

CORRELATION BETWEEN THE LIFTED WEIGHT TOTAL AND WEIGHT CATEGORIES OF THE COMPETITORS IN OLYMPIC WEIGHTLIFTING

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Abstract. *Olympic weightlifting is a dynamic sport with dominant explosive strength that manifests itself in two complex liftings (snatch, and clean and jerk). During these complex movements, the athletes have historically measured and reported incredible levels of strength. The aim of the research was to determine whether there is a statistically significant correlation between body weight and lifted total weight in the elite sample of the world record holders in the period from 1972 to 2015. Based on the results of the correlation analysis in the overall sample of the results from 1972 to 2015, it can be seen that the overall sample of linear correlation is extremely strong, thus the mutual influence of the variables "weight category" and "total" is extremely strong, and with the increase of the former, the latter increases linearly, and vice versa. Based on the results of the analysis of the correlation between the weight classes of the competitors and the totals, separately for each period, one can see that every period reports a strong linear correlation between the variables of "weight category" and "total". Based on the obtained results, we can conclude that the male category does not report statistically significant differences in arithmetic means of the totals for all weight classes. The female category, on the other hand, reports statistically significant differences between groups 1 and 3, which indicate the periods 1988-1992 and 1998-2015. Generally, the female category suggests an increase in the average total value from 1988 to 2015, in contrast to the male category in which this trend is reversed. Considering the results of previous research, starting from the 1980s to the present, we can conclude that the results of the aforementioned conducted research agree almost completely with the previously tested and proven facts.*

Key words: *body mass, lifted total weight, Olympic weightlifting*

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INTRODUCTION

One of the main characteristics of Olympic weightlifting is the struggle with oneself. A weightlifter, at every event, with every attempt, tries to overcome himself, to lift more, faster and better. Weightlifting is a great drama, where winning over oneself is most important. It is one of the few sport branches where the referee cannot declare someone the winner if they did not deserve it. The rules are clear, the weight should be moved from point A to point B. Free judgment is of minor importance, an athlete has lifted or has not lifted the weight above his head, and to date, the major international events have not reported a single major incident where the referee's wrong decision was had a significant impact on competitive ranking.

All the aforementioned facts make the Olympic weightlifting a true test of the limits of human abilities, both mental and physical. Since the dawn of man, strength has been highly appreciated. Once, the physical strength meant the difference between life and death, and today it is a matter of prestige and respect. Olympic weightlifting differs from other strength sports that include weight lifting, and generally from all other sports, by its sophisticated techniques. In the snatch and jerk, at the top level, strength with no sophisticated technique does not mean much. It is here that the beauty of this sport lies. An athlete, in addition to exceptional physical strength, must be endowed with a series of extraordinary mental abilities. Some weightlifting trainers even claim that the pull in Olympic weightlifting is the most complicated and complex set of movements in sport in general.

The experts of this branch of sport have not yet agreed on the demarcation line between weightlifting as a "manifestation of strength" and weightlifting as a sport, and it is difficult to make a clear distinction because only lifting any weight implies the manifestation of strength.

The line may be set the best if we set the Olympic weightlifting (snatch and clean) and powerlifting discipline (bench press, squat, and deadlift) as competitive sport disciplines apart from all the remaining strength competitions, which are then categorized under the term "manifestation of strength".

Olympic weightlifting is a dynamic sport with dominant explosive strength that manifests itself in two complex liftings (snatch, and clean and jerk). During these complex movements, the athletes have historically measured and reported incredible levels of strength (Storey & Smith, 2012). What separates Olympic weightlifting as a sport from other forms of strength manifestation by weightlifting are recognized and rule-established disciplines and categories that are the same in all international competitions.

Olympic weightlifting as a sport has suffered a lot of changes in the last 50 years. There has been a significant evolution of the training system and program, pharmacology and medicine have found their role in sport, the selection of athletes reached its peak, and in the last five decades we have witnessed incredible changes in this sport.

Historically, the greatest contribution to the development of Olympic lifting came from the Bulgarian and Russian lifting school (Komi, 1991). All other methods and principles of weightlifter training have evolved from these two schools.

In the period from 1920 to 1972, there were three disciplines: thrust, snatch, and clean and jerk. A competitor's score was evaluated by the sum of the greatest lifted weights in each of the three individual disciplines. Since 1972, the thrust as a discipline has been eliminated from the official competition, and Olympic weightlifting has remained among the disciplines that are current today, and these are snatch, and clean and jerk. The reasons

for eliminating thrust from the official program of the competition are numerous: competitors started to include legs in the thrust, there was strong inclination and buckling backwards when lifting, which made many lifts problematic for judging, i.e. characterizing as correct. In the period from 1973 to 1992, there were 10 weight categories for men. Since 1993, the International Weightlifting Federation has introduced new weight categories, still keeping the 10 old ones. The idea was to improve the sport by increasing the body weight of lifters, and to increase the attractiveness of the sport, because higher body weight implied higher lifted weights in the future. The new wave of changes occurred in 1998, because with the existing 10, the International Weightlifting Federation reduced the weight classes for men to 8. The upper limit of lifters' weight was again changed, and record progress expected. Great competitions in the category of women began in the season of 1987/88, and in the period from 1988 to 1992 there were 9 weight categories, in the period from 1993 to 1997 also 9, and since 1997 they were reduced to 7 weight classes in the category of women.

Shifting the borders in total has definitely occurred, and the totals (a total sum of 2 disciplines) in all the categories were significantly raised. For example, in the lightest category for men, which was up to 52 kilograms between 1972 and 1993, the record in total was 272 kilograms, and today in the lightest category, which amounts to 56 kilograms, the record in total is 305 kilograms.

In theory, the increase in the body weight of the lifters should be linearly associated with the lifted weight, it should grow in proportion to body weight gain. The training and nutrition regime should strive to maximize the lifters' percentage of muscle tissue compared to other tissues (Ford, Dettlerline, Ho, & Cao, 2000). Body weight and muscle tissue of the lifters are the main determinants of the lifted weight (Storey & Smith, 2012). That this is so in practice was supported by earlier studies on samples from the 2013 World Cup (Mattiuzzi & Lippi, 2014). At the top level of competition, the results of the competitors oscillate very little, 2.5-2.7% (McGuian & Kane, 2004). It just proves how ready the competitors are, both physically and mentally.

In 1989, a study which compared the inside factors that determined which elite junior would become the weightlifter was conducted in the United States. Both female and male athletes reported the same traits that differentiated the elite competitors: much higher level of confidence than the average, a high level of inner motivation, great mental tolerance to physical discomfort caused by hard training, and expressed ability to overcome depressive phases (Mahoney, 1989).

Strength or muscle strength is the ability which produces the peak maximum force F_{mm} . In mechanics and physics, force is defined as the measure of interaction of two bodies. Force is manifested when the body is moving or deforming (or both). Force is a vector quantity, characterized by: a - intensity, b - direction, and c - striking point. Provided that the force is of current interaction, and that people need certain time for every movement, coaches and athletes value the overall continuum of force-time ratio, not just the force at a certain point (Zatsiorsky & Kreamer, 2006). This continuum of force - time, finds the special significance in the Olympic weightlifting, where the lifters act with maximal muscular strength on the object (rod with weights) in a split second, manifesting muscle strength in order to lift the load. The increase in body strength gives many benefits to the health of the individual.

It has been proved that Olympic weightlifters in the junior category have significantly higher bone density than their peers (Virvidakis, Georgiou, Korkotsidis, Ntalles, & Proukakis, 1990).

A big study conducted in the United States on as many as 10,500 people proved that recreational weightlifting statistically significantly affects the reduction of waist circumference in men, which is directly associated with health, through the WHR (waist to hip ratio) (Mekary et al., 2015).

Human strength has always been a phenomenon that captivates and interests people, and people have been competing in it virtually since their primordial beginnings. The comparison of strength consumption in people of different body weight uses allometric modeling, which by the determined equation, obtains the value of the lifted weight in relation to the body weight.

This method tested who the most powerful woman in the world was, considering weight differences. Allometric modeling to calculate and compare the strength consumption of people of different body weights is used to reduce all participants to the same measurement scale. The allometric modeling is, therefore, useful when comparing people with big differences in body weight (Vanderburgh & Dooman, 2000).

According to the performed thorough analysis of the correlation of the body weight of lifters and the resulting totals at the World Championships in Wroclaw (Poland), the following conclusions can be made (Mattiuzzi & Lippi, 2014):

- There is an almost ideal, statistically significant linear correlation between the weight of the lifters and lifted totals in the disciplines of both genders;
- The correlation is slightly higher in women;
- Any significant deviation from the linear correlation may indicate a possible doping misuse (Mattiuzzi & Lippi, 2014; Mazanov, 2013);
- There is a formula that can reliably predict the approximate total of the competitors, which reads as follows: The total weight lifted (total) = $2.73 * (\text{body weight}) + 172$ for men and $29.3 * (\text{body weight}) + 36$ for women.

It has been found that the deviation from the results depending on internal factors in top athletes is very small, and varies between 2.5% and 2.7%. It further implies that the stability of the performance of top athletes is very large, and that any significant deviation on the relation body weight - lifted total may indicate the possibility of doping mixing (McGuian & Kane, 2004).

Doping as a term defines the use of illicit substances to improve athletic achievement. After World War II, steroids that were massively used in the recovery of the wounded, have found their place among athletes. Since the 1940's, substances that support recovery, have an anabolic effect and cause lean mass gain, strengthen the neuro-muscular connection, or on the other hand speed up metabolism and heart rate, have found their place in professional sport.

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Examining the period from 1962 to 1981, it was found that between 1962 and 1977, the use of doping was massively widespread among competitors in Norway, as the rapid decline and stagnation of results was observed between 1977 and 1981, after the introduction of doping controls in 1977. Comparison-wise, between 1962 and 1981, the average weight of the lifters increased by 18 kg, whereas that increase was almost not present after the introduction of controls (Solberg, 1982).

Similar research was resumed later, so the results of the juniors at the world level between 1978 and 1981 and 1981 and 1984 were compared, and it was found that in the first period there was a series of significant record increases, whereas after the introduction of stricter doping controls in 1981 this trend significantly decreased (Virvidakis, Sideras, & Papadakis, 1987).

It was also proved that sports results could be improved by permitted substances such as protein concentrates, amino acid complexes, creatine and carnitine, but that the improvements were not even close to those caused by prohibited substances (Szabo, 2013).

The aim of the research is to determine whether there is a statistically significant correlation between body weight and lifted total weight in an elite sample of world record holders in the period from 1972 to 2015.

METHODS

An interdisciplinary approach is necessary, because the current findings have indicated that no anthropomotor characteristic of man can have an influence in isolation, i.e. without the corresponding change in some of its other anthropological dimensions. The improvement of morphological status, as well as the achievement of success in motor action is the result of the level of development of those anthropological and anthropomotor dimensions which are significantly involved in the activity, as well as the intensity of the quality (structural) mutual relations of these dimensions. Of course, the success depends on the possibility of activating these potentials in the current situation, as well as the conditions under which a certain activity is implemented.

All these anthropological dimensions, characteristics of the environment, their similarities and differences, both within a sample of participants and among different samples of participants, should be measured and evaluated in a variety of ways, with various techniques and measuring instruments. In addition, the process of measurement and evaluation can and should be assessed in order to obtain a better picture of the valorization of the results of the anthropological measurements, i.e. the results in the appropriate anthropological research.

The measurements are used as a set of actions needed to be done to realize the measurement of relevant anthropological skills, traits and characteristics, and the conditions that are related or follow the appropriate entities in the implementation of the relevant activities.

The data obtained in the study of the correlation between the body weight of lifters and the total lifted in the elite sample of the world record holders in the period from 1972 to 2015, in various measurement conditions, are controlled and prepared for processing in accordance with the intended objective and hypothesis. Databases are organized by orderly features and prepared for the planned statistical analysis. The results obtained by the statistical analysis are presented in tables, and analyzed by the appropriate logical units. On the whole, the display of the research results, through the gradual elucidation of individual connections, allows the assessment of the overall correlation between the body weight of lifters and the total lifted in the elite sample of the world record holders in the period from 1972 to 2015, in accordance with the purpose and hypothesis of the research, i.e. contributes to the clear definition of the expected implementation of the obtained results in practice.

According to the nature of the scientific research, this study belongs to the category of empirical studies, whereas according to the aim of undertaking it represents applied, i.e.

applicable research aimed at gaining new knowledge and information needed for the practical application in the training process of the weightlifters, and on a broader scale in the teaching practice in educational institutions (Bala, 2007).

Considering the familiarity with the problem, this research represents a confirmative one, where based on the known problems the verification of the hypotheses is conducted with the use of appropriate methods and research designs.

Considering the time definition, the research is of a longitudinal character, and consists of a one-time measurement of relevant indicators of the lifters' body weight and totals lifted in the elite sample of the world record holders in the period from 1972 to 2015.

Considering the degree of control, this scientific research belongs to the category of field research, conducted in natural living conditions (Bala, 2007).

The sample of participants

The sample of participants consists of a total of 36 competitors, divided into 3 groups in the male and 3 in the female category, who set the world records in the total and disciplines in the period from March 4, 1983, and the World Championship in Odessa in the former USSR as of November 21, 2015, and the World Championship in Houston, USA.

The sample of parameters

The sample of parameters consists of the results of the total of 36 competitors, achieved in the competitions between 1972 and 2015, achieved in the major competitions, that were recognized as world records. In addition to the results, the parameters also include the weight of the competitors, which are all rounded to the upper limit of the weight categories. For this reason, the study excluded superheavy categories in all periods, because they have no upper limit of the competitors' weight. The criteria for forming the groups are the period in which the result was achieved, and the competitors' gender.

The description of the measuring procedure

All data were entered into the matrix of the SPSS 20.0 IMB program. All results subject to the study were divided into 3 groups for male and 3 for female results. The groups were formed based on the period in the Olympic weightlifting which the result belonged to. Each group contains records of competitors in each weight category for each period. The study excluded the superheavy category, with no weight limit of the competitors, because it is impossible for it to round the upper value of the body weight parameter.

By the method of linear correlation, the mutual association of the weight category of the competitors and their results for all the categories and each period was examined. Due to the age of certain results, the body weight of the competitors was rounded to the upper limit of the weight category in which the competitor performed. After the examination of the correlation, the differences between the groups in the total lifted weight was examined by the method of univariate analysis of variance.

Methods of data processing

In order to meet the objective of the research descriptive parameters, i.e. the arithmetic mean (AM), standard deviation (SD), minimum value (MIN) and maximum value (MAX) were calculated.

The discussion took place through the comparison and evaluation of data. The data processing was done in the "SPSS 20.0 IMB" program. To determine the statistical significance of the correlation between the results of the competitors and their body weight, a linear correlation at the level of statistical significance $p \leq 0.05$ was used. To determine the difference between the groups, the analysis of variance with the level of statistical significance ≤ 0.05 was used.

RESULTS

Based on the displayed basic descriptive parameters of the entire analyzed sample, it can be concluded that the body weight of the competitors, whose results were considered in this study, ranged from 44 to 110 kilograms, while their totals ranged from 180 to 455 kilograms (Table 1).

Table 1 Descriptive statistics of the evaluated parameters

Parameters	AM	SD	MIN	MAX
Weight category	69.652	17.2301	44.0	110.0
Total lifted weight (Snatch+C&J)	304.033	82.9522	180.0	455.0

The correlation between the weight categories and lifted weights in total was firstly examined in the overall sample using the Spearman correlation.

Table 2 Correlation of the weight category and the total for all results

Parameter	Total
Weight category	0.806**

Legend: ** - statistical significance at the level of $p \leq 0.01$

Based on the results of the correlation in the overall sample of the results from 1972 to 2015, it can be seen that the overall sample of linear correlation is extremely strong, thus the mutual influence of the variables "weight category" and "total" is extremely strong, and with the increase of the former, the latter increases linearly, and vice versa (Table 2). This phenomenon is logical in both theory and in practice, for the simple reason that the competitor with a higher body weight has more capacity for the development of muscles, which enables the weightlifting.

Further analysis of the results tested the correlation of the results and the weight classes for the athletes of both genders, separately for each of the 3 periods, in both the male and female category. The periods were established based on the period in which the weight classes, i.e. competition disciplines changed. For men, the intersection year is 1972, when thrust was excluded from the official competition program of the Olympic Games in Munich. The next year of intersection for men was 1993, when the 10 weight categories were reduced to 7, the upper limits for weight categories shifted once more, and records reset again to set the new ones, with new categories and weights of competitors.

For women, the intersection years are the following: 1988, when women began to compete in the Olympic weightlifting at major competitions; 1992, when they first changed the upper limit of weight categories; and 1998, when the existing 10 weight categories were

reduced to 7, and when, as in the male category, the upper limit of body weight for all the categories was shifted once again.

Table 3 Correlation of the variables “weight category” and “total” by time periods

Gender Group	Parameter	Men Total	Women Total
Men 1973-1992	weight category	0.966**	
Men 1993-1997	weight category	0.977**	
Men 1998-2015	weight category	0.984**	
Women 1988-1992	weight category		0.978**
Women 1993-1997	weight category		0.983**
Women 1998-2015	weight category		0.994**

Legend: ** - statistical significance at the level of $p \leq 0.01$

Based on the results of the analysis of the correlation between the weight classes of the competitors and the totals, separately for each period, one can see that every period reports a strong linear correlation between the variables of "weight category" and "total". The results indicate that the correlation of goods slightly increased from 1972, i.e. 1988 to 2015. It is observed that in the women's category the correlation of the variables is stronger at the beginning, and that such a trend remains through all the analyzed periods. The value of the correlation over 0.9 indicates the almost perfect linear correlation between the variables (Table 3).

By the method of Pearson's linear correlation, a strong linear correlation between the parameters in each period is obtained for both genders. In both men and women, the correlation is almost perfect. What is common to both genders is that the correlation increases from one period to another. In women, the correlation values are somewhat higher than in men. The correlation growth trend was expected, given that the control of the athletes for prohibited substances is drastically stronger and more frequent in modern sport than in the seventies and eighties of the previous century.

This trend in sport from 1972 to 2015 confirms the thesis set by Mattiuzzi & Lippi in 2014 that the body weight of weightlifters is strongly associated with the lifted weight, and that any deviation from this may indicate the use of illicit substances.

The last parameter analyzed in this study is the difference in the total between the competitors, separately for each period and for both genders.

Table 4 The results of the univariate analysis (ANOVA method) of the lifted weights for the competitors of both genders by periods

Parameter	Group	Men			Women		
		AM		π	AM		π
Total	1-2	375.6	369.2	1.000	217.78	223.4	1.000
	1-3	375.6	368.0	1.000	217.78	257,5	0.043
	2-3	369.2	368.0	1.000	223.4	257,5	0.097
		F=0.045	p=0.956		F=4.063	p= 0.034	

Based on the obtained results, we can conclude that the male category does not report statistically significant differences in arithmetic means of the totals for all weight classes. There is an evident trend of decrease of the average weight achieved in the total, which was

the biggest in the period between 1972 and 1992, and was reduced in the next two periods by an average of 6.4 kg in the period from 1993 in 1997, i.e. by 7.6 kg in the period from 1998 to 2015. The female category, on the other hand, reports statistically significant differences between groups 1 and 3, which indicate the periods 1988-1992 and 1998-2015. Generally, the female category suggests an increase in the average total value from 1988 to 2015, in contrast to the male category in which this trend is reversed (Table 4).

Comparing the arithmetic means of the total for each group of competitors by periods, extremely interesting results were obtained. The female category reports a statistically significant difference between groups 1 and 3 of the female competitors. The first group includes the results from the period 1988-1992, and the third group includes the results from the period 1998-2015. The competitors from the third group on average achieved significantly higher scores. Historically, such a trend is expected. In 1988, the Olympic weightlifting for women was a young sport, women just joined men at major events, weight classes were significantly lower (for example, the lightest category in 1988 was up to 44 kilograms, and today it is 48 kilograms) which, as the analysis shows, entails the fact that competitors have less lifting capacity, due to lower overall muscle mass of the lifters. Another important factor that influenced this trend and the progress of the sport in the female category, is the training process. The training processes are better adapted to women, more women are involved in the Olympic weightlifting, which entails the larger sample from which a top female competitor can be isolated. Overall, in the female category, the analysis reported the expected results, in the field of correlation as well as in the field of difference.

In the male category, the situation is significantly different. Considering the correlation, the results are consistent with the expectations, and in the evaluated differences, the ANOVA method did not report a statistically significant difference. However, the focus should still be on one important piece of information obtained by analyzing the differences. The competitors in the first group (1973-1992), achieved on average higher results than the competitors in groups 2 and 3. Although the testing did not report statistically significant differences, one must not dismiss the fact that the difference between the competitors from the 1st and 2nd group is approximately 6.4 kilograms, and between the 1st and 3rd 7.6 kilograms. These differences are not recognized as statistically significant, but given that it is a specific sport, which involves lifting heavy loads, and that the test results represent world records, i.e. the most elite results, which differ from a half to one kilogram, such an average difference cannot remain unnoticed. This trend can be explained by two facts. In the period from 1973 to 1992, there were 2 weight categories that no longer exist, and those were the category up to 100 kilograms and 110 kilograms. The results achieved in these categories contributed significantly to the overall average of the period, but even so, the fact remains that all other categories now have higher upper limits. Even more interesting is the difference between the 1st and 2nd group. The number of weight categories was the same, and all the weight classes were in favor of group 2, except the last two categories taken into consideration, which were for 1 or 2 kilograms higher in group 1. An average group 1 competitor weighed 77 kilograms, and group 2 competitor weighed 78.2 kilograms. It is clear that group 2 competitors were heavier on average, provided that this difference was even greater if the individual differences between each group were considered, which further implies that they were stronger on average, if we consider the trend of integration of the variables "body weight" and "total". Despite all the presented facts, the information remains that the average total is the highest in group 1, in the period when the competitors were the lightest.

In the eighties of the last century, anti-doping control was significantly increased and became significantly more frequent. This was confirmed by the studies that reported a significant reduction in record growth trend in weightlifting sports (Solberg, 1982; Virvidakis et al, 1987). The results of these studies are consistent with the changes in the results in Olympic weightlifting, and record change trends in those periods.

In addition to the increase of the anti-doping control, International Weightlifting Federation (IWF) fought against doping by raising the upper limits of weight categories, which allowed the competitors easier maintenance of weight, but again, opened more room for improvement in total.

DISCUSSION

Considering the results of previous research, starting from the eighties of the twentieth century to the present, we can conclude that the results of the aforementioned conducted research agree almost completely with the previously tested and proven facts.

Chronologically, the first indicated fact was that the results of the Norwegian competitors experienced a slight decline and stagnation since in 1977 in Norway doping controls of lifters increased (Solberg, 1982). Similar research was resumed later, so the juniors' results were compared at the world level between 1978-1981 and 1981-1984, and it was found that in the first period a series of significant record increases were achieved, while after the introduction of stricter doping controls in 1981 this trend significantly decreased (Virvidakis et al., 1987). The results of both studies agree with the results obtained in this study, where the highest average totals are observed precisely in the period from 1972 to 1992, while a slight decrease in the results is observed in the next two periods.

The evaluation of the results of the competitors and their body weight shows that there is almost an ideal linear correlation between the above parameters, and that it is more pronounced in the category of women (Mattiuzzi & Lippi, 2014). Identical results were obtained on this occasion, where in contrast to 2013, when only the results from the World Championships in Wroclaw were examined, the correlation between these parameters for the elite sample of world records for the period of 43 years was evaluated. It supports the fact that not even the world record holders who belong to the small population of especially physically and mentally gifted people deviate from the regularity in terms of integration of body weight and lifted total.

It also points to the fact that every result which deviates from the linear correlation may be taken into account when considered doping-suspicious (Mazanov, 2013; Mattiuzzi & Lippi, 2014). The same possibility is pointed out by other researchers, when they explored the size of the oscillations of the results of top athletes in relation to internal factors (McGuian & Kane, 2004).

CONCLUSION

Olympic weightlifting as a sport continues to progress every day. Training methods have been developed, and the sport itself has been experiencing great popularization in the last decade since the "Crossfit" returned Olympic weightlifting among the general population. A technically demanding sport, such as Olympic weightlifting, will probably never experience a climax, because there will always be room for competitors to perform

a snatch and clean better. Past achievements should be carefully analyzed, and learnt from in order to promote the sport.

The topic of study represents an inexhaustible source of questions that require answers. The presented results and facts have answered many questions, but also opened new ones. The World Anti-Doping Association (WADA) has definitely, since the 1980s until today, taken great steps in the eradication of doping, sports federations constantly work on that, as well as the people who are on the "dark" side of the sport. Doping agents are constantly progressing, and it can be that they follow the progress of the anti-doping methods, thus continuing the ongoing battle between good and evil in the world of sport. In the end, a question is inevitably raised whether there is any professional sport without the help of doping, or is it only the unfulfilled dream of people who want a professional sport without doping. What and how big human limitations in sport are remains to be seen in the times to come. What we can do in the meantime is to analyze in detail the already achieved results, learn from them as much as possible, and pass that knowledge onto the generations to come.

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KORELACIJE IZMEĐU PODIGNUTOG TOTALA I TELESNE TEŽINE OLIMPIJSKIH DIZAČA TEGOVA

Olimpijsko dizanje tegova je dinamičan sport u kome dominira eksplozivna snaga koja se manifestuje u dva kompleksna dizanja (trzaj i nabačaj i izbačaj). Za vreme ovih kompleksnih pokreta, kod takmičara su kroz istoriju izmereni i zapaženi neverovatni nivoi snage. Cilj istraživanja bio je da se utvrdi da li postoji statistički značajna povezanost između telesne težine dizača i podignutog totala na elitnom uzorku svetskih rekordera u periodu od 1972. do 2015. godine. Uzorak ispitanika činilo je ukupno 46 takmičara, podeljenih u tri grupe u muškoj kategoriji i tri u ženskoj, koji su postavili svetske rekorde. Na osnovu rezultata korelacione analize na celokupnom uzorku rezultata od 1972. do 2015. godine može se videti da je na celokupnom uzorku linearna povezanost izuzetno jaka, te da je međusoban uticaj varijabli „težinska kategorija“ i „total“, izuzetno jak. Na osnovu dobijenih rezultata, možemo konstatovati da u muškoj konkurenciji ne postoje statistički značajne razlike aritmetičkih sredina totala za sve težinske kategorije. U ženskoj konkurenciji se sa druge strane uočava statistički značajna razlika između grupa 1 i 3, koje označavaju periode od 1988.-1992. godine i 1998-2015. godine. Generalno se u ženskoj konkurenciji može uočiti porast prosečne vrednosti totala od 1988. do 2015. godine, za razliku od muške kategorije kod koje je taj trend obrnut. Uzimajući u obzir rezultate pređašnjih istraživanja, počev od 1980 godine do danas, možemo konstatovati da se rezultati sprovedenog istraživanja slažu gotovo u potpunosti sa prethodno ispitivanim i dokazanim činjenicama.

Ključne reči: telesna masa, podignuta težina u totalu, Olimpijsko dizanje tegova