flip (Fig. 25). The values of the second indicator - angle in the knee joints are: 176° and 178° when meeting the support with the palms when handspring, 177° when leaving the arm support when handspring, 167° when meeting the floor after handspring and 179° when bouncing for the final flip (Fig. 25). The values of the third indicator - angle in the hip joints are: 76° and 193° when meeting the support

with the palms when handspring, 190° when leaving the arm support when handspring, 189° when meeting the floor after handspring and 178° when bouncing for the final flip (Fig. 25). The values of the fourth indicator - angle in the shoulder joints are: 176° when meeting the support with the palms when handspring, 194° when leaving the arm support when handspring, 193° when meeting the floor after handspring and 138° when bouncing for the final flip (fig. 25). The values of the fifth indicator - horizontal speed of CG are: 7.4m/s when meeting the support with the palms when handspring, 9.2m/s when leaving the arm support when handspring, 7.6m/s when meeting the floor after handspring and 7.4m/s vertical velocity at rebound for final flip. (Fig. 25).

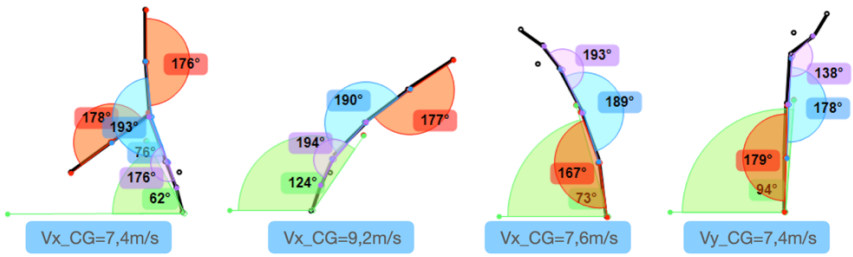


Fig. 25 Kinematic model on acrobatic series handspring front flip

III.2.7 Kinematic model on acrobatic series round-off, back handspring and back flip

The acrobatic series of round-off, back handspring and back flip is the basis for floor exercise. Gymnasts are required to include a back-acrobatic series in their combinations. This is the basic connection of three basic element in a series. Mastering and performing them at a high level provide a prerequisite for reaching high difficult and ultra-high difficult final flips. Quantitative guidelines for the quality of acrobatic elements would be very useful in the process of research and improvement. Creating a kinematic model can serve as a template for coaches and give them a quantitative assessment of the elements performed.

The indicators included in the kinematic model are derived from videos of the best performance of the acrobatic series among more than 50 analyzed recordings. The elements are digitized and with the help of specialized software for motion analysis APAS are presented kinematic values, such as horizontal and vertical velocity of CG and angular characteristics. After processing the derived data, a kinematic model was made for the standard of performance of the acrobatic series of round-off, back handspring and back flip.

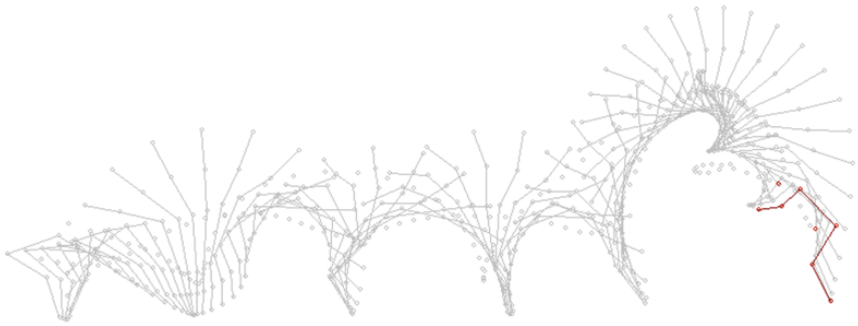


Fig. 26 Kinematic model from mechanic axis's on acrobatic series round-off, back handspring and back flip

The values of the indicator angle between the horizontal, the support and the CG are the following: 82° when meeting the floor after a round-off 120° when rebounding for back handspring, 71° when meeting the support with the palms when back handspring, 95° when leaving the support on the hands when back handspring, 58° when meeting the floor after back handspring and 72° when rebounding for the final flip. (Fig. 27). The values of the second indicator - angle in the knee joints are: 115° when meeting the floor after a round-off, 125° when bouncing for a back handspring, 180° when meeting the palm support during a back handspring, 180° when leaving the arm support at back handspring, 151° when landing after a back handspring and 156° when bouncing for the final flip. (Fig. 27). The values of the third indicator - angle in the hip joints are: 117° when meeting the floor after a round-off, 187° when bouncing for a back handspring,

190° when meeting the palm support during a back handspring, 149° when leaving the arm support at back handspring, 144° when hitting the floor after a back handspring and 172° when bouncing for the final flip. (Fig. 27). The values of the fourth indicator - angle in the shoulder joints are: 111° when meeting the floor after a round-off, 186° when bouncing back handspring, 187° when meeting the palm support when back handspring, 144° when leaving the arm support at back handspring, 137° when hitting the floor after a back handspring and 147° when bouncing for the final flip. (Fig. 27). The values of the fifth indicator - horizontal speed of CT are: 6.7m/s when meeting the floor after a round-off, 7.4m/s when bouncing for back handspring, 8.6m/s when meeting the support with the palms at back handspring, 8.5m/s when leaving the armrest in back handspring, 7.3m/s when meeting the floor after back handspring and 7.8m/s vertical speed when rebounding for the final flip. (fig. 27).

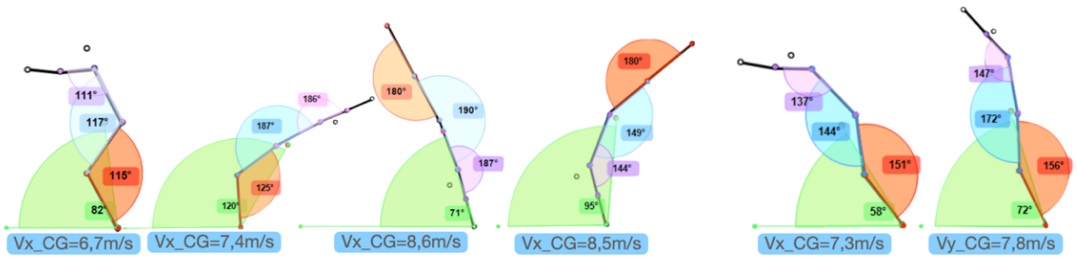


Fig. 27 Kinematic model on acrobatic series round-off, back handspring and back flip

In conclusion, we can say that it is important to know the biomechanical indicators of the basic elements of floor exercise. In the present study, kinematic indicators are indicated, which can be used to determine the level of technical mastery in performing acrobatic series. We believe that the presented values are relatively stable, but of course they can be updated and improved in the presence of new data. Approaching or reaching the values indicated in the study, we believe that it will contribute to the successful mastery of more difficult final flip

by adolescent gymnasts. The kinematic indicators set in the model are accessible and easily applicable in the practical training activity.

III.3 Results and analysis of the pedagogical experiment

III.3.1 Results and analysis of testing physical preparedness

At the beginning and end of the experiment, testing was done for the physical training of the gymnasts who took part in testing the methodology. Standard tests were used to assess the level of development of physical qualities from the unified program in gymnastics for women, in accordance with the age of the subjects. To determine whether the groups are homogeneous, we performed a variational analysis of the obtained results. To determine whether they have statistically significant differences from each other, we also made a comparative analysis of Student's t-test for independent samples with the data from the first measurement.

From the results obtained, the samples are approximately homogeneous for most of the tests, the coefficient of variation is between 10% and 30%, which defines them as samples with medium scattering. Student's t-test for independent samples showed that the groups did not have a statistically significant difference and were suitable for this type of experiment.

The results of the second measurement at the end of the experiment were also subjected to variation analysis and comparative analysis with the student's t-test for independent samples to determine whether the groups were left without a statistically significant difference. To determine the growth of the results in both groups, we compared the data with the Student's t-test for dependent samples.

Table 1

T-criterion of Student beginning of experiment CG and EG (physical preparation)

№	Indicators	ME	Group 1			Group 2			difference	Statistical significance	
			n1	X1	S1	n2	X2	S2	d	Temp	p(t)
1	20m. run	Sec.	11	3,15	0,13	11	3,14	0,09	0,01	0,15	11,80
2	High jump	Sm.	11	35,91	2,47	11	35,55	2,25	0,36	0,36	27,81
3	From "L" position on bar lifting the legs to the grip	Qty.	11	8,64	2,20	11	8,45	2,34	0,18	0,19	14,70
4	Kip to handstand	Qty.	11	6,36	1,75	11	6,45	1,92	-0,09	0,12	9,14
5	Press to handstand	Qty.	11	3	0,89	11	3	1,10	0	0	0
6	15 jumps from the lying on his back	Sec.	11	32,34	3,14	11	31,90	2,23	0,44	0,38	28,92
7	Handstand hold	Sec.	11	29,87	14,49	11	32,03	12,91	-2,15	0,37	28,34
8	Climbing a rope	Qty.	11	1,27	0,47	11	1,36	0,5	-0,09	0,44	33,43

Legend: Critical values for temp= 2,09 a = 0,05

When comparing the two groups at the beginning of the experiment, it was found that there was no statistically significant difference between them. In all physical fitness tests, the difference is below the critical values of 2.09 for this type of sample.

Table 2

Variation analysis second test CG (physical preparation)

№	Indicators	ME	n	X_{min}	X_{max}	R	X	S	V	As	Ex
1	20m. run	Sec.	11	2,8	3,3	0,5	3,09	0,15	4,92	-0,495	-0,309
2	High jump	Sm.	11	33	41	8	36,55	2,34	6,40	0,617	0,377
3	From "L" position on bar lifting the legs to the grip	Qty.	11	6	14	8	9,18	2,52	27,47	0,892	-0,028
4	Kip to handstand	Qty.	11	4	10	6	7,09	1,97	27,82	0,038	-1,403
5	Press to handstand	Qty.	11	2	5	3	3,09	0,94	30,54	0,663	0,199
6	15 jumps from the lying on his back	Sec.	11	28,6	35	6,4	31,96	2,35	7,35	-0,064	-1,504
7	Handstand hold	Sec.	11	14,1	60	45,9	31,27	13,89	44,42	1,093	0,891
8	Climbing a rope	Qty.	11	1	2	1	1,36	0,50	37,00	0,661	-1,964

Legend: Critical values for As = 1,374 and Ex = 2,668 a = 0,05

The average values in the 20m run are 3.15 sec+/- 0.13 sec. The generalized values of the indicator vary in the range of 0.42sec. In the height jump test, the average values are 35.90cm. +/- 2.47cm. The values vary in the range of 9cm.

Table 3

Variation analysis second test EG (physical preparation)

№	Indicators	ME	n	X_{min}	X_{max}	R	X	S	V	As	Ex
1	20m. run	Sec.	11	2,8	3,2	0,4	3,07	0,12	3,94	-1,014	1,311
2	High jump	Sm.	11	34	42	8	37,09	2,43	6,54	0,64	0,36
3	From "L" position on bar lifting the legs to the grip	Qty.	11	7	15	8	9,64	2,84	29,45	0,997	-0,264
4	Kip to handstand	Qty.	11	5	11	6	7,36	1,96	26,66	0,443	-0,843
5	Press to handstand	Qty.	11	2	5	3	3,36	1,12	33,30	0,155	-1,225
6	15 jumps from the lying on his back	Sec.	11	28,8	35	6,2	31,29	1,92	6,13	0,838	-0,112
7	Handstand hold	Sec.	11	15,5	60	44,5	35,15	14,17	40,33	0,429	-0,461
8	Climbing a rope	Qty.	11	1	2	1	1,27	0,47	36,7	1,189	-0,764

Legend: Critical values for As = 1,374 and Ex = 2,668 a = 0,05

The average values in the 20m sprint are 3.14sec +/- 0.09sec. The generalized values of the indicator vary in the range of 0.28sec. In the height jump test, the average values are 35.55 cm. +/- 2.25cm. The values vary in the range of 8cm.

Table 4

T-criterion of Student end of experiment CG and EG (physical preparation)

№	Indicators	ME	Group 1			Group 2			difference	Statistical significance	
			n1	X1	S1	n2	X2	S2	d	Temp	p(t)
1	20m. run	Sec.	11	3,09	0,15	11	3,07	0,12	0,01	0,23	18,18
2	High jump	Sm.	11	36,55	2,34	11	37,09	2,43	-0,55	0,54	40,26
3	From "L" position on bar lifting the legs to the grip	Qty.	11	9,18	2,52	11	9,64	2,84	-0,45	0,40	30,44
4	Kip to handstand	Qty.	11	7,09	1,97	11	7,36	1,96	-0,27	0,33	25,15
5	Press to handstand	Qty.	11	3,09	0,94	11	3,36	1,12	-0,27	0,62	45,62
6	15 jumps from the lying on his back	Sec.	11	31,96	2,35	11	31,29	1,92	0,61	0,69	49,99
7	Handstand hold	Sec.	11	31,27	13,89	11	35,13	14,17	-3,85	0,64	47,33
8	Climbing a rope	Qty.	11	1,36	0,50	11	1,27	0,47	0,09	0,44	33,43

Legend: Critical values for temp= 2,09 a = 0,05

When comparing the two groups at the end of the experiment, it was found that there was no statistically significant difference between them. In all physical fitness tests, the difference is below the critical values of 2.09 for this type of sample.

Table 5

T-criterion of Student beginning and end of experiment CG (physical preparation)

№	Indicators	ME	Beginning			End			Statistical significance			
			n1	X1	S1	n2	X2	S2	d	d%	Temp	p(t)
1	20m. run	Sec.	11	3,15	0,13	11	3,09	0,15	-0,06	-1,88	1,51	83,73
2	High jump	Sm.	11	35,91	2,47	11	36,55	2,34	0,64	1,77	0,94	63,00
3	From "L" position on bar lifting the legs to the grip	Qty.	11	8,64	2,20	11	9,18	2,52	0,55	6,32	0,97	64,54
4	Kip to handstand	Qty.	11	6,36	1,75	11	7,09	1,97	0,73	11,43	1,55	84,81
5	Press to handstand	Qty.	11	3	0,89	11	3,09	0,94	0,09	3,03	0,27	20,39
6	15 jumps from the lying on his back	Sec.	11	32,34	3,14	11	31,96	2,35	-0,37	-1,15	1,21	74,67
7	Handstand hold	Sec.	11	29,87	14,49	11	31,27	13,89	1,4	4,69	0,51	38,22
8	Climbing a rope	Qty.	11	1,27	0,47	11	1,27	0,47	0	0	0	0

Legend: Critical If P (t) < 95% he differences (increment) is insignificant;

If P (t) >= 95% the difference (increase) is statistically significant.

When comparing the data from the beginning and the end of the experiment with the t-criterion of Student for dependent samples, it was found that there was no statistical increase in the results in the control group between the two measurements.

Table 6

T-criterion of Student beginning and end of experiment EG (physical preparation)

№	Indicators	ME	Beginning			End			Statistical significance			
			n1	X1	S1	n2	X2	S2	d	d%	Temp	p(t)
1	20m. run	Sec.	11	3,14	0,09	11	3,07	0,12	-0,07	-2,09	2,2	94,79
2	High jump	Sm.	11	35,55	2,25	11	37,09	2,43	1,55	4,35	3,14	98,94
3	From "L" position on bar lifting the legs to the grip	Qty.	11	8,45	2,34	11	9,64	2,84	1,18	13,98	2,14	94,17
4	Kip to handstand	Qty.	11	6,45	1,92	11	7,36	1,96	0,91	14,08	2,32	95,71
5	Press to handstand	Qty.	11	3	1,1	11	3,36	1,12	0,36	12,12	1,30	77,88
6	15 jumps from the lying on his back	Sec.	11	31,9	2,23	11	31,29	1,92	-0,61	-1,91	2,14	94,18
7	Handstand hold	Sec.	11	32,03	12,91	11	35,13	14,17	3,1	9,68	1,55	84,85
8	Climbing a rope	Qty.	11	1,36	0,50	11	1,36	0,50	0	0	0	0

Legend: Critical If P (t) < 95% he differences (increment) is insignificant;

If P (t) >= 95% the difference (increase) is statistically significant.

When comparing the data from the beginning and end of the experiment with t-criterion of Student for dependent samples, it was found that in the test jump height (98.94%) and kip to handstand (95.71%) the increase in results is statistically significant at the experimental group between the two measurements.

III.3.2 Results and analysis of testing technical preparedness

Through a pedagogical experiment, a methodology for teaching basic acrobatic element in floor exercise was tested. At the beginning and at the end of the experiment, testing was done for the technical training of the gymnasts who took part. Quantitative value of technical skills was determined by kinematic analysis and registration of the value of horizontal and vertical speed in an acrobatic series (round-off, back handspring and back flip). To determine whether the groups are homogeneous, we performed a variational analysis of the obtained results. To determine whether they have statistically significant differences from each other, we also made a comparative analysis of t-criterion of Student for independent samples with the data from the first measurement.

According to the results obtained, the samples are approximately homogeneous, the coefficient of variation is between 10% and 30%, which defines them as samples with medium scattering. T-criterion of Student for independent samples showed that the groups did not have a statistically significant difference and were suitable for this type of experiment.

The results of the second measurement at the end of the experiment were also subjected to variation analysis and comparative analysis with the student's t-test for independent samples to determine whether the groups at the end of the experiment had a statistically significant difference. To determine the growth of the results in both groups, we compared the data with t-criterion of Student for dependent samples.

Table 7

T-criterion of Student beginning and end of experiment CG (technical preparation)

№	Indicators	ME	Beginning			End			Statistical significance			
			n1	X1	S1	n2	X2	S2	d	d%	Temp	p(t)
1	Horizontal velocity round-off	Sec.	11	4,74	1,28	11	4,92	1,24	0,18	3,84	4,10	99,79
2	Horizontal velocity back handspring before support	Sm.	11	5,76	1,55	11	5,81	1,52	0,05	0,79	1,23	75,75
3	Horizontal velocity back handspring before attack	Qty.	11	4,85	1,03	11	5,13	0,91	0,28	5,82	2,96	98,57
4	Vertical velocity back flip	Qty.	11	5,62	1,23	11	5,78	1,24	0,16	2,91	6,71	99,99

Legend: Critical If P (t) < 95% he differences (increment) is insignificant;

If P (t) >= 95% the difference (increase) is statistically significant.

When comparing the data from the beginning and the end of the experiment with Student's t-criteria for dependent samples, it was found that there was no statistical increase in the results in the control group between the two measurements.

Table 8

T-criterion of Student beginning and end of experiment EG (technical preparation)

№	Indicators	ME	Beginning			End			Statistical significance			
			n1	X1	S1	n2	X2	S2	d	d%	Temp	p(t)
1	Horizontal velocity round-off	Sec.	11	4,79	1,19	11	4,74	0,90	-0,05	-1,14	0,37	28,22
2	Horizontal velocity back handspring before support	Sm.	11	5,57	1,44	11	5,46	1,27	-0,11	-1,96	1,11	70,56
3	Horizontal velocity back handspring before attack	Qty.	11	4,78	0,98	11	4,82	0,92	0,04	0,76	0,40	30,30
4	Vertical velocity back flip	Qty.	11	5,51	1,16	11	5,54	1,00	0,03	0,50	0,36	27,56

Legend: Critical If P (t) < 95% he differences (increment) is insignificant;

If P (t) >= 95% the difference (increase) is statistically significant.

When comparing the data from the beginning and the end of the experiment with Student's t-criteria for dependent samples, it was found that the horizontal velocity increased statistically significantly (99.79%) during the round-off. The horizontal speed (x) increased statistically significantly immediately before the attack on the floot for back handspring (98.57%). The vertical speed of the CG in back handspring is also statistically significantly increased (99.99%). As a conclusion from the statistical data processing we can say that the comparison of the results at the beginning and the end of the experiment most objectively reflect the advantages of the proposed experimental training methodology.

Conclusions and recommendations

Conclusions:

1. **From the conducted pedagogical observation of floor exercise combinations, it was established that the back flips are predominant in the performances of women (77%), while in men the elements are evenly distributed (50% backwards and 50% forwards);**
2. **When performing more complex double back flip, men and women prefer to use back handspring as a previous element (100% of cases for women and over 60% for men);**
3. **The performed biomechanical analysis gives us quantitative values of the kinematic indicators, with the help of which we have established characteristic errors in the technique (loss of speed);**
4. **High correlation was found between the kinematic indicators, the horizontal speed of the preparatory handsprings and the angle of attack after the final handspring (-0.822);**
5. **The created kinematic models provide quantitative information for deviation from the model performance of the established basic element of floor exercise;**
6. **The pedagogical experiment proved the advantages of our proposed training methodology, as in three of the four kinematic indicators for determining the technical mastery the experimental group has a statistically significant increase in its results (> 95%), in contrast to the control group.**

Recommendations:

1. **To increase the motor potential of athletes, we recommend sports educators to use the proven methodology to improve technique and improve kinematic performance in basic acrobatic element and series;**
2. **We recommend that in the study of flips from running strengthening to use the technique of execution with pre-raising the arms forward upwards as the most promising in complicating the flip;**
3. **We recommend that when performing double flips in the backward direction to use back handspring for the previous element, because it provides better conditions for their performance;**
4. **To reach the high difficult flips, we recommend the coaches to check and monitor the effectiveness of the preparatory flips;**
5. **To facilitate the activities of the coaches, we recommend the prepared website with a mobile version with visualization of the sample methodology.**

SCIENTIFIC CONTRIBUTIONS

- **A study and analysis of trends in the combinations of floor exercise for the period 2017 – 2020;**
- **The biomechanical indicators have been established, which determine the technical level of performance of the basic element of floor exercise;**
- **Kinematic models of the basic element of floor exercise have been prepared;**
- **A specialized methodology for training and improving the technique of basic element and a series of floor exercise has been developed and tested.**

PUBLICATIONS ON THE THEME OF THE DISSERTATION

1. **Stoimenov, Emil. Technique variation in saltos on floor exercise / Emil Stoimenov. //** Sport and Science, Sofia, LXIII, 2019, N 3,4, p.5-12.
2. **Stoimenov, Emil. VARIATION AND ANALYSIS OF THE TECHNIQUE OF BACK HANDSPRING / Emil Stoimenov, Iliya Yanev, Irina Bojinova. // Annual на National sports academy "Vassil Levski" (Sofia). - Sofia: NSA Press, 2020, p.187-192.**

Emil Nikolaev Stoimenov was born on December 13, 1991 in the city of Sofia. In 2010 he completed his secondary education at Sofia University “Gen. Vladimir Stoychev ”- Sofia, Gymnastics Specialist. In 2014 he graduated from NSA "Vasil Levski" - Sofia, specialty "Sports Coach Gymnastics and Teacher of Physical Education and Sports" with a bachelor's degree. In 2015 he received a master's degree in the program "Sports for Excellence" with a degree in gymnastics at the same school. In 2016 he was admitted with a competitive exam for a full-time doctoral student dep. "Gymnastics" in NSA "Vasil Levski". In 2018 was selected with a competitive exam for an assistant to dep. "Gymnastics" in NSA "Vasil Levski".

Sports and coaching. He started practicing gymnastics in 1996 and is an active athlete in the sports club "CSKA" and "A-GIM" until 2018. In his sports career he is a multiple national champion at different ages - individually and as a team. He is a national gymnast for the period 2003-2013. He has participated in international tournaments, Balkan and European championships.

Since 2010 works as a coach at SC A-GIM NSA. With his graduates he has many awards and national titles in male and female.

Scientific activity. Participates in 3 international and 6 national scientific conferences. He has 12 scientific publications.