EFFECTIVENESS OF COMPETITION IN THROWING EVENTS AT MAJOR CHAMPIONSHIPS

Rumiana Karapetrova & Iva Dimova
National Sports Academy “Vassil Levski”, Sofia, Bulgaria

ABSTRACT
Throwing events in athletics are intriguing and dynamic, affecting both the competition results and the opportunities for athletes to improve their final standings. This is due to specific rules governing the events, which are generally consistent across all throwing disciplines. However, there are some differences in the equipment and areas designated for each event. This is the reason that sparked interest in analysing athletes' performance during major throwing championships. This study aims to reveal particular aspects of elite athletes' competitive performance in throwing during major championships. To carry out the study, we analysed the finals in all throws (shot put, javelin, hammer, and discus throws) from the Paris Olympic Games for both men and women, in detail assessing the sporting achievements and the distribution of attempts by strength during the competition. The total number of respondents is 95 (47 men and 48 women). After a detailed data analysis, we identified various approaches to running the race. Some athletes deliver strong performances early on, while others achieve their best in their final attempt. We analyse the athletes' performances during the most significant competition (the Olympic Games) compared to their personal bests and top performances of the season. The throwers improved two personal bests, fifteen seasonal best results, and two Olympic records in the competitions we analysed.

ORCID
Rumiana Karapetrova
https://orcid.org/0009-0006-4647-0165
Iva Dimova
https://orcid.org/0000-0002-7460-5358

Cite this article as:
Karapetrova, R., Dimova, I. (2025). Effectiveness of competition in throwing events at major championships. *Proceeding book of the 4th International Scientific Congress "Applied Sports Sciences", 2025, Sofia.* pp. 164 - 168.
https://doi.org/10.37393/ICASS2025/26

Keywords: *athletics throws, competition effectiveness, sport realisation, major competition*

INTRODUCTION

The throwing events—shot put, discus, javelin, and hammer throw—are essential disciplines within track and field, requiring a unique blend of strength, speed, and technical skill from athletes.

The effectiveness of competition in throwing events at major championships is best assessed through biomechanical metrics (release velocity, angle, height), consistency measures (dependability, ICC), and the interaction of psychological and environmental factors. Elite throwers show superior coordination and less variability, which relates to higher performance. However, technical and conditioning requirements vary across disciplines and levels of competition, and there is a significant gap in research that incorporates gender and biological factors into performance models. Psychological interventions and environmental normalisation further improve competition effectiveness, but more inclusive and long-term studies are necessary to fully understand these dynamics. (Paraskevopoulos, et al., 2024; Mizera, Horvath, 2002; Morrow, et al., 1982; Miranda-Oliveira, et al., 2023)

Major championships offer a high-pressure environment where effectiveness is judged not just by distance, but also by consistency, adaptability, and the ability to perform under changing environmental and psychological conditions. Systematic assessment of competition effectiveness is essential for improving coaching strategies, talent identification, and athlete development. (Hollings, 2012; Mastalerz, 2020)

Successfully organising a competition involving these events demands careful planning and execution that goes well beyond simply marking out a field. It entails a complex balance of logistical planning, strict adherence to regulations, and the coordination of a skilled team of officials and volunteers to guarantee a safe, fair, and competitive environment for all competitors. As highlighted by the sport's governing body, World Athletics (2022), the standards for equipment, facility layout, and event conduct are precisely defined to uphold the sport's integrity and ensure the comparability of results worldwide. Therefore, organising a throwing competition is a substantial task that tests not only the athletes' physical abilities but also the event organisers' administrative and operational skills. This process involves several vital stages, from initial planning and venue preparation to the final execution and post-event review, each presenting its own challenges and requiring specialised knowledge.

There are many studies focused on biomechanical analysis and presenting training approaches, but we could not find any revealing comparison of elite throwers during major events. (Raffly et al., 2025; Zaras et al., 2019; Chen et al., 2022)

Aim and Objective

This study aims to identify specific aspects of elite athletes' performance in throwing during major championships, providing detailed information on attempt effectiveness at these events.

To conduct the research, we analysed the finals in all throwing events (shot put, javelin, hammer, and discus) from the Paris Olympic Games for both men and women, carefully evaluating their sporting achievements and the distribution of attempts based on strength during the competition.

METHODOLOGY

For the study, we analysed elite throwers during the most prestigious competition in the sporting calendar – the Olympic Games. We analyse their personal best (PB) and season best (SB) results prior to the competition. The analysis includes detailed information about the athletes' performances in the three to six attempts they undertake in the final phase of the competition. The total number of athletes included in the study is 95 (47 men and 48 women) – see Table 1.

Table 1. *Respondents divided by discipline and gender*

Discipline	Gender	Number of athletes
Shot put	Men	11
Shot put	Women	12
Javelin throw	Men	12
Javelin throw	Women	12
Discus throw	Men	12
Discus throw	Women	12
Hammer throw	Men	12
Hammer throw	Women	12
	Total	95
	Men	47
	Women	48

For data analysis, we applied the following statistical methods: variance and frequency analysis.

RESULTS

In Table 2, we present descriptive statistics categorised by discipline and gender. The maximum value (X max) corresponds to the Olympic champion in the corresponding discipline. In contrast, the minimum value (x min) indicates the result of the athlete who qualified in the last position in the final. Based on the asymmetry and excess coefficients, we conclude that the results for all studied throwing events follow a normal distribution.

Table 2. *Descriptive statistics of sports results in the final of the Olympic Games in Paris 2024*

	n	X min	X max	*R*	M	SD	V	As	Ex
Shot put (women)	12	17.48	20.00	2.52	18.79	0.80	4.27	-0.082	-0.976
Shot put (men)	11	20.24	22.90	2.66	21.42	0.84	3.94	0.161	-0.898
Discus throwing (women)	12	57.03	69.50	12.47	63.48	3.82	6.02	-0.207	-0.661
Discus throwing (men)	12	61.89	70.00	8.11	66.92	2.42	3.62	-0.596	0.148
Javelin throw (women)	12	60.32	65.80	5.48	62.72	1.44	2.29	0.467	0.958
Javelin throw (men)	12	80.10	92.97	12.87	85.81	4.04	4.71	-0.007	-0.869
Hammer throw (women)	12	69.58	76.97	7.39	73.34	2.00	2.72	-0.162	0.29
Hammer throw (men)	12	73.34	84.12	10.78	77.87	2.82	3.62	0.546	1.359

A better understanding of competitiveness in the studied throwing events during the Olympic Games can be obtained from the coefficient of variation shown in Figure 1. It shows that the women's javelin throw and the men's hammer throw (V% < 3) are the most competitive. The competition in the women's discus throw and men's javelin throw exhibits a variation of more than 4%, indicating considerable differences between the finalists' results.

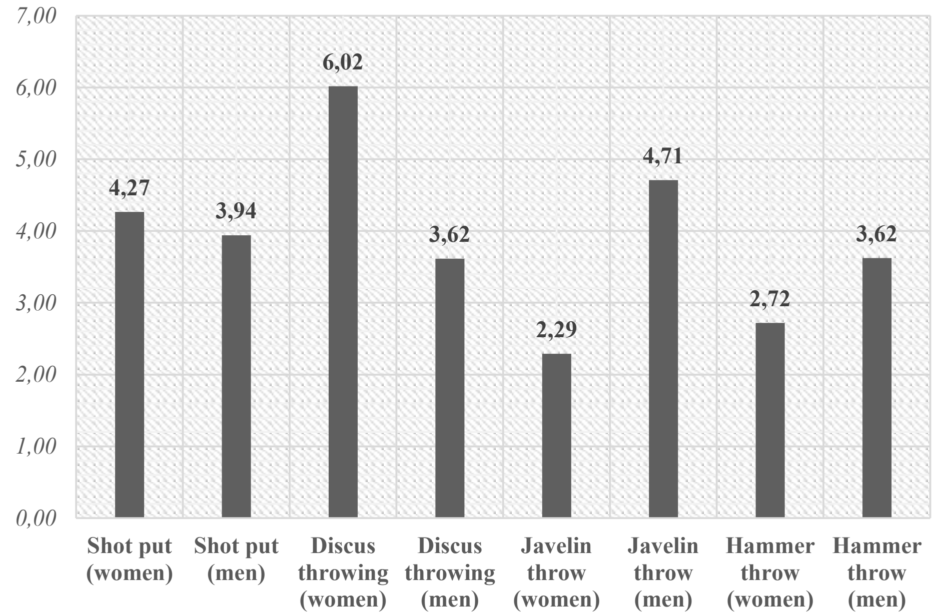

Figure 1. *Coefficient of variation of finalists' sport results from the throwing events at the Olympic Games in Paris 2024.*

Our interest lies in the distribution of the best attempts during the competition. We present the distribution of results for all athletes participating in the final in Table 2. We observe a tendency for better performance during the first three rounds, with over 80% of the best results recorded in the first half of the competition, compared to 10% in the second half.

Table 3. *Frequency analysis of the best result distribution of elite throwers*

Attempt	Frequency	Percent	Cumulative Percent
1	26	27.4	27.4
2	31	32.6	60.0
3	20	21.1	81.1
4	8	8.4	89.5
5	6	6.3	95.8
6	4	4.2	100
Total	**95**	**100**	

In Table 4, we present the frequency distribution of the best results for athletes participating in the final 8, who have the opportunity to make 6 attempts in the competition. Here, we confirm the tendency found in Table 3.

Table 4. *Frequency analysis of the best result distribution of elite throwers participating in the final eight of the competition*

Attempt	Frequency	Percent	Cumulative Percent
1	13	20.3	20.3
2	20	31.3	51.6
3	13	20.3	71.9
4	8	12.5	84.4
5	6	9.4	93.8
6	4	6.3	100
Total	**64**	**100**	

A visual comparison of the best performances of elite throwers is shown in Figure 2. It demonstrates that the initial attempts in each competition are more critical for achieving the best overall result.

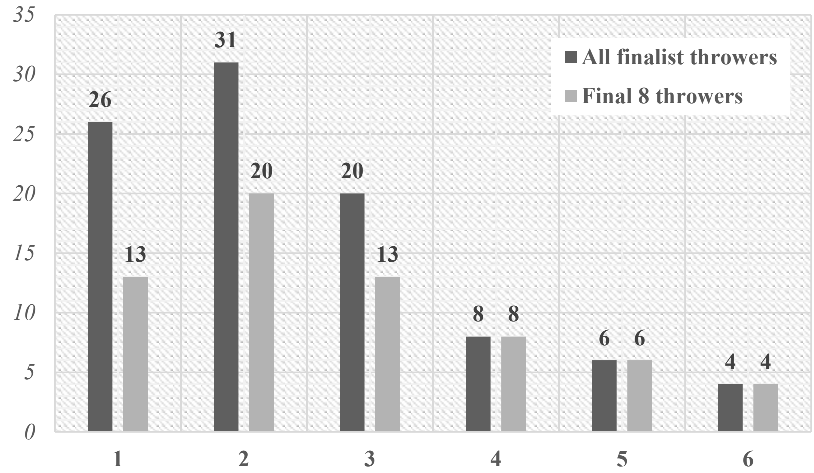

Figure 2. *Best result distribution of elite throwers*

In Table 5, we present another approach to analysing the performance of elite throwers participating in the Olympic Games athletic tournament. On average, athletes perform 4.66% below their personal best at the time. These values range from -15.47% (very low performance, in our opinion) to an improvement of 3.09% over the personal best.
The results from the Olympic Games compared to the season's best results (sport season 2024) have an average of -2.73%, ranging from a decrease of 15.47% to an increase of 7.37%.
When considering this data, we must take into account the fact that there is no normal distribution of research data, so it has only information significance.

Table 5. *Descriptive analysis of the sport result performance compared to the thrower's personal best (PB) and season best (SB) results*

	n	X min	Xmax	R	*M*	*SD*	V	As	Ex
OG sport result to PB	95	-15.47%	3.09%	18.57%	-4.66%	3.60%	-77.25	-0.75 *	0.542
OG sport result to SB	95	-15.47%	7.37%	22.84%	-2.73%	3.56%	-130.21	-0.856*	1.933 *

DISCUSSION

According to competition rules, athletes have a total of 6 attempts in the final 8 of throwing events. Our results show that performance in the initial phase of the competition—the first three attempts—is more important.
However, we must also consider that medals or better qualifications can sometimes be achieved in the last attempt, although it often carries the risk of fouling.
We recommend that coaches organise simulated competitions to help athletes learn to concentrate and perform better during the opening attempts.
To keep the research relevant, we should note that world athletics is constantly exploring new ways to organise more engaging competitions. As a result, we see certain changes in the rules of specific events as part of the search for the most spectacular way to organise competitions. The venue can also influence performance, as is often the case at continental championships: some throwing disciplines are held outside the stadium.

CONCLUSION

Based on the results presented above, we can summarise that elite throwers were able to realise their motor, technical, and psychological potential in the first half of the competition. Based on this, we propose to include this approach in specific training sessions during the training process before major competitions. This should also serve as a guideline when working with young, promising competitors in the group throwing disciplines.
Given the current lack of research, we believe that scientific studies on throwing performance should be conducted over a more extended period.

Acknowledgments

The results used in the following research are provided by the International Olympic Committee (IOC) and World Athletics (WA).

REFERENCES

Chen, C.-F., Chuang, M.-H., & Wu, H.-J. (2022). Joint energy and shot mechanical energy of glide-style shot put. Proceedings of the Institution of Mechanical Engineers, *Part P: Journal of Sports Engineering and Technology, 239*(2), 274–282. https://doi.org/10.1177/17543371221123168

Hollings, S. C., Hopkins, W. G., & Hume, P. A. (2012). Environmental and venue-related factors affecting the performance of elite male track athletes. *European Journal of Sport Science, 12*(3), 201–206.
https://doi.org/10.1080/17461391.2011.552640

Mastalerz, A. (2020). Variability of kinematics indicators in shot put technique depending on sports level. *Teoriya i Praktika Fizicheskoy Kultury*, *2020*(6), 25–27.

Miranda-Oliveira, P., Costa, F., Correia, D., Vieira, M., Ruben, R. B., & Fernandes, O. (2023). Influence of gender in the javelin throw in athletics' high-level athletes. In A. Martins Amaro, L. Roseiro, A. L. Messias, B. Gomes, H. Almeida, M. A. Castro, M. A. Neto, M. de F. Paulino, & V. Maranha (Eds.), *Proceedings of the 10th Congress of the Portuguese Society of Biomechanics (CNB 2023)* (pp. 491–501). Springer.
https://doi.org/10.1007/978-3-031-47790-4_48

Mizera, F., & Horváth, G. (2002). Influence of environmental factors on shot put and hammer throw range. *Journal of Biomechanics, 35*(6), 785–796. https://doi.org/10.1016/S0021-9290(02)00029-5

Morrow, J. R., Jr., Disch, J. G., Ward, P. E., Donovan, T. J., III, Katch, F. I., Katch, V. L., Weltman, A. L., & Telhez, T. (1982). Anthropometric, strength, and performance characteristics of American world class throwers. *Journal of Sports Medicine and Physical Fitness, 22*(1), 73–79.

Paraskevopoulos, E., Christakou, A., Plakoutsis, G., Pamboris, G. M., & Papandreou, M. (2024). Test–retest reliability of a motorized resistance device for measuring throwing performance in volleyball athletes. *Biomechanics, 4*(2), 259–268. https://doi.org/10.3390/biomechanics4020015

Raffly, H., Zulkifli, A. Y., Budi Arif, S., & Herli, P. (2025). Reliability assessment of physical education students' discus throwing competencies: A cross-sectional study. *International Journal of Human Movement and Sports Sciences, 13*(1), 243–253. https://doi.org/10.13189/saj.2025.130126

World Athletics. (2025). *Book of Rules.* Retrieved September 2025, from
https://worldathletics.org/about-iaaf/documents/book-of-rules

Zaras, N., Stasinaki, A.-N., Methenitis, S., Karampatsos, G., Fatouros, I. G., Hadjicharalambous, M., & Terzis, G. (2019). Track and field throwing performance prediction: Training intervention, muscle architecture adaptations and field tests explosiveness ability. *Journal of Physical Education and Sport, 19*(Suppl 2), 436–443.
https://doi.org/10.7752/jpes.2019.s2064

Corresponding author:
Rumiana Karapetrova, PhD
National Sports Academy "Vassil Levski"
21, Acad. Stefan Mladenov str.
Sofia, Bulgaria
E-mail: rumyanakar@abv.bg

IV International Scientific Congress "Applied Sports Sciences"

PROCEEDING BOOK

Peer-Review Statement
All full-text papers included in this conference proceedings volume have undergone a rigorous peer-review process. Each submission was evaluated by at least two independent reviewers with academic expertise relevant to the topic of the paper. Reviews were conducted in accordance with established scholarly standards, ensuring the quality, validity, and originality of the published contributions. Only papers that met the required scientific and ethical criteria were accepted for publication.

Publication Ethics and Malpractice Statement
The editors of this conference proceedings volume are committed to upholding the highest standards of publication ethics, following the principles outlined by the Committee on Publication Ethics (COPE).

By submitting their manuscripts, all authors confirm that:

- their work is original and has not been previously published or submitted elsewhere;
- the research presented is conducted in accordance with accepted ethical standards;
- all sources used are properly cited;
- there is no plagiarism, data fabrication, or falsification;
- all authors have contributed substantially to the manuscript and approve its final version;
- any conflicts of interest have been disclosed.

The editors maintain responsibility for the integrity of the publication process, ensuring fair and unbiased review, confidentiality of submissions, and immediate action in cases of suspected misconduct. Any breaches of ethical standards will lead to correction, retraction, or other appropriate measures.

21–22 November 2025

Sofia, Bulgaria

IV International Scientific Congress “Applied Sports Sciences”

21–22 November 2025
Sofia, Bulgaria

PROCEEDING BOOK

EDITORS OF THE PROCEEDING BOOK:

Prof. Ognyan Miladinov, DSc
Assoc. Prof. Milena Kuleva, PhD
Assoc. Prof. Stefka Djobova, PhD

SCIENTIFIC COMMITTEE

Design: Slavka Asenova, Svetla Kostova
Publisher: Scientific Publishing House NSA Press
ISBN (Online): 978-954-718-803-7