EVALUATION OF PHYSICAL DEVELOPMENT OF ADOLESCENT WRESTLING COMPETITORS' BASIC MOTOR QUALITIES

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ABSTRACT

The research aimed to establish the level of variability of some major indicators characterizing the physical development of adolescent wrestling competitors' basic motor qualities. The research was carried out in 2021 with the age group 12-14 years, and the results had to be compared with those obtained from a survey in 2012. The research was done among 22 coaches and wrestling specialists (part of whom are Olympic, World, and European champions) and 79 boys, divided into three age groups as follows: U12 –25, U13 –32, and U14 –22. Sports-pedagogical testing and an interview were used for the purposes of the research, as well as a review of literary sources and their theoretical analysis. The results from the research were processed statistically with Microsoft Office Excel 2016 and IBM SPSS Statistics - v23. We applied the following statistical methods: variation analysis, comparative analysis with Student's t-criterion, Cohen's d, Kolmogorov-Smirnov, and Shapiro-Wilk tests. The summary of the data and the analysis made for the three researched groups established variability of some basic indicators characterizing the physical development of basic wrestling qualities. There were three main groups of indicators in the three groups of researched individuals: indicators with low variability, relatively high variability, and very high variability. There was a decrease in the difference in the coefficient of variation in most physical indicators and an improvement in the mean values from U12 to U14. The hypothesis was confirmed that the final results after the surveys held in 2021 would be lower than those obtained in 2012. The obtained data are interesting for the specialists because they enrich training methods with new facts, which are essential for increasing the efficiency of sports preparation in sports clubs and national teams.

OPEN ACCESS

Submitted: 22 September 2022
Revised: 6 December 2022
Accepted: 12 December 2022

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Cite this article as:
Iliev, I. (2022). Evaluation of physical development of adolescent wrestling competitors' basic motor qualities. *Journal of Applied Sports Sciences*, Vol.2, pp. 36 - 52. DOI: *10.37393/JASS.2022.02.4*

Keywords: *adolescents*, *wrestling, physical development, basic motor skills*

INTRODUCTION

Combat sports involving wrestling have their special characteristics, including performance training, specialist training, and teaching technical–tactical skills. The selection of principles of organization and application of sports trainings should consider athletes' physical qualities, their conditioning level, and their strengths and weaknesses (Cynarski, Slopecki, Dziadek, Boschen, 2021). In training sessions aimed at the development of physical qualities at a young age, one should take a careful approach. Various and easily accessed forms of influence on young wrestlers' physical qualities should be used in the everyday educational-training process (Iliev, Nikolov, 2013). Control and evaluation of physical qualities are very important for sports preparation as a whole (Zheliazkov, Dasheva, 2011). The complex development of motor qualities raises the issue of evaluating and controlling adolescent competitors' specific, functional preparation (Borukova, 2021). The standard assessment of the training and com-

petitive loads and general and specific conditioning during the different stages is obligatory for the correct formulation of long and short-term training tasks (Iliev, 2015). Control is part of people's cognitive activities, where they collect information and assess the actual state of an object with the aim of its purposeful (preliminarily planned) development and perfection (Brogli, 2012). In the system of high-performance sport, sports clubs have a leading role because the preparation they provide is on the basis of the elite sport system (Chamishki, 2022a). The primary objective is to provide conditions for a quality selection of children with sports talent, a competitive environment for their development, possibilities for sports performance, opportunities for dual careers, and create a motivating environment for students' personal and professional realization (Chamishki, 2022b).

There is a wide variety of test batteries for evaluating physical qualities, including combinations of different tests, in the literary sources related to wrestling. Some indicators for speed-strength abilities of wrestlers were created by Yushkov (Yushkov, 2007), who included the tests: standing triple jump, standing long jump, standing high jump, and quadruple long jump. Kozlyakov added a few more tests to this battery (Kozlyakov, 2010), namely a forward throw of a medicine ball, a backward throw of a medicine ball, a forward and backward kettlebell throw, and a kettlebell throw over the left/right shoulder. In a survey on dynamics of the physical quality flexibility carried out by Nikolov and Iliev in 2013 among 19-21-year-old students majoring in wrestling and active athletes, after a control testing, it was established that over a year the researched individuals had increased their flexibility in the measured areas (spinal column and coxofemoral joints). In recent research by the same author (Nikolov, 2021) with the National Wrestling Team – Greco-Roman style carried out at the high-mountain sports facilities Belmeken, testing for the evaluation of flexibility under the influence of altitude was made. It established an increase in the data about most researched individuals, and the author claimed that the dynamics, especially the increase in the data, was only due to the altitude.

In 1959, Morgan and Adamson created the circuit training session to develop and evaluate strength endurance (Morgan, Adamson, 1959). The exercises are especially appropriate for the first stage of the competitive period. The Bulgarian modern wrestling school's founder, Professor Raiko Petrov, used all achievements of sports science to create the most lasting system for sports preparation: evaluation, analysis, corrections, preparation, competition, analysis, planning, and preparation (Kirov, Makaveev, 2010). His interesting schemes in the assessment of physical qualities (Petrov, 1977) and other authors' schemes (Petrov et al. 1993) are related to all physical qualities and technical-tactical skills. For speed evaluation, they recommended the tests: 30, 40, and 100 m running. To evaluate agility, they recommended tests with complicated acrobatic and gymnastic movements. The quality endurance of a wrestler was checked with control normative tables, most often with 1,500 and 3,000 m running, 3x800m running, and a lot of other tests. When examining the coordination abilities of Bulgarian wrestlers, Makaveev used the following tests: a six-angle test, sideward change of direction, a test for balance evaluation, a forward roll with throwing and catching a ball, upright stork, etc., and the exercises were chosen on the basis of the requirements of sports wrestling (Makaveev, 2011). To research the anaerobic power, a lot of authors (Saghiv, Cummings, Kusser, Kvislen, Roemmich, Dinkel, Knoll,

2017) used the influence of WanT (Wingate test) for tracing the norms of blood pressure, lactate, and NTproBNP of conditioned wrestlers and unconditioned young men. The research found that the wrestlers recovered quickly with a slight elevation 10 min after the test.

In comparison, the unconditioned men recovered slowly with a significant increase of NTproBNP 10 min after the test. Physical fitness parameters such as maximal dynamic strength, isometric strength, explosive strength, and strength endurance are closely related to high-level wrestling performance. Coaches, strength and conditional specialists, and sports scientists may consult these findings to build up a comprehensive physical and physiological profile of wrestlers that would assist them in optimizing their training interventions (Chaabene et al., 2017).

Based on the researched and analyzed literary sources, the personal presence of the researcher during the wrestling competitions in the state calendar in the past years, and his close relationship with wrestling coaches and specialists from the National Teams and sports clubs, the following work hypothesis was formulated: We suppose that after a sports-pedagogical survey of basic physical qualities, and after the analysis of the final results from the research carried out in 2021, the results would be lower than those obtained in 2012. Because of that, *the research aimed to* establish the level of variability of some basic indicators, characterizing the physical development of adolescent wrestlers' primary motor qualities. The research was carried out in 2021 among athletes aged 12-14. The obtained results had to be compared to the results in the normative system for the evaluation of sports preparation in wrestling from 2012 (Tsurova, Miladinov, Makaveev, Nikolov, 2012).

METHODOLOGY

Participants

The research was carried out from April 2021 to July 2022 among 22 wrestling coaches and specialists (part of whom Olympic, World, and European champions or coaches and sports club members abroad) and 79 boys divided into three age groups: U12 –25; U13 –32, and U14 –22. All participants were wrestlers – freestyle and Greco-Roman from different sports clubs in Bulgaria who participated in Bulgarian National championships. Their sports experience depended on their age.

RESEARCH METHODS AND INDEXES

Research and theoretical analysis of the specialized literature. In the course of the research, we studied particular sources in Cyrillic, Latin, and Internet sources.

An interview. The functions of the interview allowed for creative communication between the researcher and each of the wrestling coaches and specialists – in the form of asking questions and receiving answers. Their content concerns general issues of sports preparation and some principles of training with adolescent wrestlers. The responses revealed coaches' and specialists' knowledge, position, opinion about specific facts and regularities, and their evaluations. The manuscript is very informative as regards the opinions of Olympic, World, and European wrestling champions.

Sports-pedagogical testing along 4 indicators (Table 1): forward bend, standing long jump (cm), 30 m running from a standing start (sec), and pull-ups on a horizontal bar. All these four tests are specific to wrestling and are used for evaluation of the motor qualities both in the national teams and in wrestling sports clubs. When selecting these indicators, we considered the following requirements: they had to provide information about the development of the different motor qualities; they

had to be reliable, valid, accessible, objective, and standard; they had to be applicable in terrain conditions. We obtained informed consent and parents' permission for all the researched individuals prior to the testing. Sports-pedagogical testing (a list of indicators, Table 1) ensures the efficiency of the physical preparation through the applied tests for evaluation of the basic physical qualities. The study protocol was conducted in agreement with the principles stated in the Declaration of Helsinki for Human Research (WMA, 2013) and in compliance with the ethical code of the National Sports Academy (2019).

Table 1. *Description of sports-pedagogical tests used in the research*

№	Test/indicators/parameters	Measurement units	Direction of increase	Researched qualities
1	**Forward bend**	cm	+	Flexibility
2	**Standing long jump**	cm	+	Explosiveness, power of the lower limbs
3	**30 m running from a standing start**	sec	-	Velocity
4	**Pull-ups on a horizontal bar**	number	+	Strength endurance of upper limbs

A detailed description of the tests:

TEST 1. Forward bend (Figure 1)

Methodological guidance: The researched individual stands on a maximum 30 cm high bench or a box. His feet are next to each other; his knees are straight. He performs a forward bend by holding the body in a position of maximal bend for about 3 s. the achievement is measured with an accuracy of up to 1 cm (zero is the level of the bench, values lower than the level of the support are recorded with a positive sign, and values above the support – with a negative sign).

Necessary equipment: After the participant reaches the end position, a picture with a high resolution is taken from 1.5 m. The image enlargement option is used (Figure 1a) for a more accurate measurement.

The test provides information about the researched individual's flexibility.

Figure 1. *Forward bend in cm*

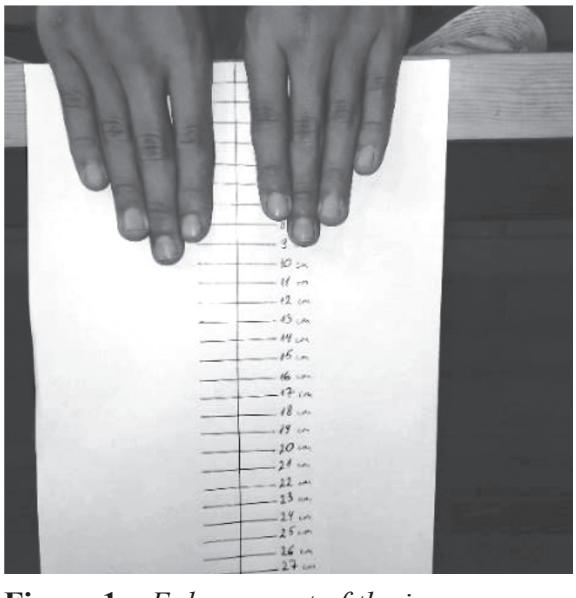


Figure 1a. *Enlargement of the image*

TEST 2. Standing long jump

Methodological guidance: Standing long jump (cm). The test is performed on a wrestling mat. Initial position – a standing start with arms forward-upward; feet are shoulder-width apart in one line. The individual lowers his body slightly and simultaneously swings his arms downward-backward (Figure 2). A swing with the arms downward-forward-upward follows, and then a jump with both legs (Figure 2b). the distance from the starting line to the last impression left by the jumper's feet is measured with an accuracy of up to 1 cm. Two attempts are made, and the best one is recorded. Necessary equipment: a meter, cones with a description of the meters (from 1 m to 3 m), and a video camera to enlarge the final result from the last impression and the way of measurement (Figure 2c). The test provides information about the explosive power of the lower limbs.

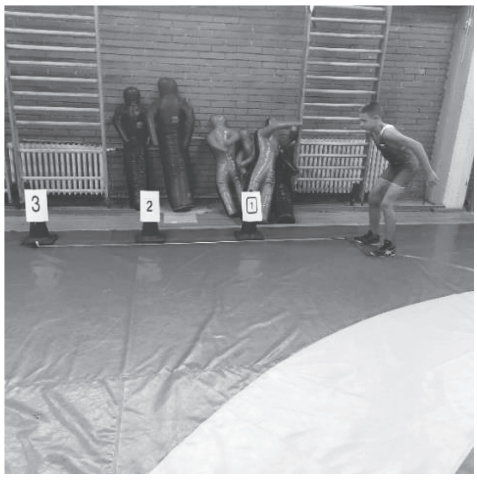


Figure 2. *Standing long jump*

Figure 2b. *Standing long jump – flying phase*

Figure 2c. *Measurement*

TEST 3. 30 m running from a standing start (Figure 3)

Methodological guidance: The test includes two dashes of 30 m performed from a standing start and after a complete recovery between the runs. The running time is recorded, and the best attempt is taken into consideration. It is measured with an accuracy of up to 0.01 s.

Necessary equipment: a stopwatch

The test provides information about the individual's speed.

Figure 3. *30 m running from a standing start*

TEST 4. Pull-ups on a horizontal bar (number) (Figure 4)

Methodological guidance: The individual hangs on the horizontal bar with an overgrip or a combined grip and pulls up and extends his arms until failure. Only the correctly executed pull-ups are counted – the ones with the chin going over the bar (Figure 4a).

Necessary equipment: a horizontal bar

The test provides information about the strength endurance of the upper limbs.

Figure 4. *Pull-ups on a horizontal bar*

Figure 4a. *Pull-ups on a horizontal bar*

Data analysis

The study results were subjected to mathematic-statistical processing with Microsoft Office Excel 2016 and IBM SPSS Statistics - v23). The following statistical methods were applied:

- Variation analysis
- Cohen's d size effect
- Kolmogorov-Smirnov Test and Shapiro-Wilk Test
- Student's *t*-test for two dependent and independent samples

RESULTS

The coefficient of variation V (Table 2) in two of the researched tests ("standing long jump" and "30 m running") varied from 8.04 to 11.58, which shows that the dispersion of the indicators was small, and the sample was homogeneous. In the test "forward bend", the coefficient of variation was (V=29.28), which indicates that the sample was relatively homogeneous. We should draw attention to the test "pull-ups on a horizontal bar", where (V = 79.58) and the sample is highly inhomogeneous.

Table 2. *Variation analysis and effect size correlations of U12 boys (research carried out in 2021)*

Test / Indicator	n	Min	Max	Mean	SD	V	As	Ex	Cohen's d	r (effect-size)
Forward bend 2021 U12	25	-10	17	4.2	1.23	29.28	-0.17	-1.40	4.83	.93
Long jump 2021 U12	25	151	192	173.6	13.9	8.04	-0.11	-1.44	17.66	.99
30 m running 2021 U12	25	4.8	6.88	5.684	0.66	11.58	0.23	-1.09	12.17	.99
Pull-ups 2021 U12	25	0	15	6.48	5.16	79.58	0.07	-1.28	1.77	.66

The characteristics of the condition of the rest quantitative variables are described below (Table 2).

Forward bend minimum value = -10 cm and maximum value = 17 cm. Mean value = 4.2 cm., Standard Deviation value = 1.23 cm. (M ± SD = 4.2 ± 1.23); Standing long jump (cm): minimum value = 151 cm and maximum value = 192 cm. Mean value = 173.6 cm., Standard Deviation value = 13.9 cm. (M ± SD = 173.6 ± 13.9); 30 m running from a standing start: minimum value = 4.80 sec and maximum value = 6.88 sec. Mean value = 5.68 sec., Standard Deviation value = 0.66 sec. (M ± SD = 5.68 ± 0.66) ; Pull-ups on a horizontal bar*:* minimum value = 0 and maximum value = 15. Mean value = 6.48, Standard Deviation value = 5.16 (M ± SD = 6.48 ± 5.16). The critical values of asymmetry (As) and excess (Ex) at n = 25 and a significance level $\alpha = 0.05$ are respectively As 0.05 = 0.927 and Ex 0.05 = 1.803. As we can see, the coefficients of asymmetry and excess for the four tests are below the critical values, which means that the values have a normal distribution.

In the size effect analysis, three indicators with large effect (Cohen's $d > 0.80$ and $r > .93$) stood out. Only for the Pull-ups indicator, the effect size is medium (Cohen's $d = 1.77$ and r above .66).

Results from the variation analysis of U13 boys (Table 3).

Table 3. *Variation analysis and effect size correlations of U13 boys (research carried out in 2021)*

Test / Indicator	n	Min	Max	Mean	SD	V	As	Ex	Cohen's d	r (effect-size)
Forward bend 2021 U13	32	-8	21	4.68	1.31	27.9	0.22	-1.07	5.05	0.93
Long jump 2021 U13	32	175	215	192.28	10.71	5.57	0.33	-1.02	25.39	0.99
30 m running 2021 U13	32	4.48	6.2	5.45	0.45	8.30	-0.10	-1.17	17.13	0.99
Pull-ups 2021 U13	32	0	20	15.05	10.27	68.2	-0.20	-1.67 *	2.07	0.72

The coefficient of variation V in two of the researched tests ("30 m running" and "standing long jump") varied from 5.57 to 8.30, which shows that the dispersion of the indicators is small and the sample is homogeneous. In the test "forward bend, the coefficient of variation was within the borders of (V=27.9), which shows that the sample was relatively homogeneous. Again, in the test "pull-ups from a horizontal bar", the coefficient of variation V was within a wide range of borders (V=68.24) or the sample was highly inhomogeneous. The characteristics of the condition of the rest quantitative variables are described below (Table 3):

Forward bend minimum value = -8 cm and maximum value = 21 cm. Mean value = 4.68 cm., Standard Deviation value = 1.31 cm. (M ± SD = 4.68 ± 1.31); Standing long jump (cm): minimum value = 175 cm and maximum value = 215 cm. Mean value = 192.28 cm., Standard Deviation value = 10.71 cm. (M ± SD = 192.28 ± 10.71); 30 m running from a standing start: minimum value = 4.48 sec and maximum value = 6.20 sec. Mean value = 5.45 sec., Standard Deviation value = 0.45 sec. (M ± SD = 5.45 ± 0.45) ; Pull-ups on a horizontal bar*:* minimum value = 0 and maximum value = 20. Mean value = 15.05, Standard Deviation value = 10.27 (M ± SD = 15.05 ± 10.27). The critical values of asymmetry (As) and excess (Ex) at n = 32 and a significance level α = 0.05 are respectively As 0.05 = 0.854 and Ex 0.05 = 1.665. As we can see, the coefficients of asymmetry and excess for the first three tests are below the critical values, which means that the values have a normal distribution. There is some positive excess observed in terms of "pull-ups from a horizontal bar" performance where the empirical value of the coefficient exceeds the critical one.

The U13 participants again showed a large size effect. (r > .72)

Results from the variation analysis of U14 boys (Table 4)

We should point out that in the tests "30 m running from a standing start" (V = 7.03) and "standing long jump" (V = 7.62), the group was homogeneous, and the test "forward bend" (V = 22.5) was with higher values of variation. The results from the other test "pull-ups on a horizontal bar" (V = 48.38), preserved their highly inhomogeneous values.

The characteristics of the condition of the rest quantitative variables showed the following values (Table 4):

Forward bend minimum value = -7 cm and maximum value = 21 cm. Mean value = 6.00 cm., Standard Deviation value = 1.35 cm. (M ± SD = 6.00 ± 1.35); Standing long jump (cm): minimum value = 177 cm and maximum value = 230 cm. Mean value = 195.45 cm., Standard Deviation value = 14.90 cm. (M ± SD = 195.45 ± 14.90); 30 m running from a standing start: minimum value = 4.60 sec and maximum value = 5.80 sec. Mean value = 5.21 sec., Standard Deviation value = 0.37 sec. (M ± SD = 5.21 ± 0.37) ; Pull-ups on a horizontal bar*:* minimum value = 2 and maximum value = 22. Mean value = 16.81, Standard Deviation value = 5.23 (M ± SD = 16.81 ± 5.23). The critical values of asymmetry (As) and excess (Ex) at n = 22 and a significance level α = 0.05 are respectively As 0.05 = 1.024 and Ex 0.05 = 1.985. As we can see, the coefficients of asymmetry and excess for all four tests are below the critical values, meaning the values have a normal distribution.

The U14 participants showed a large size effect. (r > .91)

Table 4. *Variation analysis and effect size correlations of U14 boys (research carried out in 2021)*

Test / Indicator	n	Min	Max	Mean	SD	V	As	Ex	Cohen's d	r (effect-size)
Forward bend 2021 U14	22	-7	21	6	1.35	22.5	0.23	-1.12	6.28	0.95
Long jump 2021 U14	22	177	230	195.45	14.90	7.62	0.68	-0.14	15.55	0.99
30 m running 2021 U14	22	4.6	5.8	5.21	0.37	7.03	-0.01	-1.07	19.91	0.99
Pull-ups 2021 U14	22	2	22	16.81	5.23	48.38	0.05	-1.84	4.55	0.91

The summary of the data from the analysis of the three researched groups (U12, U13, and U14) of boys found variability of some basic indicators characterizing the physical development of the basic motor qualities in wrestling. There was a decrease in the difference in the coefficient of variation in most physical indicators and an improvement in the mean values from U12 to U14 (Table 5). These results were primarily observed in the test "pull-ups on a horizontal bar" - V=79.58% for U12 progressively decreased in the following two groups - V=68.24% for U13 and V=48,38% for U12.

Table 5. *Differences in the coefficient of variation in the three groups of researched individuals*

Physical indicators	Coefficient of variation – V% U12	Coefficient of variation – V% U13	Coefficient of variation V% U14
Forward bend	29.28	27.9	22.5
Standing long jump	8.04	5.57	7.62
30 m running from a standing start	11.58	8.30	7.03
Pull-ups on a horizontal bar	79.58	68.24	48.38

There were three main groups of indicators in the three groups of researched individuals:

- indicators with low variability – "30 m running from standing start" and "standing long jump".

- an indicator with a relatively high variability – "forward bend".

- an indicator with a very high variability – "pull-ups on a horizontal bar".

This difference in the indicators is most probably due to the difference in the experience of the researched group and the category of the boys. There were competitors who had difficulties pulling up on a horizontal bar, which showed results in the heavier categories in the three researched groups (Table 6). In U12, the difference was the biggest. In the lighter categories of 27 kg, 32 kg, 35 kg, 38 kg to 42 kg (27 kg - 42 kg), the mean values were 13.23 repetitions. In the categories of 47 kg, 53 kg to 59 kg (47 kg – 59 kg), the mean values were 10.76 repetitions. In the heavy categories of 66 kg to 73 kg, the mean values were 2.65 repetitions.

Table 6. *Results from sports-pedagogical tests in categories*

Age	Categories (united) (kg)	Forward bend (cm)	Standing long jump (cm)	30 m running (sec)	Pull-ups on a horizontal bar (n)
U12	27 – 42	4.30	168.15	5.80	13.23
U12	47 – 59	4.53	174.28	5.75	10.76
U12	66 – 73	4.01	170.57	6.18	2.65
U13	29 - 47	7.53	188.33	5.40	16.11
U13	53 - 66	8.40	193.54	5.35	15.42
U13	73 – 85	6.75	189.26	5.75	4.26
U14	29 – 47	7.88	199.89	5.20	18.23
U14	53 – 66	8.76	205.45	5.10	17.15
U14	73 – 85	6.13	197.66	5.45	10.46

Comparative analysis – boys U13, surveys carried out in 2012 and 2021

Because of the great amount of work, we selected and analyzed the data only about the boys from the age group U13 from the surveys carried out in 2012 and 2021.

When we used Kolmogorov-Smirnov Test and Shapiro-Wilk Test, the normal distribution of the two groups of researched individuals was confirmed in tests 1, 2, and 3 (Table 7). For the test "Forward bend" - Kolmogorov-Smirnov - Sig = .2 > .05, Shapiro-Wilk Sig = .12 and .34 > .05. For the test "Standing long jump" - Kolmogorov-Smirnov - Sig = .2 > .05, Shapiro-Wilk Sig = .13 > .05. For the test "30 m running from a standing start" Kolmogorov-Smirnov - Sig = .2 > .05, Shapiro-Wilk Sig = .15 and .2 > .05. This allowed for applying Student's t-criterion for dependent samples so that we could check the work hypotheses. In the last test "Pull-ups on a horizontal bar", the normal distribution of the two groups of researched individuals was not confirmed - Kolmogorov-Smirnov - Sig = .001 < .05, Shapiro-Wilk Sig = .01 < .05. We used Student's t-criterion for independent samples to check the work hypothesis.

Table 7. *Kolmogorov-Smirnov Test and Shapiro-Wilk Test – U13/2012/2021*

	Kolmogorov-Smirnov			Shapiro-Wilk		
	s	n	α	s	n	α
Forward bend U13/2012	.093	32	.200*	.963	32	.336
Forward bend U13/2021	.102	32	.200*	.947	32	.120
Standing long jump U13/2012	.088	32	.200*	.948	32	.128
Standing long jump U13/2021	.108	32	.200*	.948	32	.127
30 m running from a standing start U13/2012	.085	32	.200*	.951	32	.151
30 m running from a standing start U13/2021	.103	32	.200*	.955	32	.202
Pull-ups on a horizontal bar U13/2012	.263	32	<.001	.801	32	<.001
Pull-ups on a horizontal bar U13/2021	.260	32	<.001	.818	32	<.001

Table 8 presents the data about the absolute increase *d* and the relative increase *d*% after the research done with wrestlers aged U13 in 2012 and 2021 for dependent samples, where X1 and X2 are the average achievements in the two surveys.

Table 8. *Statistical significance of the increase*

Indicator	n	U13/2021		U13/2012		Increase		Statistical significance	
		X1	S_1	X2	S_2	d	d%	Pt%	α
Forward bend	32	4.68	8.89	6.50	9.03	1.82	38.93	100	.000
Long jump	32	192.28	10.71	198.7	11.09	6.19	3.22	98	.002
30 m running	32	5.45	0.45	5.25	0.47	0.20	3.60	95	.009

The increase in the results which the wrestlers showed in the test "Forward bend" was d = 1.82 cm, (d% = 38.93%). The check with Student's t-criterion showed that the increase was statistically significant - Sig = .00 > .05, P(t) = 100%. There was a smaller increase in the results which the wrestlers showed in the test "Standing long jump" - *d* = 6.19 cm, (d% = 3.22%). The check with Student's t-criterion for dependent samples showed that the increase was also statistically significant - Sig = .002 > .05, P(t) = 98%. The increase in the results which the researched individuals showed in the test "30 m running from a standing start" was *d* = .20 sec, (d% = 3.60%). The check with Student's t-criterion for dependent samples showed that this increase was statistically significant - Sig = .009 > .05, P(t)=95%.

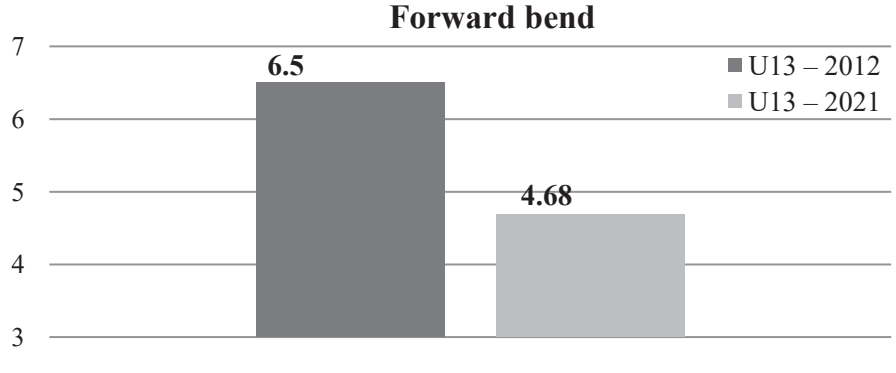
Table 9 presents the data from the test "Pull-ups on a horizontal bar". We used Student's *t*-criterion for independent samples to check the hypothesis. The results from the research showed that the mean value of the achievements of U13/2021 was 15.05, and the mean value of the achievements of U13/2012 was 17.50. The difference of d = 2.45 is statistically significant because the achieved significance level is less than 0.05 (α = .017).

Table 9. *Statistical significance of the differences between the two groups*

Indicator	U13/2021			U13/2012			Difference	Statistical significance	
	n_1	X1	S_1	n_2	X2	S_2	d	t_{emp}	α
Pull-ups on a horizontal bar	32	15.05	3.27	20	17.50	2.95	2.45	2.490	.017

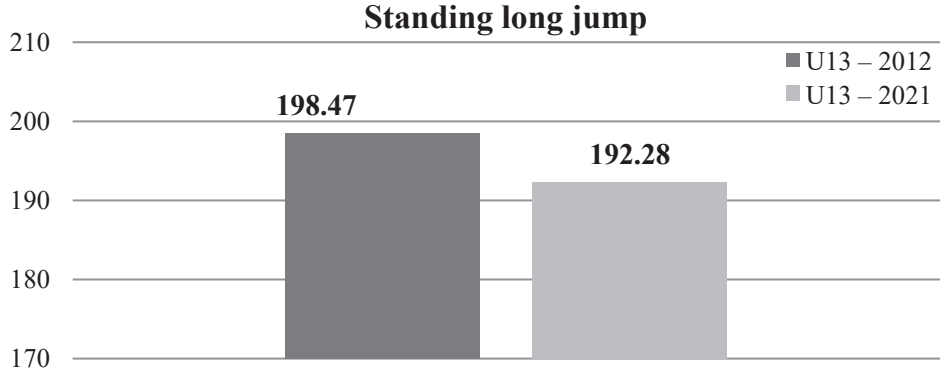
Figures 5, 6, 7, and 8 show the results from the four tests at $\alpha \leq .05$ or P/%/>95, which showed statistically significant differences.

Figure 5 shows the results from the test "Forward bend". X1 – the average level of the results obtained by U13 in the survey carried out in 2012 was 6.5 cm; X2 – the average level of the results obtained by U13 in the survey carried out in 2021 was 4.68 cm.



Figures 5. *Comparative analysis of the mean values in the two surveys*

Figure 6 shows the results from the test "Standing long jump". X1 – the average level of the results obtained by U13 in the survey carried out in 2012 was 198.47 cm; X2 – the average level of the results obtained by U13 in the survey carried out in 2021 was 192.28 cm.



Figures 6. *Comparative analysis of the mean values in the two surveys*

Figure 7 shows the results from the test "30 m running from a standing start". X1 – the average level of the results obtained by U13 in the survey carried out in 2012 was 5.25 sec; X2 – the average level of the results obtained by U13 in the survey carried out in 2021 was 5.45 sec.

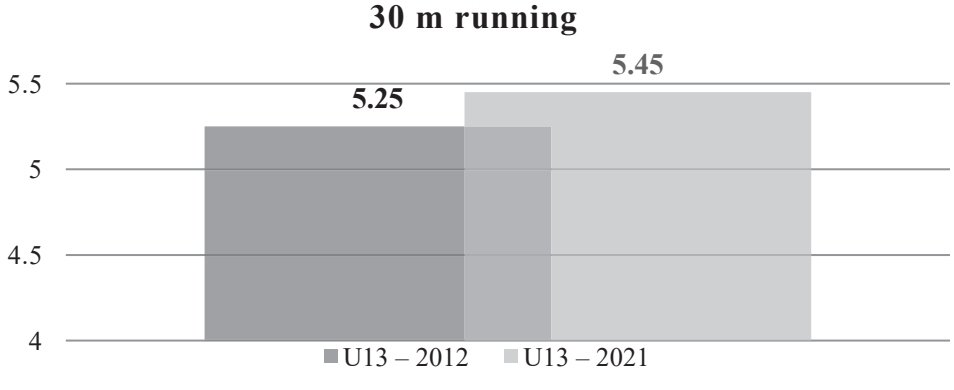


Figure 7. *Comparative analysis of the mean values in the two surveys*

The results from the comparative analysis of independent samples are visualized in Figure 8, which shows the results from the test "Pull-ups on a horizontal bar". X1 – the average level of the results obtained by U13 in the survey carried out in 2012 was 17.5 reps; X2 – the average level of the results obtained by U13 in the survey carried out in 2021 was 15.05 reps.

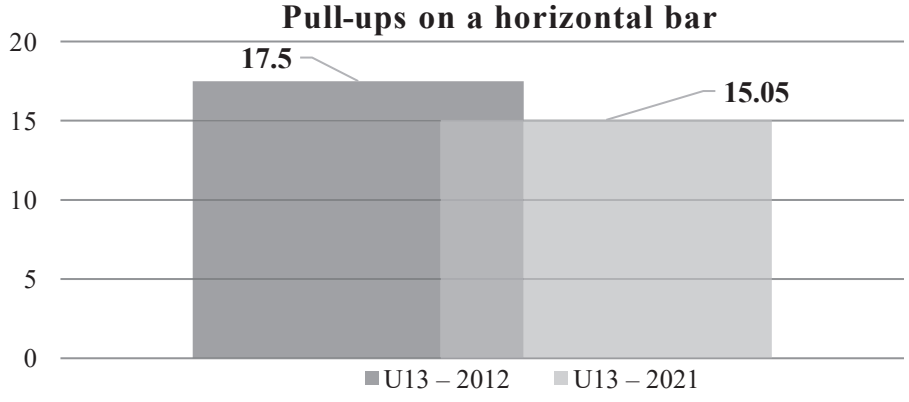


Figure 8. *Comparative analysis of the mean values of the two groups*

After the statistical processing, the data summary showed that the guaranteed probability (in the four tests) at a significance level $\alpha \leq .05$ or P/%/>95 rejected the zero hypothesis and accepted the alternative hypothesis. The difference in the achievements in all four tests has to be noted; the evaluation is lowered, which confirms the hypothesis that the results from the survey held in 2021 would be lower than those obtained ten years ago – in 2012.

DISCUSSION

In the studied group, there were wrestler competitors with the ability to demonstrate the sports-pedagogical tests at a very high level. At the same time, however, there were wrestlers who experienced serious difficulties pulling up on a horizontal bar which showed results. This difference in the indicators is most probably due to the difference in the experience of the researched group and the category of the boys.

Modern wrestling development sets up high requirements for coaches and young competitors. The issue related to the Basic Motor Qualities is an important area from the perspective of maximizing sports performance. The central consideration lies in the physical development of adolescent wrestling competitors. The research methods as sports-pedagogical tests are specific to wrestling and are used for evaluation of the motor qualities both in the national teams and in wrestling sports clubs. They are required for the execution of effective control on the growing up wrestler competitors. The theoretical analysis of the specialized literature and the opinions of Olympic, World, and European wrestling champions is invaluable information. In this sense, the presented data can help trainers and researchers to designate new methods, forms, and means of training. Sports-pedagogical research has a significant share of revealing different perceptions and searches which optimize the preparation of elite wrestlers. This scientific model helps develop working schemes for evaluating the physical qualities of adolescent wrestlers. A critical moment is the complex evaluation of wrestlers' preparation, which perfects the management system with the creation of apparatus methods and a summarized assessment of the indicators for the physical, technical, and tactical preparation of wrestlers (Stanev & Kirov, 1988). Audiovisual influence is among the newest apparatus methods for the influence of the psychic and physiological functions of the organism. It can lead both to relaxation and to an increase in the activation and improvement of athletes' sports performance (Domuschieva-Rogleva, Georgiev, Iancheva, 2015). The use of sports-pedagogical testing, which comprises tests – easily accessible to all age groups, is necessary for exercising efficient

control of adolescent wrestlers. In a survey by Chamishki (Chamishki, 2022a), he found that the requirements for the excellent evaluation of the physical qualities of students – wrestlers in the category 55 kg reduced with the years. He compared the data from sports-pedagogical tests from 2002, 2012, and 2020. He concluded that each change in the normative tests led to an easier way to obtain a better mark from the test. A study of judokas again related to weight category shows that higher lean body mass generated more elevated levels of strength. Still, it was accompanied by a lower level of endurance. Therefore, in training all tested levels, attention should be paid to developing this motor ability (Witkowski, Superson, Piepiora, 2021). Makaveev made an interesting analysis of the physical qualities of the most elite wrestlers from the recent past and present (Makaveev, 2016). He compared the control norms of the golden generation of Bulgarian wrestling with nowadays generation and found that the present level was significantly lower. According to the author, this could be because of the severe inner competition in the past or, more probably, because of the substantially higher training load. If we look at the picture in some of the other sports, we will see that in research held by Tsurova and Borukova in 2012/2015 among male and female basketball players aged 12-16 years, the authors found that nowadays competitors of all ages groups had much lower results compared to previous generations. They believed that the trend was toward a yearly reduction in the results (Borukova, 2018). Many research reports confirm that regular sports training stimulates the development of physical fitness of children and adolescents. (Witkowski, Piepiora, Migasiewicz, Maslinski, Salachna, 2018). The same researchers compared people at the age of 13-14 who are non-training sports and others practicing Greco-Roman wrestling that there are significant differences in the level of physical fitness between the wrestling group (positive results) and the school youth group.

CONCLUSION

The analysis of the data enables us to divide the three groups of researched individuals into three main groups of indicators: indicators with low variability – "30 m running from a standing start" and "standing long jump"; indicators with a relatively high variability – "forward bend"; indicators with a very high variability – "pull-ups on a horizontal bar". In all test indicators, the mean arithmetical value of the observed results changes in the direction of their increase. However, this does not mean that the measured achievement is positive. On the contrary – the reason for this difference is in a negative aspect, which is not something to be proud of. We confirmed the hypothesis that the final results after the surveys held in 2021 would be lower than those obtained in 2012.

After the interviews held with wrestling coaches and specialists, we arrived at the conclusion that the preparatory wrestling groups where some of the children train from an early age (about 6-8 years) have a strong influence on the differences in the results of some of the boys in all four tests. Those who started practicing wrestling at a young age have progressively better results. This group of researched individuals recommends that preparatory wrestling groups should be created in every club and, if possible, in every school. Moreover, a change in the methods of preparation is recommended, and the main emphasis is on increasing the training load with specific wrestling means by a gradual increase in the dosage of the load according to the principles and specifics of the adolescents.

The obtained data are interesting for the specialists because they enrich training methods with new facts, which are essential for

increasing the efficiency of sports preparation both in sports clubs and in national teams.

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