



ORIGINAL SCIENTIFIC ARTICLE

DETERMINATION OF MODEL CHARACTERISTICS AND EVALUATION CRITERIA FOR STRENGTH TRAINING OF QUALIFIED ARMWRESTLING STUDENT-ATHLETES

Dmytro Bezkorovainyi^{1ABCD}, Oleg Kamayev^{2ABC}, Stanislav Vlasko^{1BDE},
Leonid Plotnyskyi^{3ABE} and Irina Sadovska^{1BD}

¹O. M. Beketov National University of Urban Economy in Kharkiv

²Kharkiv State Academy of Physical Culture

³Kharkiv National University of Civil Engineering and Architecture

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Corresponding Author: Dmytro Bezkorovainyi, E-mail: bezkor@ua.fm

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Abstract

Research purpose. The aim of the study was to determine the model indicators of strength readiness of qualified armwrestling student-athletes in the weight category from 80 to 100 kg in 4 strength exercises: flexion of the fingers, stretch with a hammer, hook and bending of the hand.

Materials and Methods. The study involved 16 qualified armwrestling student-athletes weighing from 80 to 100 kg ($M = 86,63$ kg), 7 of which are participants of national championships of Ukraine, and 9 of which are prize-winners of competitions of regional level. During the study, strength indicators were determined in 4 competitive exercises. Strength indices in all test exercises were measured in a static mode by an FB5k series digital force gauge (Poland) with an accuracy class of up to 100 g, which was mounted on a special armwrestling table using a specially made block device. The created design was called the "ARM1 Device" (patent 43082). During the statistical analysis, the following parameters were calculated: arithmetic mean (M), standard deviation (σ), error of representativeness (m) and the coefficient of variation (V).

Results. The analysis of the strength capabilities of the qualified student-armwrestlers and the presented models of their strength readiness made it possible to develop assessment criteria for the level of strength readiness of the qualified student-armwrestlers. Three levels of strength readiness have been identified: low ($M - \sigma$), high ($M + \sigma$) and medium, i.e. more than ($M - \sigma$) but less than ($M + \sigma$). Comparative analysis of the ratios of different levels of strength training in this group of armwrestling athletes allowed to determine from 128 indicators of strength 14.84% ($n = 19$) of low level, 62.50% ($n = 80$) of medium level and 22.66% ($n = 29$) of high level.

Conclusions. The study made it possible to establish the features of the levels of development of strength training of qualified armwrestling athletes weighing from 80 to 100 kg. The model indicators of strength training of qualified armwrestlers were also determined. The analysis found that the subject athletes have an insufficient level of strength training and are not fully realized in terms of strength capabilities (62.50% indicators of the average level of strength).

Keywords: armsport, armwrestling, student-armwrestlers, model characteristics, power indicators.

Introduction

Armwrestling according to the analysis of the fulfillment of competitive exercises belongs to the group of sports of a speed-strength nature. The structure of competitive

movements and the value of overcoming the opponent's resistance indicate the need for the manifestation of maximum dynamic, and with an increase in resistance from the opponent, static efforts (Ahamed et al., 2013; Ilyushina, 2008).

The nature of dynamic efforts when overcoming resistances can be different: explosive, fast, slow. Explosive strength is characterized by the fact that overcoming resistances that do not reach the limit values is performed with maximum acceleration.

The fast nature of efforts, or fast force, manifests itself during overcoming resistances that do not reach their limit values with acceleration below the maximum. The slow nature of efforts, or slow force, manifests itself during overcoming boundary resistances at a constant speed (Kamayev et al., 2013).

It is important to distinguish that explosive strength is manifested only with overcoming muscle work. Rapid strength is manifested in both overcoming and yielding movements. Also during their combination. Slow strength is manifested during overcoming or yielding muscle work (Karakurt & Aggon, 2018). During the manifestation of slow force, the duration of the limiting stresses is greater than during the manifestation of explosive force.

The practice of sports and special studies indicate that there is no direct connection between the levels of development of certain types of dynamic and static strength (Burdukiewicz et al., 2018). Research results have shown that high static force does not provide for the possibility of its rapid manifestation (Mazurenko, 2019). Comparison of individual indices of manifestation of static and dynamic strength indicates that there is no direct connection between the level of development of certain types of muscle strength in athletes. Thus, from a methodological point of view, this means that the effective development of any kind of strength in the training of qualified athletes involves the use of a specialized methodology (Gibadullin et al., 2014). In this regard, the determination of the ability to show strength capabilities in various strength exercises allows you to effectively control and correct the training process for the development of strength.

Several studies (Bezkorovainyi, 2013; Podrigalo et al., 2017, 2019) determine the structural orientation of special strength training, respectively, thereby determining the structure of the special strength development of armwrestlers. The results of the study show that the structure of special strength training ensures the predominant development of specific muscle groups. Structurality also contributes to technical improvement, which in turn helps to increase the magnitude of the manifestation of strength.

It was found that qualified armwrestling athletes have a relatively equally high level of technical readiness. Therefore, the result of the fight will mainly depend on the level of strength readiness (Matyushenko, 2020, 2022; Nikulin et al., 2021; Podrihalo et al., 2020).

In the armwrestling technique, the main element is the attack phase, the purpose of which is to achieve quick superiority over the opponent. According to Zhivora & Rakhmatov (2001), there are three main methods of attack: top attack, hook attack and push attack. A questionnaire survey of specialists and research by Bezkorovainyi (2013) showed that highly qualified athletes use hook attack in 55% of cases, top roll attack in 40% and push attack in 5%. It was found that when performing a hook attack, the greatest load is applied to the flexors of the hand and forearm. Top roll attack requires excessive flexor force of the fingers and hand. During the push attack, the greatest load falls on the elbow joint and fingers. Usanov & Chuglina (2010) classified the fourth method of attack – a side attack. During this technique, a great deal of stress falls on the flexors of the hand.

In connection with the above, four strength exercises were selected as test indicators: flexion of the fingers, stretch with a hammer, hook and bending the hand. These exercises

were chosen to determine the level of strength readiness of qualified student-armwrestlers.

Materials and methods

Study participants

The study involved 16 qualified armwrestling student-athletes of 2-5 courses who studied at O.M. Beketov National University of Urban Economy in Kharkiv and Kharkiv National University of Civil Engineering and Architecture weighing from 80 to 100 kg ($m = 86,63$ kg), 7 athletes from which are participants of national championships of Ukraine, 9 – prize-winners of competitions of regional level.

Study organization

Measurements of strength indicators were carried out in the study group of participants one week after the end of the regional competitions. Within 4 days, one competitive movement of each athlete was measured, the order of the participants was determined by lot, which created a competitive effect.

Strength indices in all test exercises were measured with an FB5k series electrical tenzodynamometer (Poland) with an accuracy class of up to 100 g, which was fixed on a specialized armwrestling table using a specially made block device. The created design was called the “ARM1 Device” (patent #43082).

During the measurement of the strength of the muscles of the hands, the subject became facing the table, grabbed the device holders with his hand and squeezed them with maximum force, without tearing the elbow of the working arm from the table. The distance between the holders of the device easily changed and was selected individually for each subject.

The special computer program AXIS FM made it possible to process the measurement data in real time (on-line) and the previously collected data from the memory of the electrical tenzodynamometer (of-line). AXIS FM is compatible with the operating systems Windows XP, Vista, Windows 7.

Statistical analysis

Statistical analysis of the obtained data was carried out using the licensed program STATISTICA 10. Statistical analysis calculated the following parameters: arithmetic mean (M), standard deviation (σ), error of representativeness (m) and the coefficient of variation (V). On the basis of the obtained digital data, three levels of strength readiness were determined: low, medium and high.

Results

A comparative analysis of certain test exercises shows that most arm athletes do not accidentally use a hook attack during competitions. Because in all weight categories in this exercise, athletes show the highest strength in comparison with the data of other strength exercises (Table 1).

Analysis of the results of the study shows that the strength of the right hand is on average better than the strength of the

Table 1. Model indicators of strength training of qualified armwrestling athletes (n = 16; M = 86.63 kg)

Indicator	left arm				right arm			
	M	m	σ	V	M	m	σ	V
Flexion of fingers (kg)	42.78	0.95	3.80	8.90	44.33	1.31	5.24	11.82
Stretch with a hammer (kg)	49.99	1.10	4.40	8.80	51.19	1.25	5.00	9.76
Hook (kg)	53.16	1.30	5.20	9.63	54.51	1.40	5.60	1,27
Bending the hand (kg)	54.94	1.21	4.84	8.80	56.61	1.01	4.04	7.13
Total strength of the hands (kg)	200.87				206.64			
General indicator of arm strength (kg)					407.51			
Indicator of variability (%) V					36.13			
$\Sigma V, \%$					75.11			

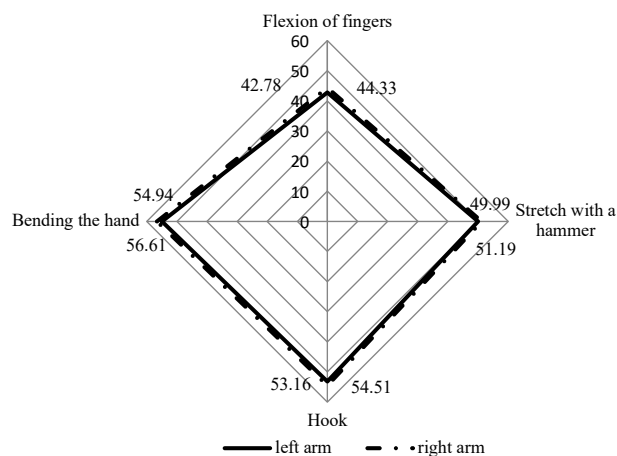
left by 2.87% (the difference ranges from 1.20 to 1.67 kg). The highest indicators of strength were registered in the test exercise of bending the hand: with the left hand – 54.94 kg, with the right – 56.61 kg (Table 1; Fig. 1). The strength of the left hand ranges from 42.87 to 54.94 kg, the right – from 44.33 to 56.16 kg. The coefficient of variation (V) or digital display of variability of left arm strength indicators indicates the homogeneity of the obtained results ($V = 8.81\text{--}9.63\%$).

Data on the strength capabilities of the right hand indicate increased variability in test results ($V = 10.27\%; 11.82\%$), in addition to data on flexion of the hand ($V = 7.13\%$).

The analysis of strength capabilities of qualified armwrestling athletes and the presented models of their strength

Table 2. Evaluation criteria for the level of strength training of qualified armwrestling athletes (n = 16; M = 86.63)

Arm	Low level (kg)	Medium level (kg)	High level (kg)
Flexion of fingers			
left	< 38.98	39.98 – 46.58	> 46.58
right	< 39.09	39.09 – 49.57	> 49.57
Stretch with a hammer			
left	< 45.59	45.59 – 54.39	> 54.39
right	< 46.19	46.19 – 56.19	> 56.19
Hook			
left	< 47.96	47.96 – 58.36	> 58.36
right	< 48.91	48.91 – 60.11	> 60.11
Bending the hand			
left	< 50.10	50.10 – 59.78	> 59.78
right	< 52.57	52.57 – 60.65	> 60.65

**Figure 1.** Model characteristics of the power capabilities of qualified armwrestling athletes

training made it possible to develop assessment criteria for the level of strength training of armwrestlers of average qualification (Table 2). Three levels of strength training are determined: low ($M - \sigma$), high ($M + \sigma$) and medium – more ($M - \sigma$), but less ($M + \sigma$).

Comparative analysis of the ratios of different levels of strength training in this group of arm athletes allowed to determine from 128 indicators of strength 14.84% ($n = 19$) low level, 62.50 % medium ($n = 80$) and 22.66% high ($n = 29$) levels (Table 3). Out of 16 athletes, only one participant in the experiment performed all eight test exercises at a high level. In all other athletes, the figures fluctuate in all three levels.

Table 3. Ratios of strength readiness levels of qualified armwrestling athletes (n = 16; M = 86.63)

Level	Flexion of fingers		Stretch with a hammer		Hook		Bending the hand		$\Sigma, \text{un.}$	$\Sigma, \%$
	left	right	left	right	left	right	left	right		
low	3	3	2	3	1	3	2	2	19	14,84
medium	9	10	10	10	10	9	10	12	80	62,50
high	4	3	4	4	5	4	4	2	29	22,66

The range of indicators of medium strength in this group ranges from 19.30% to 28.34% and is 62.50% of the total. This result proves that this indicator fully characterizes the overall level of training of qualified arm athletes.

Discussion

Arm wrestling refers to sports in which performance directly depends on the level of strength readiness, in particular, the development of arm strength. It was confirmed that the main predictions of success in hand wrestling include: muscle development, physical strength, the value of conditional moments of strength of limb segments Podrihalo et al. (2020). Strength fitness in many sports is used as criteria for assessing the physical fitness of athletes (Burdukiewicz et al., 2018; Karakurt & Aggon (2018). In arm wrestling, according to Voronkov et al. (2014), the strength component is of decisive importance in highly qualified athletes in competitive exercises.

Confirmed data based on the use of ergonomic approaches by the authors of Podrigalo et al. (2010) that high-level arm wrestlers have a significantly higher indicator of hand strength, hand flexion, forearm muscle strength, arm pronation and supination.

Kamayev et al. (2020, 2021) investigated model indicators of arm wrestlers of the highest qualification of three weight categories: to 80 kg, from 80 to 100 kg and over 100 kg. So, at qualified arm wrestlers of a weight category from 80 to 100 kg power indicators of the right hand in comparison with data of the left are identical with data of highly skilled, namely it is better, but less expressively. Thus, the difference in highly qualified arm wrestlers was 12.47%, and in the group of arm athletes we studied only 5.77%.

The studied athletes achieved higher results in the exercise of bending the hand, and highly qualified in the right hook. This condition is not accidental. Given that the hook exercise is of great importance in competitive activities, athletes of medium level of qualification should provide in the training program emphasis on the method of developing the strength capabilities of the hook exercise.

The range of indicators of medium strength in the study group is 62.50% of the total. This result proves that this indicator fully characterizes the overall level of training of athletes, because the highly qualified arm athletes weighing from 80 to 100 kg, the number of indicators of the average level of strength training was 65.50%.

Hand strength indicators are the most important in hand wrestling. All athletes are characterized by high results of hand power indices, and the higher the results of these indices, the higher the success of competitive activity. Similar data are provided by Rovnaya et al. (2019). The results of Akpina et al. (2013) also confirm that the indicators of arm muscle strength is an important predictor of success in arm wrestling (Rovnaya et al., 2019).

Victory largely depends on the athlete's ability to squeeze the opponent's hand as much as possible. This technique was used by Iermakov et al. (2016) to predict success in martial arts.

Conclusions

The study made it possible to establish the features of the levels of development of strength training of qualified arm wrestling athletes weighing from 80 to 100 kg. Model

indicators of strength training of qualified arm athletes are also determined. The analysis revealed that the studied athletes have an insufficient level of strength training and are not fully realized in terms of strength capabilities (62.50% of the average level of strength). It is obvious that athletes at this stage of preparation need to pay maximum attention to the development of strength indicators.

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Conflict of interest

The authors declare no conflict of interest.

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ВИЗНАЧЕННЯ МОДЕЛЬНИХ ПОКАЗНИКІВ Й ОЦІНОЧНИХ КРИТЕРІЇВ СИЛОВОЇ ПІДГОТОВЛЕНOSTІ КВАЛІФІКОВАНИХ СТУДЕНТІВ-АРМРЕСТЛЕРІВ

Дмитро Безкоровайний^{1ABCD}, Олег Камаєв^{2ABC}, Станіслав Власко^{1BDE}, Леонід Плотницький^{3ABE}, Ірина Садовська^{1BD}

¹Харківський національний університет міського господарства імені О. М. Бекетова

²Харківська державна академія фізичної культури

³Харківський національний університет будівництва та архітектури

Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 6 с., 3 табл., 1 рис., 23 джерела.

Метою дослідження було визначення модельних показників силової підготовленості кваліфікованих студентів-спортсменів з армрестлінгу вагової категорії від 80 до 100 кг у чотирьох силових вправах: згинання пальців, згинання молотком, гак та згинання кисті.

Матеріали та методи. У дослідженні взяло участь 16 кваліфікованих студентів-спортсменів з армрестлінгу

вагою від 80 до 100 кг (M = 86,63 кг), 7 спортсменів з яких є учасниками національних чемпіонатів України, 9 – призерами змагань обласного рівня. Під час дослідження визначали силові показники у 4 змагальних вправах. Показники сили у всіх тестових вправах вимірювалися в статичному режимі електричним тензодинамометром серії FB5k (Польща) з класом точності до 100 г, який закріплювався

на спеціальному столі для армрестлінгу за допомогою спеціально виготовленого блочного приладу. Створений прибор отримав назву «Пристрій ARM1» (патент № 43082). Під час статистичного аналізу були розраховані такі параметри: середнє арифметичне (M), стандартне відхилення (σ), похибка репрезентативності (m) та коефіцієнт варіації (V).

Результати. Аналіз силових можливостей кваліфікованих студентів-армрестлерів та представлені моделі їхньої силової підготовленості дозволили розробити критерії оцінювання рівня силової підготовленості кваліфікованих студентів-армрестлерів. Визначено три рівні силової підготовленості: низький ($M - \sigma$), високий ($M + \sigma$) і середній – більший ($M - \sigma$), але менший ($M + \sigma$). Порівняльний аналіз співвідношення різних рівнів силової підготовки у

цій групі спортсменів з армрестлінгу дозволив визначити із 128 показників сили 14,84 % ($n = 19$) низький рівень, 62,50 % середній ($n = 80$) і 22,66 % високий ($n = 29$) рівні.

Висновки. Дослідження дозволило встановити особливості рівнів розвитку силової підготовленості кваліфікованих студентів-спортсменів з армрестлінгу вагою від 80 до 100 кг. Визначено модельні показники силової підготовленості кваліфікованих армрестлерів. Аналіз виявив, що досліджувана група спортсменів має недостатній рівень силової підготовленості та не повністю реалізована за силовими можливостями (62,50 % показників середнього рівня сили).

Ключові слова: армспорт, армрестлінг, студенти-армрестлери, модельні характеристики, силові показники.

Information about the authors:

Bezkorovainyi Dmytro: Dmytro.Bezkorovainiy@kname.edu.ua; <https://orcid.org/0000-0001-9719-6131>; Department of Physical Education and Sports; O. M. Beketov National University of Urban Economy in Kharkiv, Marshal Bazhanov St, 17, Kharkiv, 61002, Ukraine.

Kamayev Oleg: kamaevoi45@gmail.com; <https://orcid.org/0000-0001-6307-1007>; Department of Olympic and Professional Sports; Kharkiv State Academy of Physical Culture, Klochkivska St, 99, Kharkiv, 61022, Ukraine.

Vlasko Stanislav: Stanislav.Vlasko@kname.edu.ua; <https://orcid.org/0000-0001-8505-8452>; Department of Physical Education and Sports; O. M. Beketov National University of Urban Economy in Kharkiv, Marshal Bazhanov St, 17, Kharkiv, 61002, Ukraine.

Plotnytskyi Leonid: ernm@ukr.net; <https://orcid.org/0000-0003-4218-4023>; Department of Physical Education and Sports; Kharkiv National University of Civil Engineering and Architecture, Sumska St, 40, Kharkiv, 61002, Ukraine.

Sadovska Irina: Irina.Sadovska@kname.edu.ua; <https://orcid.org/0000-0002-0324-2377>; Department of Physical Education and Sports; O. M. Beketov National University of Urban Economy in Kharkiv, Marshal Bazhanov St, 17, Kharkiv, 61002, Ukraine.

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