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Evaluation of training load volume in weightlifting

Bayazitov Kamil Faritovich[1]
[1]Uzbek state university of physical education and sport, Chirchik, Uzbekistan

Abstract
Aim: Development and theoretical and experimental substantiation of a new method of training load volume's evaluation in weightlifting, which would allow in a certain period of time to get more available, reliable and detailed information about specific work of various qualified weightlifters.
Methods: Retrospective analysis of the applied methods of training load volume's evaluation in weightlifting, applied pedagogical experiment, methods of mathematical statistics (arithmetic average, arithmetic average error, correlation analysis).
Results: Indicator of training load volume's concentration increases along with increasing athlete's qualification: on the beginning stage – 8.8±0.7; training stage – 9.7±0.9; on the stage of sports skills performance – 10.1±1.3; on the stage of highest sports skills performance – 11.8±1.4 amount of barbell lifts per min.
Conclusion: For further development of the method of training load volume's evaluation in weightlifting the author developed and substantiated in his experiment the new method of evaluation with the calculation of training load volume's concentration (TLVC). The author has experimentally proved that TLVC is one of the most accessible, reliable and informative method for training load volume's evaluation in weightlifting.

Keywords: Weightlifters, volume of training load, training load volume's concentration, weightlifter's training stages, snatch, clean and jerk.

Introduction

"Training load" term refers to additional functional body activity (relative to the rest level or other initial level), introduced by the performance of training exercises, and overcoming degree of difficulties (Matveev, 1977). One of the main parameters in weightlifting training load (WTL) is the training load volume (Dvorkin, 2020; Garcia-Ramos et al., 2019, Sivokhin et al., 2020).

In weightlifting currently, the volume of WTL is calculated by tonnage – the sum of the lifted kilograms, the number of training exercises, NBL – the number of barbell lifts, NBL in the intensity zones. There are three values of training load volume for planning, low volume, moderate volume and high volume. Depending on the level of different athletes' preparedness, the absolute values of load volumes are different for them. Low volume of load is – up to 50% from the maximum volume (for each weightlifter), moderate volume is – from 50 to 70%, high volume is – from 70 to 90%, and maximum volume – more than 90% (Dvorkin, 2020). In weightlifting the issue of training load volume evaluation has been studied by many specialists (Arzikulov, 2020; Matkarimov, et al., 2019; Chernyak, 1978). Earlier, as an evaluation criterion for load in individual exercises was proposed to use the amount of lifted kilograms, then physical workload in kilogram meters (Chernyak, 1978).

As an example, using these criteria, the load in a separate exercise was evaluated in the following way: with a half-squat in a snatch, where the following barbell weights were lifted: 70 x 2, 80 x 2, 90 x 2 and 100x1. The sum of the lifted kilograms (tonnage) is equal to 70x2 + 80x2 + 90x2 + 100 = 580 kg (0.58 t). Suppose that the height to which the barbell was lifted in this exercise was 1.5 m. From an elementary course of mechanics, we know that F = P x L, where F is the workload (kgm), P – is the load's weight (kg), L – is the height to which the barbell was lifted (m). When the barbell is lifted to the height of 1.5 m, spent workload on it is 580 kg x 1.5 m = 870 kgm, or 0.87 tm (kilograms converted to ton) (Dvorkin, 2005).

Later, the tonnage volume evaluating method was proposed – this indicator represent itself the amount of kilograms lifted by a weightlifter. The most common volume evaluating method of WTL is NBL (Medvedev, 1986).

Further study of the WTL volume evaluating issue is one of the main parameters of the training load and it can be a significant reserve for management improving of the weightlifters training process, as well as the growth of their sports achievements. All above mentioned are prompted the author of this work to develop the more effective WTL volume evaluating method. The author proposed to add a new method – training load volumes concentration (TLVC) to the list of WTL volume evaluating methods.

The aim of this scientific work is to develop and theoretically and experimentally substantiate a new method of training load volumes concentration (TLVC) which would allow more

accessibly, reliably and informatively evaluate the specific workload done by various qualified weightlifters in a certain period of time.

Training load volume concentration is the volume of the training load performed in a certain period of time. The calculation of this parameter is made according to the following formula:

$$\gamma = \frac{V_{NBL}}{t};$$

Where γ is training load volume concentration, V_{NBL} is the volume according to the number of barbell lifts, t – is the time.

Materials and methods

An applied research has been taken to determine TLVC in various qualified weightlifters with the aim of scientifically substantiation the effectiveness of the developed WTL volume evaluating method. Qualified, highly qualified and international level weightlifters of Uzbekistan in amount of 126 took part in the experiment. The quantitative compositions of the tested weightlifters on the long-term sports training stages looked as follows: the basic training stage (BTS) – 48 athletes, the medium training stage (MTS) – 32, the highest training stage (HTS) – 27 and the highest sportsmanship stage (HSS) – 19. To calculate the TLVC, we also analyzed the training diaries of the weightlifters who took part in the research. The volume of the WTL was analyzed over a two-month period in preparation for the main season competitions.

In order to determine the interrelationship between TLVC indicators and sports result, was carried out a pair correlation analysis "TLVC ↔ snatch", "TLVC ↔ clean and jerk" and "TLVC ↔ total".

During a two-month period, all weightlifters were tested 5 times – the snatch indicators, clean and jerk and the total results were recorded:

I test - before to start the study;

II-IV tests – intermediate (after two weeks on the trainings closed to competitions);

V test – according to the main competitions results of the season. All results shown by weightlifters were subjected to correlation analysis with the developed TLVC.

To equalize weightlifters results in various weight categories, coefficients table of Sinclair (CTS) was applied, where calculation was made in scores.

Results and discussion

During a two-month preparation for the main competitions of the season, the volume of WTL was studied in NBL, which indicated in the training diaries of weightlifters, and the time of the exercise was recorded without taking into account the rest time, namely motor training time. According to the formula presented above, the TLVC was calculated.

Table 1. The volumes of a two-month training load of weightlifters on the various stages of long-term training.

Sports training stages	Training load volumes					
	NBL (times)		Time (min.)		TLVC (times per min.)	
	X	±m	X	±m	X	±m
BTS	1659	±136	188.1	±12.6	8.8	±0.7
MTS	1836	±157	189.7	±14.9	9.7	±0.9
HTS	2358	±175	216.2	±17.6	10.1	±1.3
HSS	2864	±234	243.4	±21.4	11.8	±1.4

The volumes of a two-month training load of weightlifters on the various stages of long-term training presented in Table 1.

The BTS weightlifters mastered the training load on average 1659 ± 136 NBL, to perform training exercises they spent 188.1±12.6 minutes. TLVC among weightlifters of basic training stage was 8.8±0.7 times per minute.

Within two months MTS weightlifters performed workload in amount of 1836±157 NBL, which was finished in 189.7±14.9 minutes. The calculation of TLVC was 9.7±0.9 NBL per min. HTS weightlifters in the period of preparation for the main season competitions within two months completed the WTL volume in 2358±175 NBL and spent for training exercises 216.2±17.6 min, with the TLVC in 10.1±1.3 NBL per min. According to the training diaries, highly qualified weightlifters performed training workload in two months with a volume of 2864±234 NBL, and performed all exercises within 243.4±21.4 minutes. The TLVC indicator was 11.8±1.4 bar lifts per minute.

According to the data in Table 1 the TLVC indicator increases along with the growth of weightlifters training qualification: on the basic training stage – 8.8±0.7; medium training stage – 9.7±0.9; high training stage – 10.1±1.3; the highest sportsmanship stage – 11.8±1.4 NBL per minute. This testifies that the results of TLVC evaluation directly depend on the weightlifters results and this evaluation method can be used for training load volume measuring at various stages of long-term training.

In the Table 2 represented five tests data of weightlifters in snatch, clean and jerk and total, which were carried out in preparation process to

Table 2. Results of five tests in snatch, clean and jerk and total at various stages of weightlifters long-term training .

Sorts Training Stages		Test №	Indicators (scores CTS)					
			Snatch		Clean and Jerk		Total	
			X	±m	X	±m	X	±m
BTS		I	55.2	±3.2	69.3	±6.1	124.5	±9.2
		II	56.4	±3.7	71.5	±5.3	127.9	±11.2
		III	59.0	±4.1	69.5	±5.4	128.5	±10.3
		IV	60.4	±3.8	73.8	±6.9	134.2	±12.1
		V	62.7	±4.2	77.0	±6.4	139.7	±11.2
MTS		I	75.9	±5.2	94.3	±7.9	170.2	±13.5
		II	77.0	±4.7	96.7	±7.1	173.7	±14.7
		III	78.4	±4.8	95.1	±8.3	173.5	±14.2
		IV	78.3	±5.2	97.0	±8.6	175.3	±15.1
		V	81.1	±5.7	98.2	±7.9	179.3	±12.3
HTS		I	102.4	±6.1	127.8	±10.1	230.1	±16.7
		II	101.9	±6.8	129.7	±9.3	231.6	±17.2
		III	105.4	±5.3	130.4	±11.2	235.8	±16.1
		IV	107.1	±7.2	129.4	±10.3	236.5	±17.9
		V	107.5	±6.9	133.1	±11.4	240.6	±17.2
HSS		I	140.3	±9.2	163.1	±12.8	303.4	±21.3
		II	141.9	±10.3	174.2	±12.3	316.1	±22.4
		III	154.0	±9.8	175.4	±11.4	329.4	±20.4
		IV	155.2	±10.1	174.2	±13.1	329.4	±21.3
		V	167.4	±10.3	194.0	±12.8	361.4	±22.7
Difference between I and V tests	BTS		P<0.05		P<0.05		P<0.05	
	MTS		P<0.05		P<0.05		P<0.05	
	HTS		P<0.05		P<0.05		P<0.05	
	HSS		P<0.05		P<0.05		P<0.05	

the main season competitions at various stages of long-term training.

Weightlifters testing results on the BTS showed an increasing in total from 124.5±9.2 to 139.7±11.2 scores, MTS - from 170.2±13,5 to 179.3±12,3 scores, HTS - from 230.1±16.7 to 240.6±17.2 scores and HSS - from 316.1±21,3 to 361.4±22.7 scores. Increasing difference in snatch, clean and jerk and total indicators between I and V was reliable at $p<0.05$.

Results of various qualification weightlifters in snatch, clean and jerk and total were subjected to paired correlation analysis with the TLVC indicators. (Table 3).

0.954. According to all above showed data, we can affirm that the TLVC indicator is an informative WTL volume evaluation and the fact that along with the growth of weightlifters qualification, the value of the TLVC indicator increases as well.

For the visual substantiation of the functional relationship hypothesis of TLVC indicator with snatch, clean and jerk and total results, graphic correlation fields were built (Figur 1). From the picture it can be seen that the reliability of the trend line relationship approximation of indicators "TLVC ↔ snatch" is R2 = 0.9182 (Pic., A), "TLVC ↔ clean and jerk" - R2 = 0.9014 (Pic., B) and "TLVC ↔ total" is equal to R2 = 0.9115 (Pic.,

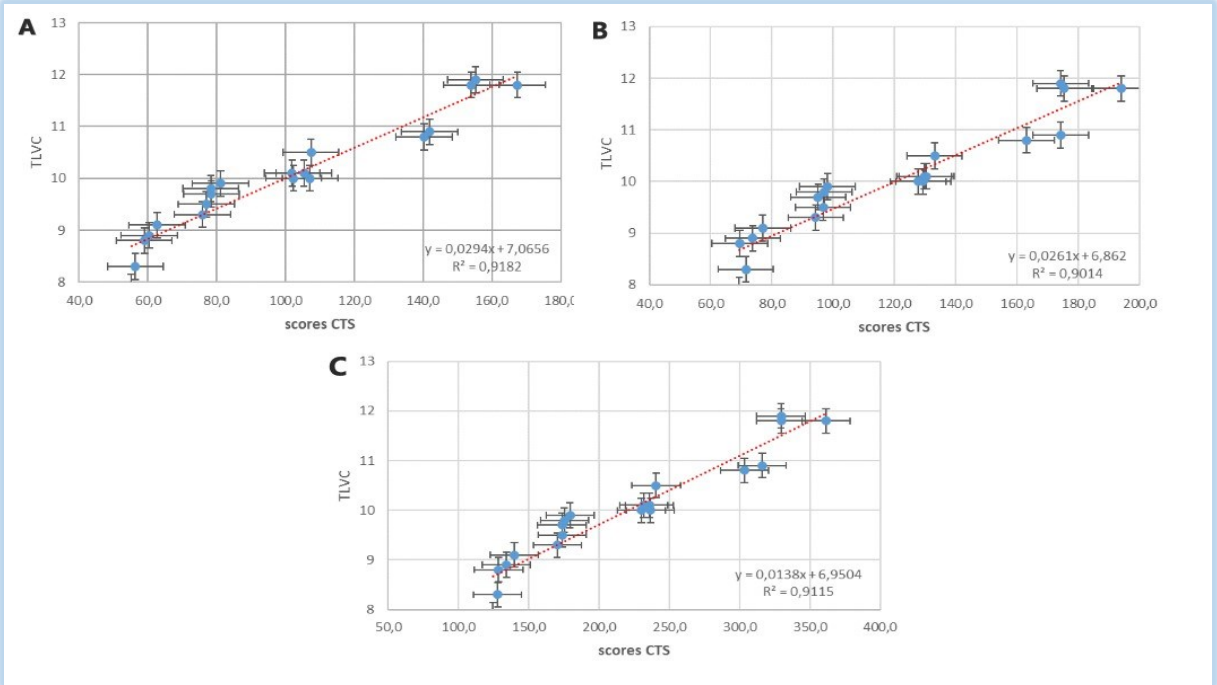
Table 3. Results of five tests in snatch, clean and jerk and total at various stages of weightlifters long-term training .

Tests results	TLVC indicators
Snatch	0.958
Clean and Jerk	0.949
Total	0.954

Paired correlation analysis of the TLVC indicator with the testing results of snatch, clean and jerk and total showed a strong direct relationship, which was TLVC ↔ snatch – r = 0.958, TLVC ↔ clean and jerk – r = 0.949 and TLVC ↔ total – r =

C). These figures confirm that the linear relationship between indicators "TLVC ↔ snatch" "TLVC ↔ clean and jerk" and "TLVC ↔ total" is more than 90%.

Figure 3. Diagram of functional TLVC relationship with snatch (A), clean and jerk (B), total (C)



Conclusion

Results of the research showed that the TLVC measurement is one of the most accessible, reliable and effective weightlifters training load volume evaluation method, which allows to master its development at various stages of long-term training, regardless of athletes weight category.

By correlation analysis data established that the weightlifters TLVC indicators have a straight-lined relationship with weightlifters sports results in snatch, clean and jerk and total. In addition, it was revealed that the weightlifters value indicator increases along with the growth of weightlifters sports qualification.

By the method of training load volume evaluation, TLVC, in contrast to the amount of workload sum, which has been done by weightlifters, characterized by the number of repetitions and impact of NBL in the training process, also shows the level of performed workload in a certain period time: in a training, a day, a microcycle, a mesocycle and a macrocycle.

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AUTHOR BIOGRAPHY



Kamil Faritovich BAYAZITOV
Employment
Associate Professor at Uzbek state university of physical education and sport.
Degree
PhD
Research interests
Weightlifting, Sport Science, Physical Education, Theory and methodology of physical culture and sports.
E-mail: bayazitov79@mail.ru