

Who Was “z-Best” Swimmer in the Paris 2024 Olympics?

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Abstract

The authors examine performances in swimming events during the 2024 Paris Olympics with the purpose of discovering the most dominant male and female swimmer. By standardizing performances using a z -score (the number of standard deviations from the average performance in the finals of each swimming event), winners were compared among fourteen men’s and fourteen women’s swimming events. The most dominant male swimmer (with the highest z -score, calculated with or without the last place finisher) was not Frenchman Léon Marchand, but rather Chinese swimmer Pan Zhanle. The most dominant female swimmer was not American Katie Ledecky, but Sweden’s Sarah Sjöström (with the highest z -score calculated with the last place finisher) or Canada’s Summer McIntosh (with the highest z -score calculated without the last place finisher).

Keywords

2024 Summer Olympics, z -Scores, Best Swimming Performance

1. Introduction

Katie Ledecky of the United States was again a standout swimmer on the Olympic stage. She was one of, if not the best female swimmer in the Paris 2024 Olympics where she won four medals, including two gold, one silver, and one bronze. Léon Marchand of France was widely considered to be the best male swimmer who won five medals, including four gold and one bronze. Admittedly, which female and male swimmer was “best” is subjective. Should this determination be simply based on medal count? Olympic or even world records established? And, how does one compare swimmers across different events and different strokes? After all, a short sprint race is quite different from a distance freestyle event.

The question was posed in a *Wall Street Journal* article titled “The Best Olympic Performances So Far” by Matthew Futterman (Futterman, 2010) converted winning scores or times to *z*-scores, that is, the number of standard deviations above or below the average performance in the finals of a particular event. MacKay, Markusen, and Sommers (MacKay et al., 2014) used *z*-scores to find the “*z*-best” Olympians in swimming, track, and gymnastics in the 2008 Beijing and 2012 London Summer Olympics.

The purpose of this brief research note is to settle the question of who was the best female and male swimmer in the Paris 2024 Olympics. The method used is to determine how many standard deviations the winner of each swimming event finished above the mean. The analysis reveals that the biggest names in the sport are not always the most dominant statistically speaking.

2. The Data

All fourteen individual swimming events were selected for women and men: 50 m(eter) freestyle (hereafter, free); 100 m free; 200 m free; 400 m free; 800 m free; 1500 m free; 100 m backstroke (hereafter, back); 200 m back; 100 m breaststroke (hereafter, breast); 200 m breast; 100 m butterfly (hereafter, fly); 200 m fly; 200 m individual medley (hereafter, IM, a combination of four different swimming styles—butterfly, backstroke, breaststroke, and freestyle—swum in this order, each for a distance of 50 m or a quarter of the total distance of the race); and 400 m IM.

Detailed event results in the finals of each event rather than semifinals or earlier heats can be viewed at (Goodman, 2024) and are shown for both women and men in Table 1. All times are expressed to hundredths of a second. Our primary data source is Goodman (Goodman, 2024).

Table 1. Times (seconds) of finalists in all swimming events, 2024 summer Olympics in Paris, France.

Women's events				
<i>50 m free</i>	<i>100 m free</i>	<i>200 m free</i>	<i>400 m free</i>	<i>800 m free</i>
23.71	52.16	113.27	237.49	491.04
23.97	52.29	113.81	238.37	492.29
24.2	52.33	114.55	240.86	493
24.21	52.34	115.29	241.12	494.55
24.33	52.72	115.38	242.14	497.82
24.35	52.82	115.47	242.26	501.09
24.37	52.83	115.59	243.53	502.8
24.39	53.04	116.6	244.96	503.27
<i>1500 m free</i>	<i>100 m back</i>	<i>200 m back</i>	<i>100 m breast</i>	<i>200 m breast</i>
930.02	57.33	123.73	65.28	139.24

Continued

940.35	57.66	124.26	65.54	139.6
941.16	57.98	125.57	65.59	141.05
944.05	58.29	125.61	65.6	142.54
961.03	58.98	127.53	65.6	143.75
962.7	59.25	127.96	65.85	144.31
962.86	59.4	128.16	66.5	144.46
972.57	59.8	130.23	66.54	145.91
<i>100 m fly</i>	<i>200 m fly</i>	<i>200 m IM</i>	<i>400 m IM</i>	
55.59	123.03	126.56	267.71	
55.63	123.84	126.92	273.4	
56.21	125.09	128.08	274.93	
56.42	127.11	128.49	275.67	
56.44	127.11	129.51	278.01	
56.93	127.73	129.74	278.83	
57.19	128.15	DNS ^a	280.17	
57.34	128.82	DSQ ^b	280.7	

^aDid Not Start; ^bDisqualified.**Men's events**

<i>50 m free</i>	<i>100 m free</i>	<i>200 m free</i>	<i>400 m free</i>	<i>800 m free</i>
21.25	46.4	104.72	221.78	458.19
21.3	47.48	104.74	222.21	458.75
21.56	47.49	104.79	222.5	459.38
21.58	47.5	104.87	222.64	462.83
21.59	47.71	105.46	222.76	463.59
21.61	47.8	105.46	224.24	463.59
21.62	47.96	105.57	226.59	466.16
21.64	47.98	106.26	227	468.36
<i>1500 m free</i>	<i>100 m back</i>	<i>200 m back</i>	<i>100 m breast</i>	<i>200 m breast</i>
870.67	52	114.26	59.03	125.85
874.55	52.32	114.82	59.05	126.79
879.63	52.39	114.85	59.05	127.9
880.91	52.41	115.38	59.11	128.46
881.22	52.58	115.39	59.3	128.79
883.35	52.73	115.47	59.32	128.83
884.66	52.77	115.6	59.5	129.52

Continued

892.61	52.84	115.97	59.98	131.44
<i>100 m fly</i>	<i>200 m fly</i>	<i>200 m IM</i>	<i>400 m IM</i>	
49.9	111.21	114.06	242.95	
49.99	111.75	115.31	248.62	
50.45	112.8	116	248.66	
50.55	113.9	116.1	248.85	
50.75	114.14	116.46	249.38	
50.83	114.17	116.82	250.44	
51.1	114.55	117.21	251.78	
51.11	114.85	117.26	257.16	

Source: <https://www.olympics.com/en/paris-2024/results/swimming>.

3. Methodology

All individual events involved eight finalists, save for a disqualified swimmer and a swimmer who did not start in the women's 200 m IM (and hence with six finalists). For each winner, we also report her or his "adjusted" z -score, that is, the winner's z -score is recalculated after dropping the finalist who finished in last place (and hence had the lowest z -score). In a swimming event where the last place finisher badly trails the pack and knows (especially in the longer races) that they are not likely to medal, the standard deviation of all eight finalists will be much larger than when the last place finisher is excluded from our calculations. This is our rationale for reporting an "adjusted" z -score that removes the last-place swimmer. In such an event, the winner's z -score which is equal to $(\text{winner's time} - \text{average time}) \div (\text{standard deviation of all times})$ will be smaller with the eighth-place finisher's slow time than without her/his time. Since fast times in swimming are preferred to slow times, the winner's unadjusted (as well as the winner's adjusted) z -score will always be reported as a positive number; the last place finisher's z -score would always be reported as a negative number. Differences in a negative and a positive z -score can be a matter of hundredths of a second.

One could compare the average unadjusted (adjusted) z -value for female and male swimmers to assess whether one gender or the other was more dominant in winning their fourteen events. Two-sample t -tests were run on the difference between the average unadjusted (and adjusted) z -scores for gold medalist women and men. These fourteen z -scores were paired by event. A statistically discernible difference (using $\alpha = 0.05$) between the two means would suggest gold medalists of one gender or the other dominated their races.

4. The Results

Table 2 shows the winner's unadjusted and adjusted z -scores in the fourteen different individual women's and men's swimming events, respectively. Sarah

Table 2. z-Scores from the 2024 Paris Summer Olympics, women's and men's individual swimming events.

Event	Gold Medalist	Country	z-Score	
			Unadjusted	Adjusted
Women				
50 m freestyle	S. Sjöström	Sweden	2.021	1.87
100 m freestyle	S. Sjöström	Sweden	1.258	1.205
200 m freestyle	<i>M. O'Callaghan</i> ^a	Australia	1.617	1.634
400 m freestyle	A. Titmus	Australia	1.548	1.534
800 m freestyle	K. Ledecy	USA	1.206	1.106
1500 m freestyle	<i>K. Ledecy</i>	USA	1.473	1.429
100 m backstroke	<i>K. McKeown</i>	Australia	1.402	1.336
200 m backstroke	K. McKeown	Australia	1.315	1.332
100 m breaststroke	T. Smith	South Africa	1.15	1.109
200 m breaststroke	K. Douglass	USA	1.385	1.32
100 m butterfly	T. Huske	USA	1.334	1.254
200 m butterfly	<i>S. McIntosh</i>	Canada	1.575	1.477
200 m IM	<i>S. McIntosh</i>	Canada	1.27	1.13
400 m IM	S. McIntosh	Canada	1.98	1.873
Men				
50 m freestyle	C. McEvoy	Australia	1.756	1.606
100 m freestyle	P. Zhanle ^b	China	2.265	2.118
200 m freestyle	D. Popovici	Romania	0.937	0.947
400 m freestyle	L. Maertens	Germany	0.953	0.882
800 m freestyle	<i>D. Wiffen</i>	Ireland	1.215	1.191
1500 m freestyle	B. Finke	USA	1.56	1.731
100 m backstroke	T. Ceccon	Italy	1.801	1.724
200 m backstroke	H. Kos	Hungary	1.773	1.763
100 m breaststroke	N. Martinenghi	Italy	0.809	0.909
200 m breaststroke	<i>L. Marchand</i>	France	1.53	1.687
100 m butterfly	K. Milak	Hungary	1.494	1.39
200 m butterfly	<i>L. Marchand</i>	France	1.642	1.528
200 m IM	<i>L. Marchand</i>	France	1.957	1.845
400 m IM	<i>L. Marchand</i>	France	1.717	2.064

^a*Italicized* names broke the Olympic record. ^bNames in **boldface** broke the World record.

Sjöström of Sweden posted the highest unadjusted z -score (2.021) and the only unadjusted z -score above 2.0 among women swimmers in the 2024 Summer Olympics in Paris, earning a gold in the 50 m freestyle and setting an Olympic record in the semifinals of this event. Canadian Summer McIntosh won gold medals in the 200 m butterfly and the 200 m and 400 m individual medleys, breaking Olympic records in both the 200 m butterfly and the 200 m IM. Her time in the 400 m IM was the highest adjusted z -score (1.873), edging out Sjöström's adjusted z -score (1.870) in the 50 m freestyle. Katie Ledecky won the two distance freestyle events, the 800 m and 1500 m. Yet her unadjusted and adjusted z -scores in the 800 m free ranked 13th and 14th, respectively; in the 1500 m free, her unadjusted and adjusted z -scores were both only 6th best.

Among the men, Chinese swimmer Pan Zhanle set a new world record and posted the highest unadjusted and adjusted z -scores (2.265 and 2.118, respectively) in the 100 m freestyle.

Zhanle's winning time of 46.40 seconds was equivalent to an average speed in the water of 4.821 miles per hour. By comparison, Australian Cameron McEvoy's winning time of 21.25 seconds in the 50 m freestyle was equivalent to 5.263 miles per hour. Frenchman Léon Marchand posted the second highest unadjusted z -score in the 200 m IM and the second highest adjusted z -score in the 400 m IM, winning two of his four gold medals and setting Olympic records in both events.

Was one gender or the other more dominant in winning their fourteen events? Insofar as the unadjusted z -values are concerned, a two-tailed paired t -test yielded an average 1.529 for men and an average 1.467 for women, with a p -value of 0.631 on the difference between the two means. As for the adjusted z -values, a two-tailed paired t -test on the difference between the two means (1.528 for men *v.* 1.401 for women) yielded a p -value of 0.321. That is, the winners in the men's races were neither more nor less dominant than the winners in the women's races.

5. Concluding Remarks

Standardized scores known as z -scores are used to determine the most dominant Olympian in women's and men's swimming at the 2024 Paris Games. Our z -scores capture dominance within a single final, not overall Olympic value across multiple events, relay contributions, or total medal count.

The most dominant or " z -best" female swimmer was Sarah Sjöström of Sweden and " z -best" male swimmer was Pan Zhanle of China. When the last place finisher is excluded from our calculations, one could argue that Summer McIntosh of Canada was " z -best" female swimmer. Fans of American Katie Ledecky (with four medals in Paris and the most decorated female swimmer in Olympic history) and Frenchman Léon Marchand (winner of four individual gold medals and one bronze in Paris) might disagree. The methodology used here could nonetheless be used to show that Katie Ledecky was z -best swimmer at the Olympic Games in Rio (2016) when she was arguably in her prime.

Future research could also compare the distribution of z -scores of the top eight

(unadjusted) and top seven (adjusted) finalists at the 2028 Summer Olympics in Los Angeles to the corresponding distribution of z -scores in 2024 and earlier Summer Games. That is, will there be more standouts or will the talent level increase more equally among future Olympic swimmers?

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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