

DIFFERENCES BETWEEN BEST OLYMPIC RESULTS AND BEST WORLD ATHLETICS EVENTS' THROWS WOMEN ACCOMPLISHED IN THE OLYMPIC GAMES' YEARS

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Abstract

The aim of the research was to determine differences between vectors of arithmetic means of the best results in athletics throwing events accomplished in the finals of Olympic Games and the results of 8 world seasons' best throwers achieved at other competitions in the same years. The sample of subjects consisted of women athletes, elite shot putters and discus, javelin and hammer throwers from different countries who competed in the Olympic Games' finals and those who were, in the same years, positioned among first eight on the world ranking lists. The collected data were processed by the software package Statistica 7.0. Module *t*-test for dependent samples was used to analyze statistical significance of the differences between arithmetic means of the best results achieved at the Olympic Games finals and the best results achieved at other competitions in the same years. The thesis was rejected that there were no statistical significant differences between the best results achieved at the Olympic Games and the results of the world best 8 women throwers accomplished at other competitions in the Olympic years for all throwing events.

Key words: athletics, throwing events, female, Olympics, season's best, progression trend

Introduction

In the beginnings of modern Olympic Games (OG) women were not so well nor comprehensively represented as men. Women participated in tennis, golf, sailing, fencing, swimming and figure skating (Wallechinsky, 2004). Only in 1928 OG in Amsterdam women athletics was introduced into competition program. Consequently, the first female throwing event – discus throwing occurred in the Olympic program for the first time. At the next OG in Los Angeles in 1932 women threw javelin for the first time; shot put for women was introduced in the 1948 OG program in London, and the most recent OG program entry of throwing event for women was hammer throwing – 2000 OG in Sydney. From the mentioned data it is obvious how much longer women throwing events should have waited for their inclusion into the OG program in comparison to men events. It should be mentioned here OG were not held in 1916, due to World War One and in 1940 and 1944, due to the World War Two, when women had already won the right to participate in OG's discus and javelin throwing. Analyses are presented in the paper of the progression trend of OG women throwing events' results and of 8 world seasons' best performance progression trend in the Olympic years. It was noticed result increases were much higher in the Olympic years than achievement increases in the years between the OG, which were slow and low (Wazni, 1978). These performance curve oscillations Skorowski (1969) designated as "Olympic cycle", primarily due to the important role OG usually plays in the world of sports. Due to the greatest increases of results in the Olympic years we tried to discern whether women achieve their best results at the most important competition, that is, at the Olympics Games, or at any other competition in

the same year. The goal of the present research was to determine are there any differences between arithmetic means of the results female finalists achieved in throwing events at the Olympic Games and arithmetic means of the results the world best female throwers accomplished at any other competition in the same year. Length of the observed periods was different for individual throwing events, due to the different years of their inclusion into the OG competition program: discus throwing was observed through the period of 1928-2012, javelin throwing through 1932-2012, shot put 1948-2012 and hammer throwing from 2000 to 2012.

The established differences, if any, will be helpful in the determination of correlation between performance and training methods applied, as well as social-related factors which influenced the development of sports results (Harasin and Milanović, 2005). The obtained results will also help to predict sports achievements expected in world elite throwing events for women. The hypothesis was tested in the paper that no statistical significant differences exist between the best results achieved at the Olympic Games and the results of the best world women throwers accomplished at other competitions in the Olympic year.

Methods

Sample of entities

The sample of entities is comprised of female field athletes, elite shot putters, as well as discus, javelin and hammer throwers from different countries of the world. The total sample of subjects is composed of two subsamples.

The first one are finalists of the Olympic Games since a particular throwing event has been introduced into its competition program (discus since Amsterdam OG in 1928, javelin since 1932 Los Angeles, shot put since 1948 London OG and hammer since 2000 Sydney OG) till the last summer OG held in London in 2012 (for each OG eight best). The second subsample embraced the eight best ranked world throwers who accomplished their best throws in the same years at any other competition than OG in the mentioned periods. Most athletes are in both subsamples.

Sample of variables

The first sample of variables embraces best results achieved in the OG finals in female throwing events: shot put, discus throwing, javelin throwing, and hammer throwing. The data were taken from the book "The complete book of the Olympics" (Walechinsky, 2004) and from IAAF

internet pages, so the variables were defined according these results. The second group of variables consists of 8 season best results accomplished at different competitions in the Olympic years.

Data processing methods

The data collected were processed by the software statistical package Statistica 7.0. The variables included in the analysis were described using the module Descriptive Statistics. Presented are: arithmetic means, standard deviations, the shortest throws, the longest throws and ranges between the shortest and the longest results. These data were used to calculate statistical significance of the difference between arithmetic means of the results accomplished in Olympic Games' finals and the best results accomplished at other competitions in the world in the same years. The differences were established using *t*-test for dependent samples.

Results

Table 1. Descriptive parameters of the best discus throwing results achieved in the OG finals and of the eight best ranked female discus throwers in the Olympic years 1928-2012

Year	Best Olympic results					Best world results				
	M	SD	MIN	MAX	R	M	SD	MIN	MAX	R
1928	35.48	2.24	32.72	39.62	6.90	37.96	0.97	36.75	39.62	2.87
1932	36.31	3.08	33.15	40.58	7.43	40.59	0.99	38.81	42.43	3.62
1936	39.35	4.99	34.43	47.63	13.20	42.64	3.17	39.74	48.31	8.57
1948	39.67	1.34	38.44	41.92	3.48	45.07	3.52	42.05	53.25	11.20
1952	44.76	3.34	41.61	51.42	9.81	49.93	4.08	45.36	57.04	11.68
1956	49.52	3.23	45.78	53.69	7.91	52.25	1.39	50.90	54.76	3.86
1960	51.91	1.50	50.12	55.10	4.98	55.25	1.20	53.91	57.15	3.24
1964	55.64	1.63	53.08	57.27	4.19	56.91	0.90	55.86	58.82	2.96
1968	54.67	2.20	52.80	58.28	5.48	60.08	1.63	58.14	62.54	4.40
1972	62.78	2.49	59.00	66.62	7.62	64.18	2.02	62.02	67.32	5.30
1976	65.97	1.79	63.43	69.00	5.54	68.37	1.26	66.60	70.50	3.90
1980	66.23	2.31	63.14	69.96	6.82	68.78	1.92	67.26	71.80	4.54
1984	61.49	3.48	55.88	65.36	9.48	72.65	1.14	71.22	74.56	3.34
1988	69.13	2.18	65.94	72.30	6.36	73.08	1.89	71.06	76.80	5.74
1992	65.57	2.36	63.42	70.06	6.64	70.08	1.47	67.80	71.68	3.88
1996	65.31	2.18	62.48	69.66	7.18	66.83	1.68	65.26	69.96	4.70
2000	64.66	1.87	62.57	68.40	5.83	67.34	0.98	65.90	68.70	2.80
2004	65.23	1.57	62.37	67.02	4.65	67.26	1.19	65.76	69.14	3.38
2008	62.13	1.48	60.66	64.74	4.08	65.96	1.01	64.70	67.89	3.19
2012	65.85	2.15	63.01	69.11	6.10	67.12	1.63	64.76	68.89	4.13

Table 3. Descriptive parameters of the best javelin throwing results achieved in the OG finals and of the eight best ranked female javelin throwers in the Olympic years 1932-2012

Year	Best Olympic results					Best world results				
	M	SD	MIN	MAX	R	M	SD	MIN	MAX	R
1932	38.55	4.76	30.81	43.68	12.87	42.56	2.63	39.51	46.75	7.24
1936	41.13	2.77	36.93	45.18	8.25	44.58	0.99	42.65	45.71	3.06
1948	41.57	2.34	38.23	45.57	7.34	46.91	2.06	43.80	48.92	5.12
1952	47.23	2.73	44.30	50.47	6.17	50.04	1.84	47.57	53.35	5.78
1956	49.79	1.93	48.00	53.86	5.86	52.58	0.74	51.60	53.86	2.26
1960	52.65	1.73	50.92	55.98	5.06	56.43	1.47	55.23	59.55	4.32
1964	55.69	2.89	52.37	60.54	8.17	58.93	2.18	56.61	62.40	5.79
1968	56.92	2.30	53.96	60.36	6.40	58.62	1.29	56.96	60.63	3.67
1972	59.59	2.56	56.36	63.88	7.52	62.14	1.36	61.02	65.06	4.04
1976	62.20	3.07	57.50	65.94	8.44	65.12	1.95	63.26	69.12	5.86
1980	66.10	1.61	63.98	68.40	4.42	68.72	1.17	66.66	70.08	3.42
1984	65.54	2.93	62.06	69.56	7.50	71.61	2.41	67.64	74.72	7.08
1988	66.63	4.48	60.76	74.68	13.92	71.81	3.62	68.80	80.00	11.20
1992	63.78	3.88	58.26	68.34	10.08	68.11	1.64	65.88	70.36	4.48
1996	64.26	2.26	60.74	67.94	7.20	67.80	1.20	66.58	69.42	2.84
2000	64.83	2.48	62.10	68.91	6.81	67.15	1.18	65.76	69.48	3.72
2004	64.56	3.09	61.75	71.53	9.78	65.50	2.68	63.32	71.53	8.21
2008	65.55	4.04	59.64	71.42	11.78	66.77	3.38	63.44	72.28	8.84
2012	61.14	2.69	60.73	69.55	8.82	67.15	1.55	65.11	69.55	4.44

Table 5. Descriptive parameters of the best shot put results achieved in the OG finals and of the eight best ranked female shot putters in the Olympic years 1948-2012

Year	Best Olympic results					Best world results				
	M	SD	MIN	MAX	R	M	SD	MIN	MAX	R
1948	12.86	0.50	12.17	13.75	1.58	13.93	0.54	13.23	14.89	1.66
1952	14.04	0.78	13.02	15.28	2.26	14.81	0.40	14.06	15.42	1.36
1956	15.49	0.76	14.56	16.59	2.03	15.87	0.68	15.12	16.76	1.64
1960	16.19	0.66	15.14	17.32	2.18	16.72	0.46	16.26	17.78	1.52
1964	16.98	0.81	15.83	18.14	2.31	17.42	0.48	16.82	18.40	1.58
1968	17.84	1.04	16.23	19.61	3.38	18.08	0.86	17.04	19.61	2.57
1972	19.35	0.87	18.34	21.03	2.69	19.64	0.66	19.06	21.03	1.97
1976	20.23	0.81	18.89	21.16	2.27	21.39	0.41	20.94	21.99	1.05
1980	20.82	0.92	19.66	22.41	2.75	21.42	0.45	21.00	22.45	1.45
1984	18.58	1.32	17.23	20.48	3.25	21.50	0.50	21.00	22.53	1.53
1988	20.65	0.77	19.82	22.24	2.42	21.55	0.48	21.08	22.55	1.47
1992	19.70	0.73	18.96	21.06	2.10	20.45	0.40	19.78	21.06	1.28
1996	19.37	0.59	18.68	20.56	1.88	19.98	0.45	19.56	20.97	1.41
2000	19.31	0.71	18.49	20.56	2.07	20.15	0.73	19.36	21.46	2.10
2004	19.06	0.44	18.56	19.59	1.03	20.02	0.58	19.12	20.79	1.67
2008	19.56	0.61	19.00	20.56	1.56	20.05	0.61	19.46	20.98	1.52
2012	19.71	0.67	19.00	20.70	1.70	20.33	0.69	19.72	21.58	1.86

Table 7. Descriptive parameters of the best hammer throwing results achieved in the OG finals and of the eight best ranked female hammer throwers in the Olympic years 2000-2012

Year	Best Olympic results					Best world results				
	M	SD	MIN	MAX	R	M	SD	MIN	MAX	R
2000	68.32	1,68	66.15	71.16	5.01	71.27	1.97	69.73	75.68	5.95
2004	72.69	1.30	70.40	75.02	4.62	73.92	0.99	72.73	75.18	2.45
2008	73.62	2.08	71.00	76.34	5.34	75.77	1.10	74.65	77.32	2.67
2012	76.04	1,56	74.06	78.18	4.12	77.53	0,82	76,56	78,69	2,13

The differences between the best Olympic and other best world results achieved in the same years in discus throwing

Descriptive statistical parameters of the original discus throwing results achieved in the OG finals 1928-2012 and of the eight world best female discus throwers in the same period are presented in Table 1 and Figure 1.

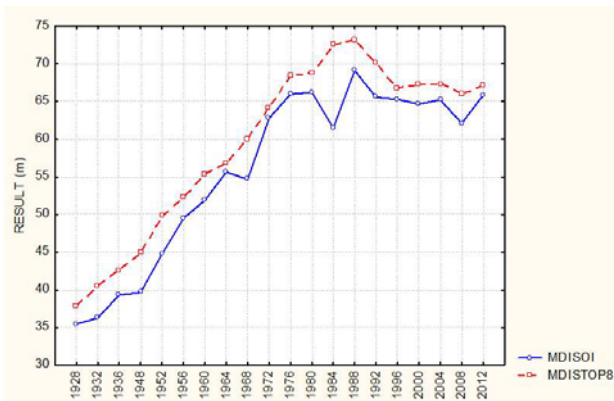


Figure 1. Graphical representation of the best Olympic results average and of the average of the 8 best ranked female discus throwers' results in the same year

The performance at the OG finals was poorer than the best performance at the other world competitions in the same years. The difference is most pronounced for the 1984 results and Los Angeles OG, when athletes from the Eastern socialist countries boycotted the Olympic Games. The smallest difference in the achieved results was 2012. Best ranked throwers that year, almost threw so far at the OG except Sandra Perković who threw in the OG season's best 69.11m.

The results of descriptive statistical analyses and of t-test are presented in Table 2.

Table 2. Differences between arithmetic means of the best discus throwing results achieved in the OG finals and of the eight best ranked female discus throwers in the Olympic years 1928-2012

	M	SD	N	t	df	p
DISKFINOI	56,08	11,39				
DISKTOP8	59,62	11,27	20	-7,05	19	0,00

The differences between the best Olympic and other best world results achieved in the same years in javelin throwing

Descriptive statistical parameters of the original javelin throwing results achieved in the OG finals 1932-2012 and of the eight world best female javelin throwers in the same period are presented in Table 3 and Figure 2.

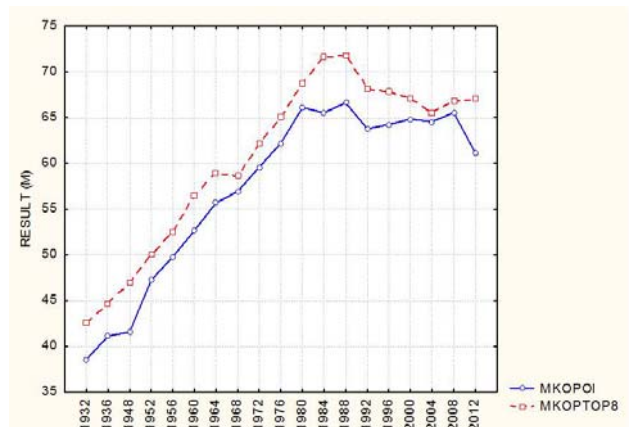


Figure 2. Graphical representation of the best Olympic results average and of the average of the 8 best ranked female javelin throwers' results in the same year.

The results at the OG finals were poorer than the best achievements at the other world competitions in the same years. Similar as in discus throwing, the biggest differences between two series were obtained for the year 1984. Our presumption is that the difference obtained for the year 1988 (Seoul Olympic Games) between two points can be attributed to systematic and more rigorous doping control than ever before. The results of descriptive statistical analyses and of *t*-test for dependent sample are presented in Table 4.

Table 4. Differences between arithmetic means of the best javelin throwing results achieved in the OG finals and of the eight best ranked female javelin throwers in the Olympic years 1932-2012

	M	SD	N	t	df	p
KOPFINOI	57,25	9,39				
KOFTOP8	60,66	9,31	19	-10,05	18	0,00

The differences between the best Olympic and other best world results achieved in the same years in shot put

Descriptive statistical parameters of the original shot put results achieved in the OG finals 1948-2012 and of the eight world best female shot putters in the same period are presented in Table 5 and Figure 3.

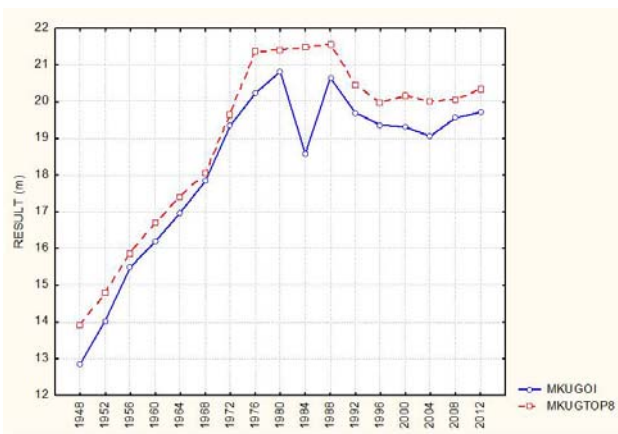


Figure 3. Graphical representation of the best Olympic results average and of the average of the 8 best ranked female shot putters' results in the same years.

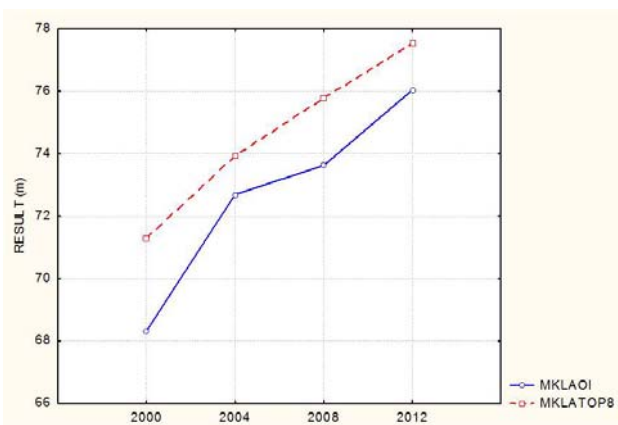


Figure 4. Graphical representation of the best Olympic results average and of the average of the 8 best ranked female hammer throwers' results in the same year

The performance at the OG finals was poorer than the best performance at the other world competitions in the same years. The results of descriptive statistical analyses and of *t*-test for dependent sample are presented in Table 6.

The differences between the best Olympic and other best world results achieved in the same years in hammer throwing

Descriptive statistical parameters of the original hammer throwing results achieved in the OG finals 2000-2012 and of the eight world best female hammer throwers in the same period are presented in Table 7 and Figure 4.

Table 6. Differences between arithmetic means of the best shot put results achieved in the OG finals and of the eight best ranked female shot putters in the Olympic years 1948-2012

	M	SD	N	t	df	p
KUGLAFINOI	18.22	2.33				
KUGLATOP8	19.02	2.43	17	-5.42	16	0.00

The performance at the OG finals was poorer than the best performance at the other world competitions in the same years. In the 2000 time point the difference between arithmetic means between the two groups of results was high, whereas it was considerably low in the year 2004. This trend of curves becoming closer did not continue in the next time point (2008). On the contrary, the difference was even more pronounced in favor of the best world results other than those achieved at OG. Since there are only three time points, no statistically reliable inference can be reached upon this sample. However, we can presume that hammer throwing result development trends are similar to those in other throwing events. It will be interesting to follow the development of performance in this athletics event. The results of descriptive statistical analyses and of *t*-test for dependent samples are presented in Table 8.

Table 8. Differences between arithmetic means of the best hammer throwing results achieved in the OG finals and of the 8 best ranked female hammer throwers in the Olympic years 2000-2012

	M	SD	N	t	Df	p
KLADIVOFINOI	72.67	3.22				
KLADIVOTOP8	74.62	2.68	4	-5.09	3	0,01

Discussion

From the presented data it is obvious women throwers perform poorer at Olympic Games than at other competitions in the same year. The differences are most pronounced for the year 1980 when OG were held in Moscow and boycotted by the Western countries athletes, and for the year 1984 when OG were held in Los Angeles and boycotted by the Eastern, socialist countries. The latter year was even more important for the magnitude of difference since female throwers from the Eastern countries were predominant in throwing events.

The samples of result sequences were analyzed in several time points: for discus throwing there were 20 time points, for javelin throwing 19 points, for shot put 17 points, whereas hammer throwing was observed only through 4 time points. The samples are limited to as many time points as there were many OG for a particular throwing event on the OG competition program. For the all throwing events (discus, hammer and javelin throwing and shot put) values of *t*-test were computed between arithmetic means of results achieved in the OG finals and the results of the 8 best world women throwers accomplished in the same years and due to the obtained results, the hypothesis was rejected. The values of *t*-test are different for each event and indicate statistically significant poorer performance at the Olympic Games. The biggest difference was obtained in javelin throwing (-10.05), followed by discus throwing (-7.05), shot put (-5.42) and hammer throw (-5.09). With the certainty of 99% it can be claimed that result trend in all throwing events will continue in the next Olympic year, meaning that the best world female throwers will accomplish statistically significantly poorer results in the OG's finals. The obtained results – better throws accomplished at the competitions other than Olympic Games, which should be, hypothetically speaking, the most important competition of a year, if not of a four-year cycle, are not circumstantial, therefore, the reasons or factors should be sought for. Probable reasons can be found in social, psychological, methodological and pharmacological factors (Vazni, 1978). Sport is an important segment of any society, which social role has led to its high popularity and professionalization, resulting in much better training work conditions. These factors contributed to constant increase of results in throwing events. Egger (1994) indicates better financial reimbursement for top performance at other competitions than for prominent achievements at OG as one of the main reasons. Extrinsic motivation (financial, material) speaks in favor of athletics meetings. The result is the enlarged number of appearances in such competitions, which hinder sports form peaking for the "most important" competition in the competition calendar – the Olympic Games. Neither should we neglect a psychological factor associated with big competitions, especially in women.

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Stress, strong emotional pressure, occurring in female throwers at the most important competitions like the OG, has a negative impact on their performance. Frequently, athletes accomplish their best results immediately after the OG, at athletics meetings (Scheibe & Dickwach, 1993). Pharmacology must also be taken into account since factors related to it probably influence the difference between the OG finals results and those accomplished somewhere else in the same year. There is no secret that doping control (forbidden performance enhancing drugs control) is, or was, much stricter at the Olympic Games than at certain lower ranked competitions (meetings). We must assume certain associations between the former mentioned procedures and oscillations of performance in the same year. It is corroborated by the doping control findings about stimulation substance presence in athletes competing in the lower ranked competitions, where maximum high results have been achieved (Dolle, 1995).

Conclusion

The differences between the throwing events finals results accomplished at the Olympic Games and other seasons' best results achieved at other competitions in the Olympic year were statistically significant. Therefore, it is feasible to conclude that women throwers perform poorer in the Olympic years at the Olympic Games competition than at the other competitions. Lower financial motivation related to the OG, too high anxiety pressures to perform best at the OG and win a medal, bad timing in sports form planning (tapering and peaking) and doping scrutiny at the OG are factors that probably influence lower achievements of women throwers at the OG. This research and its findings open certain questions about the spirit of Olympic Games, its meaning in society and sports in history, present and in the future as well as the issue of quantifying the contribution of factors influencing poorer achievements at the most important competitions. Namely, theory of training claims that high level of fitness and preparedness should be developed in training process as a reliable resource that is going to be engaged at right time at the most important competition for high level performance (Fuchs, 1990).

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RAZLIKE IZMEĐU NAJBOLJIH OLIMPIJSKIH REZULTATA I NAJBOLJIH REZULTATA NA SVJETSKIM NATJECANJIMA BACAČICA U OLIMPIJSKIM GODINAMA

Sažetak

Cilj ovog istraživanja bio je utvrditi razlike između vektora aritmetičkih sredina najboljih rezultata u atletskim bacačkim disciplinama ostvarenih u finalima Olimpijskih igara i rezultata najboljih osam bacačica ostvarenih u svijetu u olimpijskim godinama. Uzorak ispitanika u ovom istraživanju čine atletičarke, vrhunske bacačice kugle, bacačice diska, bacačice koplja i bacačice kladiva iz različitih zemalja svijeta, koje su se natjecale u finalima olimpijskih igara i koje su u olimpijskim godinama zauzimale jedno od prvih osam mjesta na svjetskim tablicama rangiranih atletičarki bacačica. Prikupljeni podaci obrađeni su programskim paketom „Statistica 7.0“. Na prikupljenim podacima provedena je analiza statističke značajnosti razlika između aritmetičkih sredina najboljih rezultata postignutih u finalima Olimpijskih igara i najboljih rezultata postignutih u svijetu u istim godinama u kojima su se održavale Olimpijske igre. U tu svrhu korištena je metoda i program za analizu razlika vektora aritmetičkih sredina pomoću modula „t-test za zavisne uzorke“. Odbačena je hipoteza da ne postoje statistički značajne razlike između rezultata postignutih u finalima Olimpijskih igara i rezultata najboljih 8 bacačica postignutih u olimpijskim godinama na drugim natjecanjima u svim bacačkim disciplinama.

Ključne riječi: atletika, bacačka natjecanja, žene, Olimpijske igre, najbolji rezultat godine, trend razvoja

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