Performance variability and progression of world-class Paralympic 100m freestyle swimmers: an update for the postponed 2020 Paralympics

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Introduction

- The 2020 Paralympic Games have been postponed due to the COVID-19 pandemic, allowing athletes and coaches one more year of training and preparation.
- What can we expect with regards to swimming performance next summer?
- Performance variability is a very important indicator of performances[7], which was previously quantified in Paralympic swimmers in 2009[5].
- Since then, technical, competitive and classification changes have been implemented in World Para-swimming, including the inclusion of intellectual disability classification[4].
- **Therefore, a re-evaluation of performance progression and variability is required prior to the 2020(1) Paralympic Games.**

Methods

- Top 16 male and female 100m freestyle Paralympic swimmers in the S8 to S14 classes from 2016-2019.
  - S8 to S10: physical impairments; S11 to S13: visual impairments; S14: intellectual disabilities.
- Performance times of 112 athletes were extracted for analysis from publicly-available websites
- A total of 1883 (n=978 male, 905 female) 100m freestyle race performances from 2016 to 2019 were included.
- Smallest worthwhile change (SWC) in performance calculated from within-swimmer variability by year[2,6].
- Using time-series forecasting analysis[3], we estimated the Top 3 (medal-winning) and Top 8 (entry into Finals) times for the 2020(1) Paralympic Games.

Results

- No significant differences in the observed number of races analyzed by year between sexes nor by class (p>0.11).
- **Performance Improvement from 2016-2019:** Females significantly improved (p=0.03) by 3.1%. Males did not (p=0.56).
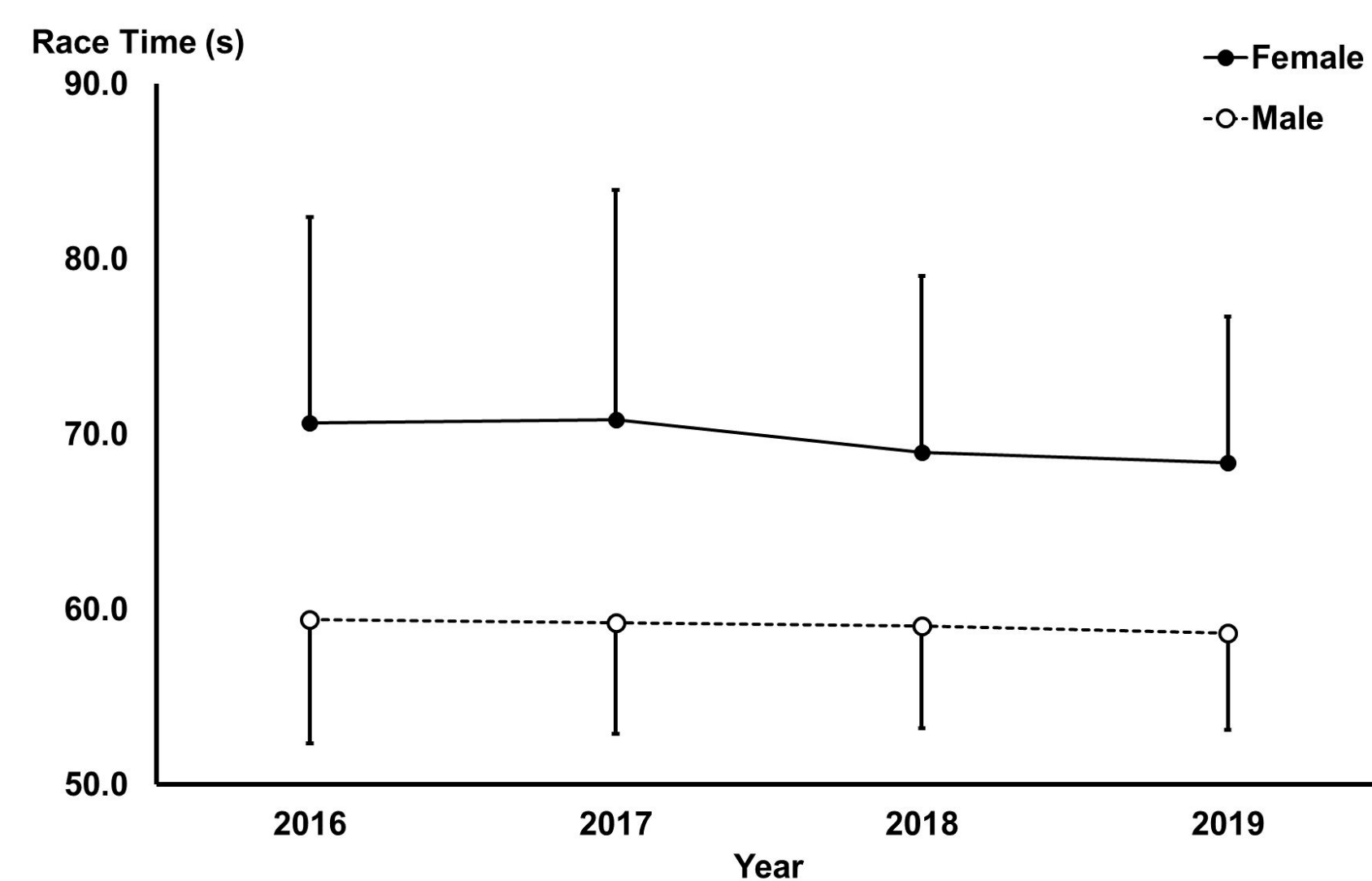

Figure 1. Mean (±SD) 100m freestyle race time for male and female Paralympic swimmers from 2016 to 2019.
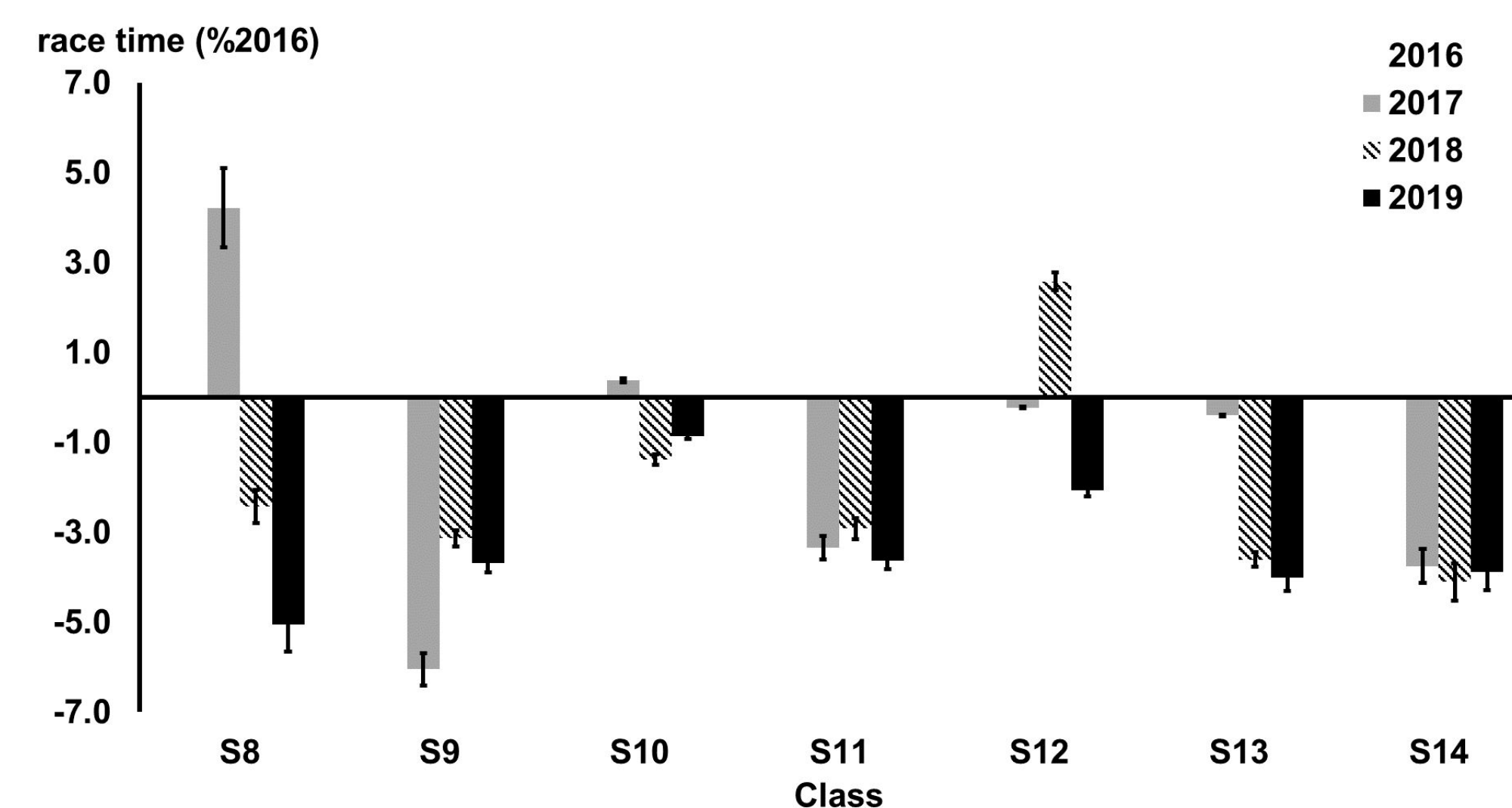

Figure 2. Mean (±SD) performance progression by class. Race time is expressed as a percent of 2016 mean time. Negative values indicate performance improvement.

Results

- Mean **performance progression was ~2%** (Table 1). A main effect of class (p=0.001) was shown: higher disability classes (S8) improving to a greater extent than visual (S12) or intellectual impairment (S14) classes (Figure 2).

Sex	Class	TE	SWC	CV	Progression
Female	S8	1.3	0.7	2.4 ± 1.3	2.6±6.9
	S9	1.0	0.5	1.5 ± 1.0	-0.9±1.1
	S10	1.4	0.7	2.1 ± 1.3	2.6±4.9
	S11	0.8	0.4	1.8 ± 0.7	1.2±1.5
	S12	0.6	0.3	1.2 ± 0.7	-0.6±2.3
	S13	1.9	1.0	2.4 ± 1.9	-0.3±1.7
	S14	1.0	0.5	1.9 ± 1.0	1.9±4.2
Male	S8	1.6	0.8	2.7 ± 1.6	6.1±6.4
	S9	1.8	0.9	2.1 ± 1.8	1.0±1.5
	S10	1.0	0.5	2.0 ± 1.0	0.9±1.8
	S11	1.0	0.5	2.5 ± 0.9	3.4±5.7
	S12	0.9	0.5	1.0 ± 0.8	0.1±1.3
	S13	1.6	0.8	1.7 ± 1.5	4.5±6.1
	S14	1.0	0.5	1.5 ± 0.9	2.7±4.5

(World Para Swimming, n.d.)

(SwimSwam, 2016)

Table 1. Mean Technical error (TE), smallest worthwhile change (SWC) and coefficient of variation (CV), expressed as a %, in male and female Paralympic 100m freestyle swimmers from 2016 to 2019.

Predicting the winning time for the 2020(1) Paralympic 100m Freestyle:

Sex	Class	2017		2018		2019		2021			
		Top-3	Top-8	Top-3	Top-8	Top-3	Top-8	Top-3	90% CI	Top-8	90% CI
Female	S8	66.83	73.46	66.41	69.76	66.11	70.59	66.11	(64.44, 67.78)	71.03	(67.13, 74.93)
	S9	63.52	66.03	63.46	64.95	63.00	64.79	63.05	(62.14, 63.95)	65.21	(63.90, 66.53)
	S10	61.43	63.41	61.21	62.51	60.76	62.82	61.08	(60.38, 61.78)	62.88	(61.98, 63.77)
	S11	70.53	76.25	69.49	74.85	68.30	71.30	69.16	(66.63, 71.68)	74.07	(69.15, 78.98)
	S12	63.08	70.81	60.91	66.84	60.72	61.89	61.45	(58.87, 64.03)	57.97	(50.30, 65.63)
	S13	61.60	64.26	59.46	62.74	59.80	62.53	60.32	(58.10, 62.53)	62.82	(62.09, 63.55)
	S14	62.21	64.26	61.29	63.35	61.10	62.39	61.10	(58.93, 63.27)	60.76	(59.90, 61.61)
Male	S8	60.46	61.87	59.82	62.04	58.89	61.23	58.94	(56.32, 61.56)	61.26	(59.77, 62.74)
	S9	57.13	58.07	56.29	57.90	56.38	57.20	56.70	(55.70, 57.70)	57.67	(56.74, 58.59)
	S10	52.58	55.87	51.99	54.84	51.47	54.90	51.88	(50.64, 53.12)	54.90	(53.43, 56.37)
	S11	60.85	64.08	59.79	61.92	59.09	60.98	59.80	(58.03, 61.58)	62.13	(58.93, 65.32)
	S12	55.00	56.67	53.97	55.95	52.99	54.86	53.94	(51.99, 55.88)	55.87	(54.11, 57.63)
	S13	53.72	56.42	52.57	54.92	52.40	55.08	51.47	(50.06, 52.89)	55.09	(53.20, 56.97)
	S14	54.17	55.51	53.99	55.47	52.76	54.21	51.75	(50.58, 52.92)	53.49	(52.17, 54.82)

Table 2. *Top 3 and Top 8 world rankings from 2016 to 2019, used to predict top 3 and top 8 times for the 2020(1) Paralympic 100m freestyle.*

Conclusions

- Within-swimmer variability is ~2%, which is similar to previous reports in Paralympic swimmers[5], but greater than Olympic swimmers[7].
- Annual performance progression is also ~2%, but differs by sex and by class.
- Time-series forecasting is a quick, convenient method for coaches and athletes to predict future race performances, including those for the 2020(1) Paralympic Games.
- The time-forecasting analysis also suggests that in some classes, there is a ***small but probable chance*** that a Top 8 ranked swimmer could win a medal (Table 2).
- Quantifying within-swimmer variability may be a valuable tool in the World Para-swimming classification process[4].
- Calculating the smallest worthwhile change in performance allows coaches and athletes to determine the effectiveness of training, technical and/or tactical interventions aimed at improving performance.

References available here