

The influence of results in various types of climbing on the result in the Olympic Climbing Combined at the 2018 World Cup (men)

ZHANNETA KOZINA¹, NASTASYA UVAROVA¹, HANNA KNIAZ², OLGA KABANSKA³, MARYNA KOCHINA⁴, ANDRII CHERNOZUB⁵, OLEG KOCHIN⁴, IVAN PROKOPENKO⁵, YURI SHKREBII⁶, VADYM ZDANYUK⁷, VADIM ALTUKHOV⁸

¹Department of Olympic and Professional Sport and Sport Games, H.S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

²Department of Practice English Oral and Written Speech, H.S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

³Department of English language, H.S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

⁴Department of Medical and Biological Foundations of Sport and Physical Rehabilitation, Petro Mohyla Black Sea National University, UKRAINE

⁵Rector, H.S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

⁶Department of Water Sports, National University of Physical Education and Sports, UKRAINE

⁷Department of Physical Rehabilitation and Medical and Biological Bases of Physical Education, Kamianets-Podilskyi National Ivan Ohienko University, UKRAINE

⁸Department of choreography, H. S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

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Abstract

Climbing will be presented at the 2020 Olympic Games as an independent competitive discipline in the "Climbing Combined" format, which will include all competitive disciplines. **The aim of the study:** identifying the relationship between the ranking in certain types of sports climbing and the ranking in the Olympic discipline of climbing "Climbing Combined" in men according to the results of the 2018 World Cup. **Material and methods.** The study involved 87 climbers (men) who took part in the 2018 World Cup. The data presented in the competition protocols on lead, speed, bouldering and Climbing Combined were summarized (places occupied by the athlete, points were awarded to him to summarize the results). Pearson's correlation analysis was performed to identify the relationship between rating in various climbing disciplines and Climbing Combined rating. Using the analysis of variance, the effect of the results in various disciplines on the result in Climbing Combined was determined.

Results There is no significant relationship between the rating disciplines "Speed" and "Lead". Also, no reliable relationship between the rating in the disciplines "Speed" and "Bouldering" was revealed. ANOVA of the impact of the results in some types of climbing on the result in Climbing Combined showed the presence of reliable dependence of the result in the discipline "Bouldering" on the result in Climbing Combined ($p < 0,05$), of the result in the discipline "Lead" on the result in the Climbing Combined ($p < 0,05$) and from the combined interaction of results in these types of climbing on the result in the Climbing Combined ($p < 0,05$).

Conclusions. It is shown that athletes who specialize in the Lead and Bouldering disciplines are more likely to compete in the Climbing Combined, as the results in these disciplines are interrelated and significantly affect the result in the All-round.

Keywords: climbing, bouldering, speed climbing, lead climbing, Climbing Combined.

Introduction

Climbing refers to sports that have significantly increased their popularity over the past decades (Langseth & Salvesen, 2018; Michailov, Balas, Tanev, Andonov, Kodejska & Brown, 2018; Morrison, Schöffl, 2007; Ryepko, 2013; Siegel & Fryer, 2015). This, ultimately, led to the fact that this sport was recognized by the International Olympic Committee as an Olympic in 2010 (Uvarova, Kozina, Kolomiets, & Tieniakova, 2019). At the IOC session in 2013 in Buenos Aires, it was decided to include it in the Olympic program of the Games 2020 (Uvarova, 2016; Uvarova, Kozina, Kolomiets, & Tieniakova, 2019). Climbing will be presented for the first time at the 2020 Olympic Games in Tokyo of the discipline "Climbing Combined", which includes the athlete's performance in climbing speed along a standard track, climbing lead and bouldering (passing of short difficult tracks).

Speed competitions are held on a reference wall, 15 m high with an inclination angle of 5°, on which two tracks are placed, each of which has a width of 3 m, climbing holds are wound on both tracks identically. The winner is determined by the best route time (Guo, Wang, Liu, & Hanson, 2019; Kozin, 2019; Kozina, Repko, Safronov, Kozin, Evarnickii, & Grebniova, 2018).

Lead competitions are held on new tracks unfamiliar to athletes, which they must pass as above, using the “lower insurance” (a climber fastens the rope to the carabiners in braces as the course passes) (Ignjatović, Stanković, Pantelić, Puletić, 2017; Kozina, Ryepko, Prusik, Prusik, & Cieślicka, 2014; Sheel, Newbury, Sulentic, 2004).

Bouldering is considered to be trails with a length of 6 to 14 interceptions (competition rules), during the passage of which the result is affected by the number of attempts spent on reaching the finish line. Climbing takes place on tall mats that protect the safety of athletes (Kozin, 2019; Kozina, Repko, Safronov, Kozin, Evarnickii, & Grebniova, 2018; Schweizer, Andreas & Furrer, 2007; Sibella, 2007; Whitaker, Pinton, Tarampi, & Rand, 2019).

According to the IOC requirements, athletes will need to compete in all three types of competitions, although different types of climbing require different physical and functional training.

Different types of competitive climbing activities require the inclusion of different energy supply mechanisms (Ryepko, 2013; Siegel, & Fryer, 2015; Watts, 1996). This complicates the training process and requires an in-depth analysis of the athlete’s capabilities to choose a specialization and build the training process so that the athlete’s universalization does not harm his narrow specialization. To solve this problem, first of all, it is necessary to determine which types of climbing are most preferable for successful performance in the Olympic Climbing Combined discipline.

Despite having empirical data in coaching practice, an accurate statistical determination of the degree of impact of each type of climbing on success in the Climbing Combined is necessary. This is necessary for predicting the success of individual athletes specializing in various types of climbing, for success in the Olympic discipline. These facts are necessary to complete the national teams, which implies the choice of athletes specializing in various types of climbing. To solve this problem, it is necessary to analyze the already existing competition data with the participation of the world's leading athletes. Based on the analysis of literature data, a hypothesis was formulated: the results in various types of climbing quantitatively affect the result in the Olympic discipline "Climbing Combined" in different ways.

The aim of the study: identification of the relationship between the rating in certain types of sports climbing and the rating in the Olympic discipline of climbing "Climbing Combined" in men according to the results of the 2018 World Cup.

Material and methods

Participants

The study involved 87 climbers (men) who participated in the 2018 World Cup.

Experimental protocol

To solve the tasks, the following research methods were used: analysis and synthesis of literature data, pedagogical observation, analysis of protocols of the results of competitions. During the study, the data presented in the competition protocols on difficulty, speed, bouldering and Climbing Combined were rallied (places were occupied by the athlete, points were awarded to him to summarize the results) and the time taken for each of them to go through the speedway.

Statistical analysis

Pearson's correlation analysis was performed to identify the relationship between rating in various climbing disciplines and the Climbing Combined rating.

Using the analysis of variance, the effect of the results in various disciplines on the result in Climbing Combined was determined. Analysis of variance was carried out using the general model method. The dependent value was the result in the Climbing Combined, the independent values were the results in the disciplines “Lead”, “Bouldering”, “Speed”. Data was processed using computer programs EXCEL and SPSS.

Results

Reliable correlations were found between the results in individual types of climbing and Climbing Combined, between the results in the forms “Climbing Combined” and “Lead” ($r = 0.68, p < 0.01$), “Climbing Combined” and “Bouldering” ($r = 0.70, p < 0.01$), “Climbing Combined” and “Speed” ($r = 0.48, p < 0.01$) (Table 1). Results in the discipline “Speed” is not a leading factor determining the result in the Climbing Combined. The data obtained also indicate that success in the disciplines “Difficulty” and “Bouldering” has a greater effect on the result in the Climbing Combined as compared with the results in the discipline “Speed”. There is no significant relationship between the rating disciplines “Speed” and “Lead”. Also, no reliable relationship was found between the rating in the disciplines “Speed” and “Bouldering” (Table 1).

Table 1

Relationship between the results of competitions in the disciplines “Speed”, “Bouldering”, “Lead” and “Climbing Combined” among climbers at the 2018 World Cup (men) (n = 87)

Indicators	Speed, place	Boulder, place	Lead, place	Climbing Combined, place
Speed, place	1	-0.022	-0.027	0.482**
Boulder, place	-0.022	1	0.657**	0.703**
Lead, place	-0.027	0.657**	1	0.676**
Climbing Combined, place	0.482**	0.703**	0.676**	1

Notes:

Boulder, place - rating in the discipline "Bouldering"

Lead, place - rating in the discipline "Lead";

Speed, place - rating in the discipline "Speed";

Climbing Combined, place - rating in the discipline "Climbing Combined"

** - Correlation is significant at the 0.01 level (2-tailed).

A variance analysis of the effect of results in individual types of climbing on the result in Climbing Combined showed the presence of a reliable dependence of points in Climbing Combined on the result in the discipline "Lead" ($p < 0.05$) (Table 2), on the result in the discipline "Bouldering" ($p < 0.05$) (Table 4) and from the combined interaction of the results in these types of climbing on the result in Climbing Combined ($p < 0.05$) (Table 6). There was no significant effect of the result in the “Speed” discipline on the result in the Climbing Combined ($p > 0.05$) (Table 3). There was also no significant effect of the combination of results in the disciplines “Speed” and “Bouldering” on the result in the Climbing Combined ($p > 0.05$) (Table 5). Also, there was no significant effect of the combination of results in the disciplines “Speed” and “Lead” on the result in the Climbing Combined ($p > 0.05$) (Table 7).

Table 2

The results of the analysis of variance of the impact of the results in the discipline "Lead" on the Climbing Combined result for climbers at the 2018 World Cup (men) (n = 87)

Source	Type III Sum of Squares	df	Tests of Between-Subjects Effects			
			Mean Square	F	Sig.	Partial Eta Squared
Dependent Variable: All-round, place						
Corrected Model	1.20E+12	57	2.11E+10	1.759	0.049	0.776
Intercept	7.71E+11	1	7.71E+11	64.209	0.00	0.689
Lead, place	1.20E+12	57	2.11E+10	1.759	0.049	0.776
Error	3.48E+11	29	1.20E+10			
Total	2.48E+12	87				
Corrected Total	1.55E+12	86				

Notes: a. R Squared = 0.776 (Adjusted R Squared = 0.335)

Dependent Variable: Climbing Combined, place;

Boulder, place - rating in the discipline "Bouldering"

Lead, place - rating in the discipline "Lead";

Speed, place - rating in the discipline "Speed";

Climbing Combined, place - rating in the discipline "Climbing Combined"

The obtained results of the variance analysis of the influence of the results in various types of climbing on the Climbing Combined result confirmed the results of the correlation analysis of these indicators. Thus, it can be noted that for men who participated in the 2018 World Cup, the results in the Climbing Combined are affected by the results in the disciplines “Lead” and “Bouldering”. The results in these disciplines are also related. Anyone with a high score in the discipline “Lead” also shows a high score in the Bouldering discipline, and vice versa. Most clearly, this pattern can be traced from 1 to 60 place in the ranking (Fig. 1). The result in the “Speed” discipline is not related to the results in the “Lead” and “Bouldering” disciplines and does not reliably affect the total number of points in the Climbing Combined (Tables 3, 5, 7).

Table 3

The results of the analysis of variance of the impact of the results in the discipline "Speed" on the result in the Climbing Combined for climbers at the 2018 World Cup (men) (n = 87)

Source Dependent Variable: Climbing Combined, place	Type III Sum of Squares	df	Tests of Between-Subjects Effects			
			Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.15E+12	72	1.60E+10	0.562	0.941	0.743
Intercept	6.55E+11	1	6.55E+11	23.004	0.00	0.622
Speed, place	1.15E+12	72	1.60E+10	0.562	0.941	0.743
Error	3.99E+11	14	2.85E+10			
Total	2.48E+12	87				
Corrected Total	1.55E+12	86				

Notes: a. R Squared = 0.143 (Adjusted R Squared = 0.178)

Dependent Variable: Climbing Combined, place;

Speed, place - rating in the discipline "Speed";

Climbing Combined, place - rating in the discipline "Climbing Combined"

Table 4

The results of the variance analysis of the impact of the results in the Bouldering discipline on the Climbing Combined result of climbers at the 2018 World Cup (men) (n = 87)

Source Dependent Variable: Climbing Combined, place	Type III Sum of Squares	df	Tests of Between-Subjects Effects			
			Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9.91E+11	44	2.25E+10	1.684	0.046	0.638
Intercept	2.92E+11	1	2.92E+11	21.835	0	0.342
Boulder, place	9.91E+11	44	2.25E+10	1.684	0.046	0.638
Error	5.62E+11	42	1.34E+10			
Total	2.48E+12	87				
Corrected Total	1.55E+12	86				

Notes: a. R Squared = 0.638, (Adjusted R Squared = 0.312)

Dependent Variable: Climbing Combined, place;

Boulder, place – rating in the discipline "Bouldering"

Climbing Combined, place - rating in the discipline "Climbing Combined"

The data obtained show that in order to achieve a high result in Climbing Combined events, athletes specializing in the disciplines "Difficulty" and "Bouldering" are more likely. In addition, the results in these disciplines are interconnected (Table 1). For athletes specializing in the discipline "Speed", achieving a high result is a difficult task, since the results in the discipline "speed" are not related to the results in the disciplines "Difficulty" and "Bouldering" (Table 1) and do not significantly affect the result in the Climbing Combined (tab. 3, 5, 7).

Table 5

The results of the analysis of variance of the impact of the results in the disciplines "Bouldering" and "Speed" on the result in the Climbing Combined result of climbers at the 2018 World Cup (men) (n = 87)

Source Dependent Variable: overall, quality	Type III Sum of Squares	df	Tests of Between-Subjects Effects			
			Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.55E+12	85	1.82E+10	5.206	0.338	0.998
Intercept	3.04E+11	1	3.04E+11	86.855	0.068	0.989
Boulder.place	3.95E+11	13	3.04E+10	8.688	0.26	0.991
Speed.place	5.58E+11	41	1.36E+10	3.889	0.385	0.994
Boulder.place* Speed.place	0	0	.	.	.	0
Error	3.50E+09	1	3.50E+09			
Total	2.48E+12	87				
Corrected Total	1.55E+12	86				

Notes: a. R Squared = 0.998 (Adjusted R Squared = 0.806)
 Dependent Variable: Climbing Combined, place;
 Boulder, place – rating in discipline "Bouldering"
 Speed, place - rating in the discipline "Speed";
 Climbing Combined, place - rating in the discipline "Climbing Combined"

Table 6

The results of the analysis of variance of the impact of the results in the disciplines “Difficulty” and “Bouldering” on the Climbing Combined result for climbers at the 2018 World Cup (men) (n = 87)

Source	Type III Sum of Squares	df	Tests of Between-Subjects Effects			
			Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.55E+12	84	1.85E+10	67.477	0.015	1
Intercept	4.60E+11	1	4.60E+11	1680.438	0.001	0.999
Boulder,place	3.26E+11	23	1.42E+10	51.79	0.019	0.998
Boulder,place	5.39E+11	36	1.50E+10	54.738	0.018	0.999
Boulder,place* Lead,place	2.16E+10	4	5.40E+09	19.72	0.049	0.975
Error	5.48E+08	2	2.74E+08			
Total	2.48E+12	87				
Corrected Total	1.55E+12	86				

Notes: a. R Squared = 1.000 (Adjusted R Squared = 0.985)
 Dependent Variable: Climbing Combined, place;
 Boulder, place – rating in discipline "Bouldering"
 Lead, place - rating in the discipline "Lead";
 Climbing Combined, place - rating in the discipline "Climbing Combined"

Table 7

The results of the analysis of variance of the impact of the results in the discipline “Lead” and “Speed” on the Climbing Combined result for climbers at the 2018 World Cup (men) (n = 87)

Source	Type III Sum of Squares	df	Tests of Between-Subjects Effects			
			Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1.55E+12	85	1.82E+10	5.43	0.331	0.998
Intercept	6.39E+11	1	6.39E+11	190.493	0.046	0.995
Load,place	3.95E+11	13	3.04E+10	9.064	0.255	0.992
Speed, place	3.45E+11	28	1.23E+10	3.671	0.394	0.99
Lead,place* Speed,place	0	0	.	.	.	0
Error	3.36E+09	1	3.36E+09			
Total	2.48E+12	87				
Corrected Total	1.55E+12	86				

Notes: a. R Squared = 0.998 (Adjusted R Squared = 0.814)
 Dependent Variable: Climbing Combined, place;
 Load, place – rating in the discipline "Lead";
 Speed, place - rating in the discipline "Speed";
 Climbing Combined, place - rating in the discipline "Climbing Combined"

Thus, the results of correlation and analysis of variance have shown: the results in the disciplines “Bouldering” and “Lead” reliably influence the rating in the Climbing Combined. This relationship is most pronounced up to 60th place in the Climbing Combined ranking.

Discussion

The hypothesis that was posed in this study was completely confirmed. The data obtained on the greatest impact on the result in the Climbing Combined results in the disciplines “Lead” and “Bouldering” and the lack of influence of the results in the disciplines “Speed” can be explained by the fact that the climbing technique in the disciplines “Lead” and “Bouldering” is somewhat eastern and differs from the technique passing the route in the discipline "Speed". In addition, as shown by Kozina, Ryepko, Prusik, Prusik, & Cieślicka (2014),

the physical qualities that determine the outcome in the disciplines “Speed” and “Lead” are antagonists. The main physical quality for success in the discipline “Speed” is speed-power qualities with an emphasis on speed. In the discipline “Lead” the main physical quality is strength endurance. The development of speed-strength qualities is determined by the percentage of white muscle fibers of type b, and the development of endurance, including power, due to the predominant development of red muscle fibers and white muscle fibers of type a. In addition, the antagonism of these qualities is due to the physical laws of the relationship between speed and maximum time to complete work at a given intensity (Ryepko, 2013; Siegel, & Fryer, 2015; Kozina, Iermakov, Bartík, Yermakova, Michal, 2018; Kozina, Shepelenko, Osiptsov, et. all., 2017). The same applies to the strength and maximum time to complete work at a given intensity. This dependence is hyperbolic (Kozin, 2019; Kozina, Repko, Safronov, Kozin, Evarnickii, & Grebniova, 2018). Therefore, it is no coincidence that the relationship between the results in the discipline “Lead” and in the discipline “Speed” is not reliable. Performance in the Bouldering discipline requires the development of explosive power. In addition, in the “Lead” and the “Bouldering” disciplines, this is a similar technique, especially for the lowest stages in the “Lead” discipline (Schweizer, Andreas & Furrer, 2007; Sibella, 2007; Whitaker, Pointon, Tarampi, & Rand, 2019).

These provisions explain why success in the "Climbing Combined" discipline is more likely for athletes specializing in the “Lead” and “Bouldering” disciplines, since these disciplines are similar in motor structure (Schweizer, Andreas & Furrer, 2007; Sibella, 2007; Whitaker, Pointon, Tarampi, & Rand, 2019). In order for an athlete to show high results in the Climbing Combined due to the equal contribution of results in all three disciplines, endurance strength, explosive strength and speed must be developed equally, but it becomes impossible to achieve maximum success in a separate type of climbing. This is a certain problem in the preparation of climbers for performances in the discipline "Climbing Combined". The data we obtained using correlation and analysis of variance allowed us to provide a mathematical justification of the performance characteristics of climbers in various disciplines. This is new data in comparison with the literature, because it allows us to predict the success of athletes in the discipline "Climbing Combined", based on an analysis of its results in the disciplines "Speed", "Bouldering", “Lead”. It should be noted that the organizers of international climbing competitions based on empirical experience came to similar conclusions, and at the Olympics 2024 in France, it is supposed to separate the discipline "Speed" with offset in the Climbing Combined (Uvarova, Kozina, Kolomiets, & Tieniakova, 2019).

It is worth noting that the search for ways to predict the results in the Olympic Climbing Combined climbing discipline is not accidental. Different types of competitive climbing activities require the inclusion of different energy supply mechanisms (Ignjatović, Stanković, Pantelić, Puletić, 2017; Kozina, Ryepko, Prusik, Prusik, & Cieślicka, 2014; Sheel, Newbury, Sulentic, 2004 Schweizer, Andreas & Furella, 2007; Whitaker, Pointon, Tarampi, & Rand, 2019). This complicates the training process, and requires coaches to deeply analyze the athlete's abilities to choose a specialization. The key to successful all-rounder performance in competitions is a decent result in at least two disciplines.

Conclusions

1. There is no significant relationship between the rating disciplines “Speed” and “Lead”. Also, no reliable relationship was found between the rating in the disciplines “Speed” and “Bouldering”.

2. The variance analysis of the impact of the results in some types of climbing on the result in the Climbing Combined showed the presence of reliable dependence of points in the Climbing Combined from the result in the discipline "Bouldering" ($p < 0.05$), from the result in the discipline “Lead” ($p < 0.05$) and from the combined interaction of results in these types of climbing to result in Climbing Combined ($p < 0.05$). No significant effect of the result in the discipline "Speed" on the result in Climbing Combined ($p > 0.05$) and the combined effect of the result in the disciplines "Speed" and "Bouldering" and "Speed" and “Lead” on the result in the discipline "Climbing Combined".

3. It is shown that athletes who specialize in the “Lead” and the “Bouldering” are more likely to compete in Climbing Combined, as the results in these disciplines are interrelated. For athletes who specialize in the Speed discipline, achieving a high score is a difficult task because the results in the Speed discipline are not related to the results in the “Lead” and the “Bouldering” disciplines and do not significantly affect the result in the "Climbing Combined".

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Conflict of interest

Authors state that there is no conflict of interest.

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