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Development of the ability to maintain body balance in young athletes 12-13 years practicing judo

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A Study Design
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Abstract

Background and Study Aim: Preservation of postural stability of the body during competitive fights is considered an important factor in achieving success in judo. It is believed that the indicators of maintaining the balance of the body is much higher in adults and experienced athletes. The aim of this study is the knowledge the possibility of increasing the body balance of young athletes practicing judo through modification of training sessions.

Material and Methods: The contingent studied 30 young athletes practicing judo. Age of athletes of 12-13 years. Experience judo 1.5-2 years. The duration of the research is 1 year. To increase the body balance of athletes in static and dynamic conditions, specially selected exercises were used. The athletes of the experimental group (n = 15) performed these exercises in each training session (at least 30 minutes). Athletes of the control group (n = 15) used these exercises irregularly and in a smaller volume. To assess the level of body balance of athletes used tests: Hirtz's test, "flamingo balance test", "stork balance stand test" (Alpha-Fit version), "modified bass test of dynamic balance", a motor test with somersaults, the implementation of technology uchi-mata and o-uchi-gari. To determine the ability to maintain a stable equilibrium, the stabiloplatform – "Stabilan 01-2" (production of "OKB RITM", Russia) was used. The level of competitive activity of athletes was estimated by the method of analysis of video recordings of competitive matches. Evaluation of the test results was performed using Mann-Whitney U-test.

Results: At the end of the study period, a significant ($p<0.01$) advantage of athletes of the experimental group was revealed in a number of tests that determine the dynamic balance of the body. The highest differences were found in the data of" Flamingo balance test"," Target " test, motor test with somersaults. The results of tests that allow to assess the static balance of the body, did not reveal a significant advantage of athletes of any group. The positive influence of the purposeful training of balance of a body of athletes on speed of performance by judo athletes of complex coordination throws (uchi-mata and o-uchi-gari) is revealed. Comparative

analysis of the level of competitive activity of athletes did not reveal a significant relationship between the indicators of the balance of the body and the activity of judo athletes aged 12-13 in competitive matches.

Conclusions: The use of specially selected exercises can significantly increase the body balance of young athletes practicing judo. High body balance indicators allow athletes to have a significant advantage over their peers in the speed of performing some complex coordination shots (uchi-mata and o-uchi-gari) and resistance to dynamic effects.

Key words: competitive activity • Hirtz's test • judo sessions • modified bass test of dynamic balance • throwing technique

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INTRODUCTION

It is generally agreed today that judo is one of the most popular martial arts in the world. One of the ways to achieve victory in a duel of the judo athletes is to throw an opponent on the tatami. At the same time, it is estimated that in order to carry out a qualitative throw (in effective way) a judoka must lead the competitor out of a posture of stable equilibrium. At the same time, when the opponent is deprived of equilibrium, the athlete must take care of maintaining his own stable vertical posture of the body [1-3]. It was revealed that the ability to retain a throw over an opponent's kimono (judogi) and control the body's balance is of great importance for the effective technical and tactical actions of judo [4-6]. Thus, the ability to maintain the postural stability of the body in a duel with the competitor is an important factor in achieving success in judo. First of all, the experts believe that postural control and body balance under static conditions is expressed by the ability to maintain a stable posture with minimal movement. In dynamic conditions, the balance of the body is characterized by the ability to perform motor tasks while maintaining a stable body posture [7, 8].

It is important to note that the achievement of a high result will have a significant impact on the morphological characteristics of the athletes in judo [9]. Nevertheless, the studies show that maintaining a stable balance in the fight depends on the strength and volume of the legs, the body weight and anthropometric profile of the athletes [10-12]. It was revealed that the elite judo athletes have a higher body mass index than less experienced athletes. A higher body mass index of the elite athletes is associated with the need to maintain a stable body posture during competitive fights [13]. According to the ability of the judo athletes to maintain balance in a competitive duel also depends on the age and experience of the competitive activities [14]. It was found that the postural stability indicators during intensive anaerobic work are significantly higher among the adult athletes than young judo athletes [15, 16]. However, there are studies that disprove the claim about the significant advantage of the elite judo athletes in the ability to maintain body balance in comparison with less experienced athletes [17]. So there were no significant deviations in the effectiveness of the postural balance of the body of elite and national fighters in conditions of the competitive matches [18, 19]. Hence, the purposeful training of the body balance allows to the athletes to level the advantage of more experienced judokas in this component from a young age. The judo athletes are quicker to achieve meaningful sports results if they had a high level of the ability to maintain body balance under complicated conditions at a young age [20].

Actually, the experts say that training to maintain the body balance under dynamic conditions is effective for improving neuromuscular control of the body and postural effect. However, the significant methodological limitations and variability of the various training schemes for the athletes dictate the need for further qualitative research on this issue [21-23]. An essential drawback of the

Throwing techniques (*nage-waza*) – hand techniques (sub classification: *te-waza*); hip techniques (sub classification: *goshi-waza*); leg techniques (sub classification: *ashi-waza*); rear-fall and side-fall judo throws, synonym: "dedication throws" (sub classification: *sutemi-waza*).

Ne-waza (prone techniques) – a related concept is that of **katame-waza** (grappling techniques) – judo techniques executed from a horizontal posture: *osaekomi-waza* (pinning techniques), *shime-waza* (strangle technique), *kansetsu-waza* (joint holds).

Shido – (instruction / light penalty) is called when a rules violation occurs during a judo contest.

Uchi-mata – inner-thigh.

O-uchi-gari – big inner reap.

Tatami – traditional straw mats used in *jūdō* and *aikidō* training halls [51].

Technique – *noun* a way of performing an action [51].

Tactics – *plural noun* the art of finding and implementing means to achieve immediate or short-term aims [51].

Balance – *noun* **1**. the act of staying upright and in a controlled position, not stumbling or falling **2.** a state of emotional and mental stability in which somebody is calm and able to make rational decisions and judgments **3.** the

traditional methods of teaching in judo and in other kinds of wrestling [24] is a fairly rigid rationing and standardization of the process of training the athletes. This prevents the successful development of the variability of the motor and individualization of the technical skills of the young athletes [25, 26]. Furthermore, the studies show that the most training methods of judo training are aimed at developing the speed-strength characteristics of the athletes [27]: the explosive strength [28] and endurance [29]. The development of the ability to maintain the balance of the body in a duel is not given due attention. Physically stronger athletes have static stability indicators which are at a high level [30]. This result is achieved by increasing the muscle effort and increasing the body mass index [31].

It is known that the most objective criterion of the effectiveness of training methods for the athletes is their competitive results [32, 33]. However, the results are influenced by the morphological characteristics of the judo athletes and training programs during which the coaches and athletes do their best to achieve the optimal form in sports [34]. Some scientists consider one of the most important conditions for success are highly developed coordination [35, 36] and the manoeuvre ability of the young athletes in judo [37, 38]. It is generally agreed that it is necessary to develop these abilities simultaneously with the speed-strength characteristics of the athletes. This will help to achieve success in competitions [39]. It was revealed that the level of coordination abilities of the athletes significantly correlates with the level of activity of judo players in the competitive matches [40]. It is known that the level of activity of the athletes in fights is an important criterion for achieving high sports results [41]. Thus, it is necessary to give attention to the development of coordination abilities and the preservation of the balance of judo starting from the young age [42].

At the same time, many coaches do not pay enough attention to developing the coordination abilities of the young judokas. Moreover, this negatively affects on the level of maintaining the balance of the body of the athletes in duels. An analysis of the scientific research by the Russian judo specialists has shown that the aspects of the purposeful development of coordination abilities and the preservation of postural stability of the body have not been studied last 16 years [43]. It goes without saying that the trainers believe that the increase in these indicators will occur directly as a result of intensive training activities. Indeed, there are studies that show an increase in the indicators of maintaining the balance of the body in judo during the practice of judo [14, 44]. However, the analysis of such studies shows that in most scientific papers the indicators of the preservation of postural stability of the body of athletes of different ages and different levels of sports qualification are compared [45]. Unfortunately, there is a lack of research on the targeted development of the ability to maintain body balance of young and young athletes practicing judo. But it is known that learning to balance at a young and young age will be important for the development of sensorimotor indicators of the athletes. A high level of development of such indicators is necessary in competitive practice [46].

All in all, sport practice shows that the use of the athletes' level programs of the exercises to maintain the balance of the body in dynamic conditions is used in different sports. However, the experts still find it is difficult to identify the most effective type of training in the practice of maintaining a balance and the methods of training are also not fully defined [47]. It is generally agreed that there are studies that prove the effectiveness of the strength training on unstable surfaces for the development of the ability to maintain the body balance of the young people [48]. The effectiveness of the use of jumping exercises on the trampoline of the young athletes practicing the martial arts was proved [49]. It is necessary to use the special exercises that increase the competitiveness of the athletes to increase the effectiveness of training in judo. Studies show that the ability to maintain the body balance in judo fights has a significant impact on achieving a victory in fights [38, 40]. You need to use special exercises in training sessions to develop this ability.

The aim of this study is the knowledge the possibility of increasing the body balance of young athletes practicing judo through modification of training sessions.

MATERIAL AND METHODS

Participants

In the studies, the young athletes (12-13 years old) practicing judo took part. The sports experience of the athletes is 1.5 to 2 years of judo. Consequently the number of the athletes is

proportions of substances in a mixture, e.g. in the diet [51].

Judogi – is the formal Japanese name for the traditional uniform used for judo practice and competition [52].

Waza – a technique or movement which is based on a standard form and is used to challenge and defeat the opponent [51].

Coordination – *noun* the ability to use two or more parts of the body at the same time to carry out a movement or task [51].

Endurance – *noun* the ability or power to bear prolonged exertion, pain or hardship endurance athlete [51].

Strength – *noun* the fact of being strong [51].

Strength training – *noun* training that aims to build muscle strength, usually resistance training [51].

Speed training – *noun* training that uses exercises designed to improve reaction times [50].

Endurance training – *noun* exercises designed to increase an athlete's level of aerobic fitness [51].

Form – *noun* **1.** the condition of a player, team or athlete with regard to fitness, health and ability to perform well **2.** the posture and positioning in which a person does something such as lift a weight **3.** (*in some martial arts*) a formal series of movements, used either for training or to demonstrate technique [51].

Training session – *noun* a period of time during which an athlete trains, either alone, with a trainer or with their team [51].

30 boys. Weight category of the athletes is 55 kg. All athletes were selected according to the results of the test and had the closest possible results. The athletes were randomly divided into two equal groups to conduct research: experimental group (n = 15) and control group (n = 15). One should note here that all young men had no health problems and regularly underwent medical examinations.

Organization of the researches

The basis for research was the Academy of Struggle named after D.G. Mindiashvili (Krasnoyarsk, Russian Federation). The duration of the research was 1 year (from September 2016 to October 2017). The authors made changes to the standard methods of training young athletes to achieve the research goal. The changes consisted in the selection of the special exercises for the purposeful development of the ability to maintain the balance of the body of the athletes. Such exercises include: attempts of mutual stalling from the main rack with a capture for the lids of the judogi pushing each other out of the small diameter zone (1-2 m), mutual pushing out of the area of the tatami standing on one leg and etc. Gymnastic exercises were widely used: maintaining balance in a complicated position of the body (stand on one leg with movements of the trunk, hands and unsupported leg), trampoline tumbling and tumbling with a change of direction. Part of the exercises was conducted in a game or competition form. This contributed to increasing the interest of the young athletes in their implementation. The means of special training of the martial arts were used: exercises performed in the position of the wrestling bridge and judo techniques performed at the time of various vestibular stimuli. So after performing 10 somersaults or jumping with the body rotating the athletes were asked to perform various techniques of judo. Also, the time for performing these exercises was increased (10 minutes in the warm-up and at least 20 minutes in the main part of the exercises). A series of exercises were included in the daily training sessions of the athletes. Training sessions lasted 60-80 minutes, daily, 6 days a week. The standard methods for training young and beginner athletes involve performing exercises that promote the development of the balance only at the beginning of the session (warm-up which lasts not more than 10-15 minutes). In the main part of the training sessions such exercises are not provided.

The anthropometric indices of the athletes were estimated by measuring the growth and weight of the young judokas at the beginning and at the end of the study period. Measurement of the growth of the athletes occurred using an anthropometer of the Martin system. The weight of the athletes was measured by means of electronic scales (TB-S-60.2-A1 manufactured in Russia) which have a certificate for measuring the accuracy of the measurements. The BMI was determined by the Quetelet index.

Besides, a number of the tests were used to assess the ability to maintain the balance of the body of the athletes in static and dynamic conditions. They used: “Flamingo balance test”, “Stork balance stand test” (Alpha-Fit version), “Modified bass test of dynamic balance”, Hirtz test (number of turns on a gym bench is 10 cm wide for 20 seconds), motor test with somersaults around the area of the tatami and the subsequent passage of a straight line length of 10 m. At the same time, the athletes performed somersaults at the fastest pace around the area of the tatami: first, a somersault was performed in one direction and then in the other direction. After performing the somersaults, the athletes were to pass along a straight line 10 cm wide and 10 m long quickly. Chalk was spread along the line. Therefore, any deviations in the motion from a straight line were easily fixed on the left tracks. The test took into account: the time of the somersaults execution and the average amplitude of the deviation of the stop athletes from a straight line when moving forward. The calculation of the results of the “Modified bass test of dynamic balance” was carried out by adding penalty points for the loss of balance (5 points) or going beyond the area of the marker when jumping (3 points). The athletes performed jumps on the right and left leg. The average values of the results of the penalty points of the athletes of both groups were summarized. A test was used with the implementation of judo techniques to assess the degree of the ability influence to maintain a balance in the dynamic conditions. The athletes performed the classical technique of *uchi-mata* and *o-uchi-gari*. Each athlete performed 10 throws each. The average time of performing the *uchi-mata* and *o-uchi-gari* technique of the athletes of both groups was taken into account. In the opinion of the authors of the article, the successful implementation of these techniques makes the athletes increased requirements for maintaining the balance of the body in dynamic conditions for performing the judo technique.

Currently, the method of structural analysis of video recordings of the competitive fights was applied to analyse the level of competitive activity of the young athletes. Five specialists were invited: judges of the national and international judo category who have the right to service competitions under the auspices of the IJF (International Judo Federation) to assess the competitive activity of the athletes. The following indicators were taken into account: the total number of technical actions *nage-waza* and *ne-waza*, the number of *shido* of the athletes, the intervals between attempts to conduct attacks. The number of competitions in question was 527. The athletes from experimental group held 259 matches and the athletes from control group 268.

It is known that the stable platform was used Stabil 01-2 (produced by experimental design bureau Rhythm, Russia) to analyse the ability to maintain body balance. The software is StabMed2 (experimental design bureau Rhythm, Russia). This platform allows you to record fluctuations in the centre of mass of the body of the athletes in different planes. One should note here that the athletes stood on the stable platform in the main rack, closed their eyes, pulled their hands forward (Romberg's test) and stood motionless for 30 seconds. Evaluation of the ability to maintain the body balance was carried out by comparing the following stabilographic indicators: R (mm) the average deviation of the projections of the general centre of gravity of the judo body in the process of controlling the vertical posture; S (mm^2) is the area of the ellipse of the zone within which the trajectory of the projection of the common centre of gravity of the athletes' body was located. The "Target" test was used to test the function of maintaining the balance of the body under dynamic conditions. The athlete on the stable platform must hold the marker in the centre of the target due to the deviations of the body. The marker was displayed on the monitor screen installed in front of the athlete. The marker was constantly shifted in different directions. The software StabMed2 (experimental design bureau Rhythm, Russia) produced a mathematical analysis of the displacement vectors of the common centre of mass of the examined athletes relative to the coordinate axes. The result was expressed as a percentage and was the equilibrium function quality of the athletes (EFQ). The greater the percentage of the equilibrium function quality the more the ability of the athletes to maintain a stable balance of the body is developed.

Statistical analysis

The analysis of the results of the studies was carried out using the statistical processing program SPSS20. Mann-Whitney U-test was used to evaluate the results obtained during the research. This statistical criterion makes it possible to detect differences in the values of the investigated indicators in fairly small samples of the subjects.

RESULTS

The measurements of anthropometric indices of the athletes did not reveal significant differences between groups at the beginning and end of the study. The average body weight at the beginning of the study was 55.62 ±0.58 kg for the athletes of experimental group and 55.34 ±0.82 kg for the athletes of control group. At the end of the study period, the body mass index of the athletes of experimental group averaged 56.73 ±0.94 kg and in control group was 57.02 ±0.28 kg. The growth data of young judokas at the beginning of the study was 162.13 ±1.32 cm of the athletes of group, 162.24 ±1.51 cm of the athletes of control group. At the end of the studies, the mean growth rates of young athletes were experimental group 165.22 ±1.47 cm and in control group 166.34 ±1.79 cm. The BMI indices of the athletes of both groups did not differ significantly at the beginning of the studies. At the end of the study, a slight decrease in the mean BMI values of the athletes of both groups was found.

At the beginning of the studies the results of the Flamingo balance test performed by the athletes showed that the time for maintaining the stable posture in the experimental group athletes averaged 18.23 ±1.46 seconds. The time for maintaining a stable equilibrium of the athletes' of control group averaged 18.41 ±1.85 seconds. The differences in the indicators were considered insignificant. At the end of the study, the results of this test were: 23.52 ±1.34 seconds for the athletes of group 1 and 21.44 ±1.47 seconds for the athletes of control group. The testing showed the presence of a significant ($p<0.01$) advantage of the athletes of experimental group.

Moreover, the performance of the Hirtz test (turns on the gym bench) did not reveal any significant differences in the level of development of the athletes' dynamic balance at the beginning

of the studies by the athletes. In the athletes of experimental group the number of the turns was on the average 8.46 ±0.24. In the athletes of control group the result was 8.14 ±0.72. At the end of the study, the performance of this test increased in both groups. The number of turns for the athletes of experimental group was 11.57 ±0.24 and for the athletes of control group 10.42 ±0.86. The statistical analysis showed a significant ($p<0.01$) advantage in the number of rotations performed by the athletes of the experimental group.

Performance by the young athletes "Stork balance stand test" (Alpha-Fit version) at the beginning of the studies did not show significant differences in the results of both groups. One should note here that the time interval for maintaining a stable body balance of the athletes of experimental group was 37.24 ± 0.61 seconds and for the athletes of control group 38.06 ±0.29 seconds. At the end of the study, it was found that the athletes of experimental group significantly increased the time interval for maintaining the static balance of the body. It should be pointed out that on average, the time interval for maintaining the balance of the body of the athletes of experimental group increased by 7.31 ±0.88 seconds and amounted to 44.56 ±0.49 seconds. In the athletes of control group the performance of the "Stork balance stand test" increased by an average of 6.33 ±0.14 seconds and amounted to 44.39 ±0.43 seconds. The test results did not show the significant advantage of the athletes of any group at the time of the "Stork balance stand test" (Alpha-Fit version).

The results of the performance of the "Modified bass test of dynamic balance" athletes at the beginning of the research showed that the number of penalty points for the athletes of experimental group was on the average 84.72 ±2.45. The number of penalty points for the athletes of control group on average 84.46 ±2.81. At the end of the study, the athletes of experimental group showed a significant reduction in the number of penalty points in the performance of this test to 60.24 ±1.63. The number of penalty points in the performance of this test of the athletes of control group decreased to 61.38 ±1.49. The results indicate that the number of penalty points is significantly ($p<0.01$) higher of the athletes control group.

Thus, the results of the Romberg test with closed eyes of both athletes groups at the beginning of the studies do not contain significant differences. Meanwhile, the average R value of the athletes of experimental group was 10.04 ±1.24 mm and the athletes of control group showed an average 10.07 ±1.15 mm. At the end of the study, the R values of the athletes of experimental group averaged 7.98 ±1.32 mm. The value of the athletes group R is 8.25 ±1.22 mm on the average. The differences between the average results were found to be unreliable. The indices S at the beginning of the studies of both athletes groups did not differ significantly. At the end of the study, there were also no significant differences between the mean values of S in the experimental group (159.86 ±1.63 mm^2 and the control group (160.22 ±1.45 mm^2).

Besides, the data of the test "Target" at the beginning of the research did not allow revealing the significant advantage of the athletes from any group in maintaining a stable equilibrium of the body. The result of the athletes of group 1 is 64.55 ±3.42%. The athletes from group 2 showed an average of 65.14 ±2.29%. It should be noted that the StabMed2 software interprets these results as average. At the end of the study period a significant ($p<0.01$) advantage of the athletes Group 1 in the results of the test "Target" was revealed. The athletes of this group showed an average result of 76.34 ±2.53%. The average result of the athletes from group 2 is 70.66 ±3.47%. If the result of the athletes of group 2 is considered average so the result of the athletes from group 1 is assessed by the program as a result of the above average.

Furthermore, the results of the motor test with somersaults at the beginning of the studies show that the level of preservation of equilibrium of the athletes did not differ significantly. The average time for performing somersaults by the athletes of group 1 was 36.24 ±1.44 seconds. The athletes of group 2 performed the task on average for 35.91 ± 1.93 seconds. At the end of the study, the results became significantly different. The athletes of group 1 performed the task on average for 31.26 ±0.91 seconds. The athletes of group 2 performed the task on average for 34.67 ±0.86 seconds. The time of the test in the control group was reliable ($p<0.01$) large. The amplitude of deviations in the movement of the athletes in a straight line at the beginning of the

study was: for the athletes of experimental group 33.45 ±2.51 cm; in the athletes of control group 33.87 ±2.84 cm. These differences were considered insignificant. At the end of the study, the amplitude of the deviations when moving along a straight line was: for the athletes of experimental group 21.17 ±2.73 cm; in the athletes of control group 26.82 ±2.17 cm. The received data differed significantly in favour of the athletes of experimental group.

Moreover, performing the *uchi-mata* technique at the beginning of the studies did not reveal significant differences in the temporal data in both groups. The athletes of experimental group performed the throws on average for 49.62 ±1.32 seconds. At the same time, the athletes of group 2 performed the task on average for 50.02 ±0.43 seconds. At the end of the studies, a significant dynamics of the decrease in the average time for performing the *uchi-mata* technique was found. The athletes of experimental group performed the task on average for 44.37 ±1.54 seconds. The athletes of control group completed the task for 46.78 ±1.82 seconds. At the same time, the difference in the results of the timing of the reception is recognized as significant. Both groups of the athletes significantly improved the performance of the casting time of *uchi-mata*. At the same time, a significant ($p<0.01$) difference in the temporal values of the performance of the *uchi-mata* technique in favour of the athletes of experimental group was found. Implementation of the *o-uchi-gari* technique at the beginning of the studies did not reveal significant differences between the athletes groups. On average, the judo athletes performed the task for 45.21 ±0.19 seconds. At the end of the study, the mean time to perform the *o-uchi-gari* technique was significantly reduced of both athletes groups. At the same time, a significant ($p<0.01$) difference in the test runtime between experimental group (41.54 ±1.43 seconds) and control group (43.86 ±1.39 seconds) was found. The performance time of the *o-uchi-gari* technique of the experimental athletes group is much smaller.

It should be taken into account that the analysis of the competitive activity of the young athletes has shown that the number of different *nage-waza* receptions in fights is approximately the same for the athletes of both groups. On average, the athletes from the experimental group perform 5.57 ±0.16 technical actions. The athletes from the control group perform 5.64 ±0.14 admissions. A significant ($p<0.01$) advantage in the number of *ne-waza* receptions performed on average in each duel by the athletes from the control group was found. The amount of *shido* is approximately the same for the athletes of both groups. The time values of the intervals between attempts to conduct attacking actions in groups also do not contain significant differences. This figure for the athletes of experimental group averages 17.54 ±0.22 seconds. This figure was 17.41 ±0.29 seconds for the athletes from the control group.

The results of the authors' studies are presented in Table 1.

DISCUSSION

At the beginning of the discussion it is worthwhile to note that the authors of the article faced a significant lack of information about the purposeful development of the ability to maintain the body balance of the young athletes practicing judo. At the same time, the analysis of the literature shows that the majority of the specialists indicate the dependence of the athletes' body balance on the age and experience of sports practice [14]. The trainers and experts believe that the indicators of maintaining the body balance of the judo athletes will increase along with the biological age and the increase in competitive practice. There are scientific studies confirming this position and proving an increase in the indicators of maintaining a stable body balance of the athletes in the course of increasing the practice of judo [44]. However, a detailed analysis of such studies shows that in the overwhelming majority of works the indicators of the preservation of postural stability of the body are compared: either athletes of different ages and levels of sporting achievements [30] or the athletes and people who do not practice judo [45]. In the opinion of the authors of the article, such comparisons are informative but not completely correct. What is more for the objective scientific concepts of building sports training in judo exact studies with approximately the same composition of the participants are required: age, gender, experience of judo practice, level of physical fitness of athletes, etc. Unfortunately, there is a lack of research on the purposeful development of the ability to maintain body balance of

Table 1. Results (and standard deviation) of the tests of the examined judo athletes of experimental (n = 15) and control (n = 15) groups.

Test (indicator)	September 2016		October 2017	
	experimental group	control group	experimental group	control group
Body weight (kg)	55.62 ±0.58	55.34 ±0.82	56.73 ±0.94	57.02 ±0.28
Height (cm)	162.13 ±1.32	162.24±1.51	165.22±1.47	166.34 ±1.79
BMI	21.19 ±0.22	21.08 ±0.46	20.83 ±0.52	20.69 ±0.24
Flamingo (s)	18.23 ±1.46	18.41 ±1.85	**23.52±1.34***	21.44 ±1.47
Hirtz (number of turns)	8.46 ±0.24	8.14 ±0.72	**11.57 ±0.24***	10.42 ±0.86
Stork (Alpha-Fit) (s)	37.24 ±0.61	38.06 ±0.29	44.56 ±0.49	44.39 ±0.43
Modified bass (penalty points)	84.72 ±2.45	84.46 ±2.81	60.24 ±1.63	**61.38 ±1.49***
Romberg (R) (mm)	10.04 ±1.24	10.07 ±1.15	7.98 ±1.32	8.25 ±1.22
Romberg (S) (mm^2)	166.24 ±1.45	165.76 ±1.84	159.86 ±1.63	160.22 ±1.45
Target (%)	64.55 ±3.42	65.14 ±2.29	**76.34 ±2.53***	70.66 ±3.47
Flips (s)	36.24 .±1.44	35.91 ±1.93	31.26 ±0.91	**34.67 ±0.86***
Straight line (cm)	33.45 ±2.51	33.87 ±2.84	21.17 ±2.73	**26.82 ±2.17***
Uchi-mata (s)	49.62 ±1.32	50.02 ±0.43	44.37 ±1.54	**46.78 ±1.82***
O-uchi-gari (s)	45.27 ±1.29	45.14 ±1.08	41.54 ±1.43	**43.86 ±1.39***
Nage-waza (number)	-	-	5.57 ±0.16	5.64 ±0.14
Ne-waza (number)	-	-	2.08 ±0.03	**3.21 ±0.02***
Shido (number)	-	-	1.61 ±0.35	1.65 ±0.29
Attack interval (s)	-	-	17.54 ±0.22	17.41 ±0.29

*reliability of differences ($p<0.01$).

the young athletes practicing judo. The specialists do not pay enough attention to the development of the ability to maintain the balance of the young judokas body in static and dynamic conditions. This trend is not entirely clear: there are studies emphasizing the importance of purposeful development of the ability to maintain the balance of the body of the young wrestlers [38]. Targeted learning balance at a young age will be important for the development of sensorimotor indicators of the athletes. A high level of the development of such indicators is necessary for the professional athletes in competitive practice [46]. Nevertheless, the experts also recommend the integration of methods for the development of body balance in curricula: for the young and beginning athletes or elite athletes practicing judo [4].

The lack of attention of many specialists to the purposeful development of the balance of the body of the judo athletes can be explained by the results of some tests. The tests for the balance of the body of the athletes in static conditions ("Stork balance stand test" Alpha-Fit version) and Romberg's test performed on the stable platform) did not show significant differences in the results of the static balance of the body of the athletes. Furthermore, the lack of visible results allows a number of specialists to assert that the ability to maintain the postural balance of the body will grow during the training practice of judo [50]. At the same time, there is no purposeful work on their development. However, we should pay attention to the results of tests to identify the ability to keep the dynamic balance of the young judokas body. The results of the tests show a significant ($p<0.01$) advantage for the athletes who regularly perform balance retention exercises. There was also revealed a significant advantage in the time of implementation of some complex co-ordination throws (*uchi-mata*, *o-uchi-gari*) by the young athletes purposefully performing exercises to maintain the balance.

According to the research of the authors of the article confirms the earlier expressed suppositions about the high effectiveness of the strength training

conducted on various unstable surfaces. This contributes to an increase in body balance and development of the athletes' coordination abilities [48]. It is revealed that the use of swinging platforms and trampolines [49] in the process of training activity allows demonstrating a significantly higher level of maintaining the balance of the body and resistance to various dynamic influences to the young judo athletes.

In the studies, a significant correlation between the level of development of the athletes' coordination abilities and the high level of competitive activity of the judo athletes was not found as indicated by some experts [40]. The main indicators of competitive activity (the number of technical actions, *shido*, intervals between attacks) in the experimental and control groups are approximately the same. Perhaps, in terms of *ne-waza* technique a significant advantage of the athletes with lower body balance maintenance was revealed. At the same time, the authors are not inclined to reject this statement and believe that the relationship between the level of coordination abilities development and the activity of the judo athletes will manifest itself in a more adult age.

CONCLUSIONS

The research of the authors of the article is intended to fill the lack of the objective scientific data on the development of the ability to maintain a stable body balance of the young and beginning athletes practicing judo. Moreover, the analysis of the literature shows that coaches do not pay due attention to the purposeful formation of the ability of the athletes to maintain a body balance training judo. Perhaps, the scientists note that an increase in the body balance will occur directly in the course of long-term practice of judo. The authors of the article justify the need for a purposeful formation of the habit of preserving the balance of the body in judo starting from a young age. It should be mentioned that the results of the tests allow us to state about the significant advantage in maintaining the body balances the experimental athletes group. The technique of increasing the body balances of the young judo athletes in static and dynamic conditions of training activity is proposed and tested.

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