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## The perspective of the Paris 2024 Olympic Games from the analysis of continental championships in women's artistic gymnastics

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### Abstract

*Aim.* By analyzing the performances of all participants in the continental competitions of women's artistic gymnastics, we aim to create a 'profile' of the potential winning gymnast in team events, individual all-around, as well as apparatus competitions at the 2024 Paris Olympics.

*Material and methods.* The study was conducted by analyzing the scores achieved by gymnasts from four continents at the continental competitions mentioned above. At the African Championships, 25 athletes from 7 countries participated, at the European Championships, 154 gymnasts from 38 countries participated, at the Asian Championships, 46 athletes from 14 countries participated, at the Pan American Championships, 60 athletes from 20 countries participated.

*Results.* Following the execution of this study and monitoring the results of each previously mentioned continental competition, we have gathered a set of valuable data, including: Team competition results; Individual all-around competition results; Apparatus competition results. All of these data/grades/results can provide us with valuable information regarding the skill level of the continental representative athletes, either on a national level, in the individual all-around, or on specific apparatuses, at this training stage. By analyzing the obtained data, we have been focusing on preparation for the most crucial competition concluding this Olympic cycle.

*Conclusions.* We consider that the winners at the 2024 Paris Olympic Games, based on the profile obtained from the data collected, will be those who accumulate a minimum total of 166,000 points in the team competition, over 56,000 points in the Individual All-Around competition, an average of over 14,000 points between the two vaults in the Vault competition, a minimum of 14,600 points on Uneven Bars, a minimum of 14,400 points on Beam, and over 14,000 points in Floor Exercise.

**Key words:** women's artistic gymnastics, Olympic Games, continental championships.

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## Introduction

Artistic gymnastics continues to spark genuine interest globally among spectators, viewers, and online streaming audiences. In the last four editions of the Summer Olympics, gymnastics overall and Women's Artistic Gymnastics specifically have taken the top spot among viewers, based on recordings and statistical indicators.

In May 2013, the International Olympic Committee declared that gymnastics is in the top tier of the three most popular and revenue ranking Olympic sports, which ensures that gymnastics will remain in the Olympics as one of the five original sports (Grossfeld, 2014).

After the 2000 - Sydney and 2004 - Athens Olympics, the regulations governing Artistic Gymnastics, under which all official competitions of this sport discipline take place, underwent significant systematic changes. These modifications were justified by the 'monopoly' held by the four countries, namely Romania, Russia, the USA, and China, who had become regulars on the Olympic podium in team events, individual all-around, and apparatus competitions. Following these repeated changes, supported across various sections of the scoring code, other countries with their representative athletes and teams emerged, competing for medals. Among these, we can mention: Great Britain, Italy, Germany, France, Australia, Canada, Brazil, South Africa, Japan, South Korea, Mexico, Slovenia, etc.

In 2021, Atiković, A., Kamenjašević, E., made a prediction related to the individual all-around competition from the perspective of difficulty and execution scores and concluded that the vault apparatus carries significantly more weight than the other apparatuses and that an issue lies in the inequality among the apparatuses, specifically that the vault apparatus has special rules compared to the other three apparatuses. Additionally, the authors noted that success in the individual all-around competition may be influenced by the D and E scores on uneven bars and the E score on beam. The non-significant predictors were the D scores on Vault, beam, and floor.

The purpose of the paper: By analyzing the performances of all participants in the continental competitions of women's artistic gymnastics, we aim to create a 'profile' of the potential winning gymnast in team events, individual all-around, as well as apparatus competitions at the 2024 Paris Olympics.

The tasks of the paper: One of the first tasks was to collect and tabulate the data. The monitored competitions included:

- 2024 European Women's Artistic Gymnastics Championships – Rimini, Italy;
- 2024 Pan American Artistic Gymnastics Championships – Santa Marta, Colombia;
- 2024 Asian Women's Artistic Gymnastics Championships - Tashkent, Uzbekistan;
- 2024 African Artistic Gymnastics Championships - Marrakesh, Morocco.

The research hypothesis: We consider that by collecting, analyzing, and interpreting the data recorded from the female athletes participating in continental competitions, we can objectively outline the profile of the gymnasts, the value of the scores, and potential winners at the Paris 2024 Olympics.

## Material and methods

The study was conducted by analyzing the scores achieved by gymnasts from four continents at the continental competitions mentioned above. At the African Championships, 25 athletes from 7 countries participated, with an average age of 19 years. Among them, 16 competed in the all-around event, 13 performed 2 vaults, 21 competed on the uneven bars, 22 on the balance beam, and 22 on the floor exercise.

At the European Championships, 154 gymnasts from 38 countries participated, with an average age of 20 years. Among them, 86 competed in the all-around event, 38 performed 2 vaults, 123 competed on the uneven bars, 127 on the balance beam, and 124 on the floor exercise.

At the Asian Championships, 46 athletes from 14 countries participated, with an average age of 20 years. Among them, 29 competed in the all-around event, 19 performed 2 vaults, 38 competed on the uneven bars, 39 on the balance beam, and 36 on the floor exercise.

At the Pan American Championships, 60 athletes from 20 countries participated, with an average age of 20 years. Among them, 39 competed in the all-around event, 17 performed 2 vaults, 50 competed on the uneven bars, 54 on the balance beam, and 52 on the floor exercise.

## Results

Following the execution of this study and monitoring the results of each previously mentioned continental competition, we have gathered a set of valuable data, including:

- Team competition results;
- Individual all-around competition results;

- Apparatus competition results.

All of these data/grades/results can provide us with valuable information regarding the skill level of the continental representative athletes, either on a national level, in the individual all-around, or on specific apparatuses, at this training stage. By analyzing the obtained data, we have been focusing on

preparation for the most crucial competition concluding this Olympic cycle.

Figure 1 displays the average scores achieved by the 4 continents (Africa, America, Asia, and Europe) in the monitored competitions, in the team competition, at each apparatus, and the final score.

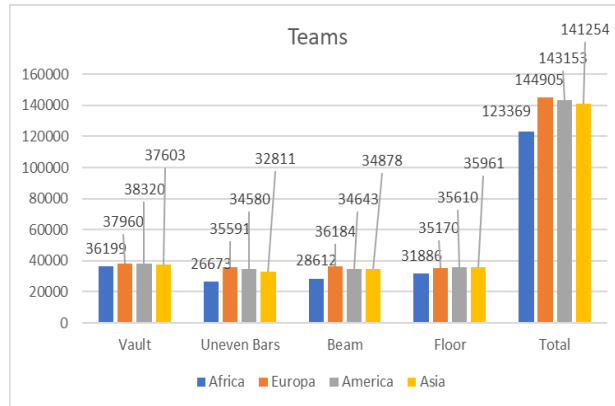


Fig. 1. Average scores in the team competition

In Table 1, a ranking of the top 10 nations has been compiled based on the final score.

Table 1. Ranking in the team competition

Nr.crt.	Team	Total
1	ITA	165,296
2	GBR	161,430
3	FRA	159,130
4	ROU	158,798
5	CHN	154,598
6	ESP	154,462
7	NED	153,995
8	GER	153,697
9	BRA	153,334
10	SWE	152,430

In Figure 2, the average scores achieved by the 4 continents (Africa, America, Asia, and Europe) in the monitored competitions, in the individual all-around competition, at each apparatus, and the final score are presented.

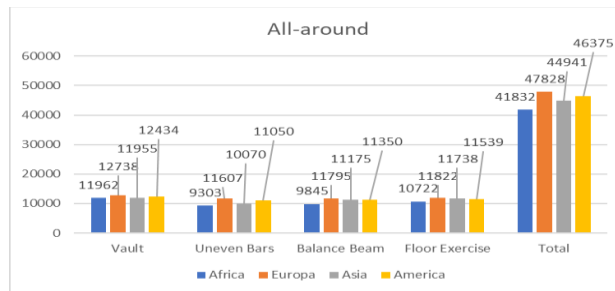


Fig. 2. Average scores in the individual all-around competition

In Table 2, the scores achieved by the competing gymnasts in the individual all-around competition are shown, and a ranking of the top 15 athletes has been compiled.

**Table 1.** Ranking in the individual all-around competition

Nr. Crt.	Team	Name	Vault				Uneven bars				Balance beam				Floor exercise				Total
			D	E	pen	Total	D	E	pen	Total	D	E	pen	Total	D	E	pen	Total	
1	ITA	ESPOSITO Manila	4,6	8.966		13.566	5,9	8.166		14.066	6,0	8.200		14.200	5,7	7.900		13.600	55,432
2	ITA	D'AMATO Alice	5,0	8.966		13.966	6,4	8.233		14.633	5,8	7.966		13.766	5,7	7.166	0.4	12.466	54,831
3	ITA	ANDREOLI Angela	4,6	9.033		13.633	5,4	7.633		13.033	5,7	8.000		13.700	5,9	7.800	0.3	13.400	53,766
4	GBR	KINSELLA Alice	5,0	9.000		14.000	5,8	7.533		13.333	5,3	7.500		12.800	5,5	7.966		13.466	53,599
5	ROU	MANECA-VOINEA Sabrina	5,0	8.600		13.600	4,4	6.900		11.300	6,5	7.600		14.100	5,8	7.900		13.700	52,700
6	ESP	PETISCO Alba	4,6	8.800		13.400	5,3	7.700		13.000	5,6	7.533		13.133	5,4	7.766		13.166	52,699
7	GBR	FENTON Georgia-Mae	4,6	9.033		13.633	5,8	7.933		13.733	5,4	7.066		12.466	5,3	7.833	0.3	12.833	52,665
8	MEX	Pineda Michelle	4,6	8.733		13.333	4,6	8.267		12.867	5,0	8.133		13.133	5,1	8.100		13.200	52,533
9	FRA	OSYSSEK-REIMER Morgane	4,4	8.766		13.166	5,2	7.800		13.000	5,5	7.466	0.1	12.866	5,6	7.900	0.1	13.400	52,432
10	ROU	COSMAN Lilia	4,6	8.800		13.400	5,5	7.600		13.100	5,8	7.466		13.266	5,1	7.500		12.600	52,366
11	HUN	SZEKELY Zoja	4,2	8.800		13.000	6,1	7.566		13.666	4,8	8.033		12.833	4,7	7.833		12.533	52,032
12	BRA	Lima Andreza	4,2	9.133		13.333	5,0	7.100		12.100	5,8	7.700		13.500	5,2	7.833		13.033	51,966
13	BEL	BRASSART Maellyse	4,2	9.000	0.1	13.100	5,7	7.833		13.533	4,8	8.133		12.933	4,7	7.766	0.1	12.366	51,932
14	GBR	EVANS Ruby	5,0	9.066		14.066	5,2	7.633		12.833	4,6	7.166		11.766	5,4	7.700		13.100	51,765
15	ROU	BARBOSU Ana	5,0	8.666		13.666	6,1	6.833		12.933	5,5	7.133		12.633	5,5	7.100	0.1	12.500	51,732

Below are the average scores achieved by the 4 continents in the monitored competitions in the Vault competition - Figure 3, Uneven Bars competition - Figure 4, Balance Beam competition - Figure 5, and Floor Exercise competition - Figure 6.

The following tables show the scores of the gymnasts who performed 2 vaults to qualify for the final on this apparatus (Table 3), the scores obtained by gymnasts on the Uneven Bars (Table 4), Balance Beam (Table 5), and Floor Exercise (Table 6), and a ranking of the top 15 gymnasts at each apparatus has been compiled.

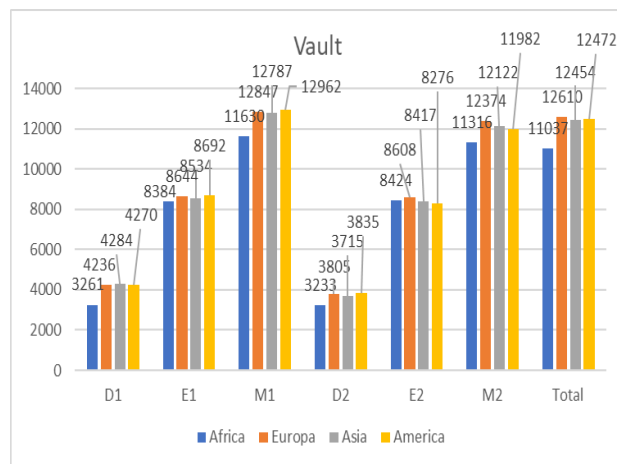
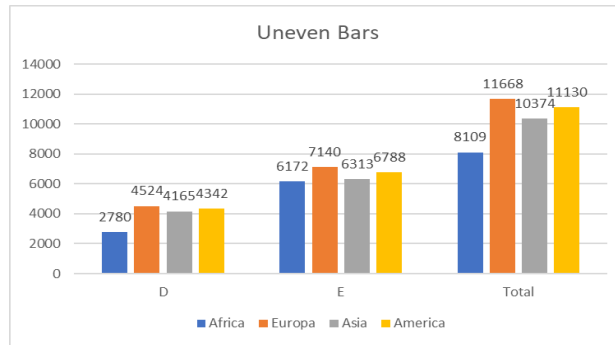


Fig. 3. Average scores in the Vault competition

**Table 3.** Ranking in the Vault competition

Nr. Crt.	Team	Name	Vault 1				Vault 2				Medie
			D	E	pen	Total	D	E	pen	Total	
1	FRA	DEVILLARD Coline	5,4	9.100		14.500	4,4	9.066		13.466	13.983
2	FRA	VAN EIJKEN Ming	5,4	8.900		14.300	4,4	8.966		13.366	13.833
3	BUL	GEORGIEVA Valentina	5,0	9.100		14.100	4,4	9.133		13.533	13.816
4	PAN	Karla Navas	4,6	8.967		13.567	5,2	8.733		13.933	13.750
5	ROU	BARBOSU Ana	5,0	8.666		13.666	4,8	8.800		13.600	13.633
6	DEN	RASMUSSEN Camille	5,0	8.766		13.766	4,4	8.700		13.100	13.433
7	PRK	KIM Son Hyang	5,0	8.566	0,1	13.466	5,4	8.100		13.400	13.433
8	GER	SCHOENMAIER Karina	4,2	9.033		13.233	4,8	8.833	0.1	13.533	13.383
9	PRK	JO Kyong Byol	5,0	8.633		13.633	4,0	8.800		12.800	13.216
10	GER	GOTTHARDT Marlene	4,6	8.900		13.500	4,2	8.766	0.1	12.866	13.183
11	HUN	PETER Sara	4,2	9.066		13.266	4,0	9.033		13.033	13.149
12	ECU	Ashley Bohorquez	4,6	8.833		13.433	4,4	8.400		12.800	13.117
13	PAN	Hillary Heron	4,6	8.900		13.500	4,0	8.567		12.567	13.034
14	ESP	MASFERRER Laia	4,6	8.900		13.500	3,8	8.766		12.566	13.033
15	NED	GEURTS Elisabeth	5,0	8.766	0.3	13.466	3,8	9.100	0.3	12.600	13.033



*Fig. 4.* Average scores in the Uneven bars competition

**Table 4.** Ranking in the Uneven bars competition

Nr.crt.	Team	Name	D	E	Total
1	ITA	D'AMATO Alice	6,4	8.233	14,633
2	GBR	DOWNIE Rebecca	6,4	8.100	14,500
3	ITA	IORIO Elisa	6,3	8.000	14,300
4	ITA	ESPOSITO Manila	5,9	8.166	14,066
5	GER	KEVRIC Helen	6,2	7.866	14,066
6	CHN	HU Jiafei	6,3	7.500	13,800
7	SWE	WESTLUND Nathalie	5,6	8.133	13,733
8	GBR	FENTON Georgia-Mae	5,8	7.933	13,733
9	POR	MARTINS Filipa	5,4	8.300	13,700
10	HUN	SZEKELY Zoja	6,1	7.566	13,666
11	FIN	KUUSIKKO Maisa	6,0	7.600	13,600
12	BEL	BRASSART Maellyse	5,7	7.833	13,533
13	SWE	PAULSSON Tonya	5,3	8.200	13,500
14	NED	GEURTS Elisabeth	5,7	7.766	13,466
15	FRA	CHARPY Lorette	5,8	7.533	13,333

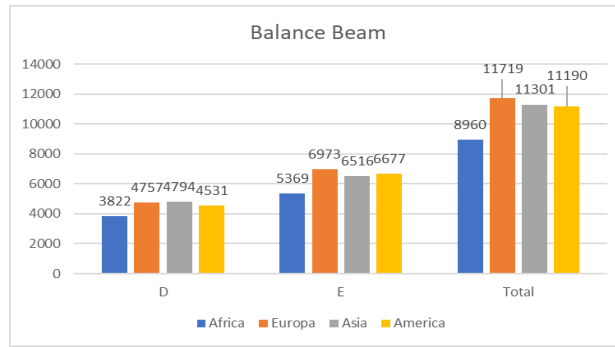


Fig. 5. Average scores in the Balance beam competition

Table 5. Ranking in the Balance beam competition

Nr.crt.	Team	Name	D	E	Total
1	ITA	ESPOSITO Manila	6,0	8.200	14,200
2	ROU	MANECA-VOINEA Sabrina	6,5	7.600	14,100
3	FRA	BOYER Marine	6,0	7.800	13,800
4	ITA	D'AMATO Alice	5,8	7.966	13,766
5	ITA	ANDREOLI Angela	5,7	8.000	13,700
6	CHN	QIN Xinyi	6,0	7.700	13,700
7	BRA	Andreza Lima	5,8	7.700	13,500
8	TPE	TING Hua-Tien	5,8	7.566	13,366
9	PRK	PAK Un Jong	6,1	7.233	13,333
10	ROU	COSMAN Lilia	5,8	7.466	13,266
11	ITA	D'AMATO Asia	5,1	8.133	13,233
12	ESP	PEREZ Ana	5,2	7.966	13,166
13	ESP	PETISCO Alba	5,6	7.533	13,133
14	MEX	Michelle Pineda	5,0	8.133	13,133
15	UKR	DIACHENKO Polina	5,4	7.600	13,000

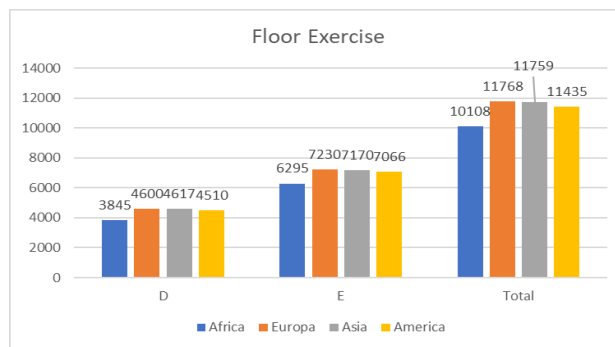


Fig. 6. Average scores in the Floor Exercise competition

Table 6. Ranking in the Floor Exercise competition

Nr.crt.	Team	Name	D	E	Pen.	Total
1	ROU	MANECA-VOINEA Sabrina	5,8	7.900		13,700
2	ITA	ESPOSITO Manila	5,7	7.900		13,600
3	GBR	KINSELLA Alice	5,5	7.966		13,466
4	FRA	OSYSSEK-REIMER Morgane	5,6	7.900	0.1	13,400
5	ITA	ANDREOLI Angela	5,9	7.800	0.3	13,400
6	PHI	MALABUYO Emma	5,1	8.233		13,333
7	GBR	MARTIN Abigail	5,7	7.633	0.1	13,233

8	MEX	Michelle Pineda	5,1	8.100		13,200
9	ESP	PETISCO Alba	5,4	7.766		13,166
10	EGY	Jana MAHMOUD	5.1	8.033		13,133
11	GBR	EVANS Ruby	5,4	7.700		13,100
12	KAZ	BAUYRZHANOVA Aida	5,0	8.066	0	13,066
13	FRA	VAN EIJKEN Ming	5,2	7.833		13,033
14	BRA	Andreza Lima	5,2	7.833		13,033
15	TPE	LIAO Yi-Chun	5,0	8.000	0	13,000

**Discussion**

In the team competition, in Figure 1, we observe that in the Vault apparatus, America has the highest score - 38.320 points, followed by Europe and Asia with scores above 37.000 points, and Africa with a score of 36.199 points. On the Uneven Bars, Europe has the highest score, 35.591 points, followed by America with 34.580 points, Asia with 32.811 points, and a significantly lower score for Africa, 26.673 points. On the Balance Beam, Europe has a score of 36.184 points, while America and Asia scored above 34.600 points, and Africa scored 28.612 points. For the Floor Exercise, Asia, America, and Europe scored above 35.000 points, while Africa scored 31.886 points. Regarding the final score, Europe totals 144.905 points, America 143.153 points, Asia 141.254 points, and Africa 123.369 points. In Table 1, it is highlighted that the top 4 ranked nations are from Europe. Among the top 10 countries, 8 teams are from Europe, 1 from Asia, and 1 from America.

In the individual all-around competition, from Figure 2, the following is apparent: in the Vault, Europe and America have close scores, both above 12.400 points, followed by Africa and Asia with scores around 11.900 points. On the Uneven Bars, Europe and America scored over 11.000 points, Asia over 10.000 points, and Africa over 9.800 points. On the Balance Beam, Europe, America, and Asia scored above 11.000 points, while Africa scored 9.845 points. For the Floor Exercise, Europe, America, and Asia achieved close scores, all above 11.500 points, with Africa scoring 10.722 points. In the final score, Europe accumulated 47.828 points, America 46.375 points, Asia 44.941 points, and Africa 41.832 points. In Table 2, it is observed that among the top 15 gymnasts in the individual all-around competition, 13 athletes are from Europe and 2 from America. The highest score was achieved by a gymnast from Europe, totaling 55.432 points.

In the Vault competition, as shown in Figure 3, we observe that for the difficulty of the first vault, Asia, America, and Europe averaged 4.2 points, while Africa

averaged 3.2 points. The average difficulty of the second vault was 3.8 points for America and Europe, 3.7 points for Asia, and 3.2 points for Africa. For the execution of the first vault, the average scores ranged from 8.693 points (America) to 8.384 points (Africa). For the second vault, the execution score was 8.608 points for Europe, around 8.400 points for Africa and Asia, and 8.276 points for America. The average score for both vaults was 12.610 points for Europe, 12.400 for America and Asia, and 11.037 for Africa. In Table 3, it is noted that among the top 15 gymnasts who performed 2 vaults, 10 athletes are from Europe, 3 from America, and 2 from Asia. The highest score was achieved by a gymnast from Europe, totaling 13.983 points. A surprise in this event is the appearance of a gymnast from Panama, ranked among the top 4 athletes.

In the Uneven Bars competition, as depicted in Figure 4, we see that the average difficulty score is 4.5 points for Europe, 4.3 points for America, 4.1 points for Asia, and 2.7 points for Africa. The execution score was above 7.000 points in Europe and above 6.000 points in America, Asia, and Africa. The total score on this apparatus was 11.668 points in Europe, 11.130 points in America, 10.374 points in Asia, and 8.109 points in Africa. In Table 4, it is evident that among the top 15 gymnasts who competed on the Uneven Bars, 14 athletes are from Europe and 1 from Asia. The highest score was achieved by a gymnast from Europe, totaling 14.633 points.

In the Balance Beam competition, as shown in Figure 5, we observe that the average difficulty score is 4.7 points for Asia and Europe, 4.5 points for America, and 3.8 points for Africa. The execution score was above 6,000 points in Europe (6.973), America (6.677), and Asia (6.516), while Africa scored 5.369 points. The total score on this apparatus was 11.719 points in Europe, 11.190 points in America, 11.301 points in Asia, and 8.960 points in Africa. In Table 5, it is noted that among the top 15 gymnasts who competed on the Balance Beam, 10 athletes are from Europe, 3 from Asia, and 2 from America. The highest score was

achieved by a gymnast from Europe, totaling 14.200 points.

In the Floor Exercise competition, as depicted in Figure 6, we see that the average difficulty score is 4.6 points for Asia and Europe, 4.5 points for America, and 3.8 points for Africa. The execution score was above 7,000 points in Europe (7.230), Asia (7.170), and America (7.066), while Africa scored 6.295 points. The total score on this apparatus was 11.768 points in Europe, 11.759 points in Asia, 11.435 points in America, and 10.108 points in Africa. In Table 6, it is observed that among the top 15 gymnasts who competed on the Floor Exercise, 9 athletes are from Europe, 3 from Asia, 2 from America, and 1 from Africa. The highest score was achieved by a gymnast from Europe, totaling 13.700 points. It is noteworthy to see a gymnast from the Philippines ranked among the top 6 athletes. Additionally, it is a surprise to find a gymnast from Africa among the top 15 ranked athletes.

### Conclusions

The majority of gymnasts/teams with a track record, especially the USA, Brazil, China, and Japan, did not participate in continental competitions or presented a team with younger members to enhance their competitive experience. Others opted to continue their training, believing it would significantly boost their preparation for a successful participation in the 2024 Paris Olympics, compared to athletes who took part in continental competitions. This scenario was observed in both individual all-around and apparatus competitions. This approach is part of the tactical component of individual training.

In the case of the United States women's artistic gymnastics team, we noted that the athletes did not compete in the Pan American Games. The American federation organized national competitions, thus

avoiding direct confrontation with opponents until the upcoming Paris Olympic Games this summer.

Some athletes chose to perform easier routines in these competitions and did not increase the difficulty level of their exercises in the monitored competitions.

We consider that the winning podium at the 2024 Olympics, based on the profile obtained from the data analysis, will have a minimum score of 166,000 points.

The podium in the individual all-around competition at the 2024 Olympics will consist of gymnasts who manage to achieve a score of over 56,000 points, with an average D score of over 5.5 points, and an execution score around 8.4.

The podium in the vault competition at the 2024 Olympics will be composed of gymnasts who achieve an average score of over 14,000 points for the two vaults, with an average D score of over 5.0 points, and an execution score ranging between 9.2 and 8.8.

The podium in the uneven bars competition at the 2024 Olympics will be composed of gymnasts who manage to achieve a minimum score of 14,600 points, with a D score of 6.4 points and an execution score above 8.2.

The podium in the balance beam competition at the 2024 Olympics will consist of gymnasts who achieve a minimum score of 14,400 points, with a D score of over 6.0 points, and an execution score around 8.5-8.2.

The podium in the floor exercise competition at the 2024 Olympics will be composed of gymnasts who achieve a final score of at least 14,100 points, with a D score of 6.0 points and an execution score of 8.3-8.1.

To highlight the statements above, we create a centralized table showing the scores that gymnasts need to achieve in competition to secure a place on the Olympic podium (Table 7) as follows:

**Table 7.** The prediction of winning scores at the Olympic Games, Paris 2024

Competition	D score	E score	Final Score
Team			166,000 p.
All-around			56,000 p.
Vault	5,0	8,8-9,2	+14,000 p.
Uneven bars	6,4	8,2	+14,600 p.
Balance beam	6,0	8,2-8,5	+14,400 p.
Floor exercise	6,0	8,1-8,3	+14,000 p.

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