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## Relative Age Effect Among French Swimmers

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► **To cite this version:**

Audrey Difernand, Quentin de Larochembert, Robin Pla, Juliana Antero, Jean-François Toussaint, et al.. Relative Age Effect Among French Swimmers. ECSS Sevilla 2022, Aug 2022, Séville, Spain. hal-04002132

**HAL Id: hal-04002132**

**<https://hal.science/hal-04002132>**

Submitted on 23 Feb 2023

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## Context

**Relative age** is defined by the exact age as a precision of the integer age which does not consider the day and month of birth<sup>1</sup>. Thus, within the same age category, there can be up to 365 days difference between two athletes. This age difference can also be translated into differences in height, weight, strength, experience and agility. For this reason, older athletes within the same age group may be favored in selections compared to younger ones: this is called **relative age effect (RAE)**<sup>2</sup>. The RAE has been shown for both sexes<sup>3</sup> and in multiple sports like ice hockey, football, volley-ball, basket-ball, baseball, rugby, tennis, track-and-field<sup>4</sup> and swimming<sup>5</sup>. This phenomenon can have several consequences. The older, taller, bigger and more experienced athletes have a non negligible advantage<sup>4</sup> as selections are based on current performances<sup>6</sup>. Also, the motivation of younger athletes is negatively impacted<sup>7</sup>.

References : <sup>1</sup>Helsen & al, 1998, <sup>2</sup>Musch & al, 2001, <sup>3</sup>Smith & al, 2018, <sup>4</sup>Cobley & al, 2009, <sup>5</sup>Costa & al, 2013, <sup>6</sup>Post & al, 2020, <sup>7</sup>Delorme & al, 2010

## Objectives

- 1- To **test** the presence of RAE in all individual swimming events and performance levels
- 2- To **determine and apply** corrective adjustment procedures for all disciplines and age categories
- 3- To **rebalance** individual performances

## Data

- 62 610 swimmers between the ages of 10 and 16
- 100m Male Freestyle in Olympic pool
- Competition between 2000 and 2020
- All performances from local to international level were collected by the French Swimming Federation
- Date of birth, date of competition

## Methods

### 1- Birth quarters distribution

In the first part, we kept only the season best performance for each swimmer. Swimmers were divided into birth quarters (Q1: January, February, March, Q2: April, May, June, Q3: July, August, September, Q4: October, November, December). To test for a significant difference between the birth quarters, chi-square test, odds ratios and 95% confidence intervals were calculated.

### 2- Corrective adjustment procedures

To better visualize the differences between swimmers, we defined the relative age gap. It is the time between the last birthday and the competition date. Within each age category, we used the relative age gap and performance in order to reveal the nature of the relationship between these two variables. Then, using the regression coefficient, we calculated the rebalanced performance, where:

$$T_r = T_0 - c * m$$

$T_r$ : rebalanced performance time,  $T_0$ : initial performance time,  $c$ : slope coefficient,  $m$ : time until the next birthday

### 3- Validation

In the second part, in order to validate our rebalancing method, we used a database composed of swimmers having achieved 2 performances in the season with a minimum of 6 months difference. The rebalancing method is applied to the first performance considering the difference with the second performance. where:

$$T_r = T_1 - c * (T_2 - T_1)$$

$T_r$ : rebalanced performance time,  $T_1$ : initial performance time,  $T_2$ : second performance time,  $c$ : slope coefficient

Thus, it has been possible to compare the rebalanced performance with the second performance achieved with significance tests (Friedman test and Wilcoxon test).

Age	Top %	Total	Q1 (%)	Q2 (%)	Q3 (%)	Q4 (%)	$\chi^2$	p-value	OR	p	95%CI
10	100	3767	897 (23.81)	871 (23.12)	1087 (28.86)	912 (24.21)	30.78	***	0.98	**	[0.97 ; 0.99]
11	100	6982	1706 (24.43)	1738 (24.89)	1941 (27.8)	1597 (22.87)	35.46	***	1.09	**	[1.06 ; 1.12]
12	100	9807	2661 (27.13)	2498 (25.47)	2554 (26.04)	2094 (21.35)	75.20	***	1.37	**	[1.28 ; 1.47]
13	100	12787	3655 (28.58)	3426 (26.79)	3152 (24.65)	2554 (19.97)	211.99	***	1.60	**	[1.5 ; 1.7]
14	100	15140	4559 (30.11)	4147 (27.39)	3540 (23.38)	2894 (19.11)	418.50	***	1.82	**	[1.72 ; 1.93]
15	100	14127	4547 (32.19)	3976 (28.14)	3034 (21.48)	2570 (18.19)	679.78	***	2.13	**	[2.01 ; 2.25]
10	10	376	48 (12.77)	92 (24.47)	134 (35.64)	102 (27.13)	40.26	***	0.39	**	[0.29 ; 0.52]
11	10	698	91 (13.04)	179 (25.64)	267 (38.25)	161 (23.07)	90.15	***	0.50	**	[0.43 ; 0.58]
12	10	980	156 (15.92)	262 (26.73)	365 (37.24)	197 (20.1)	101.69	***	0.75	**	[0.71 ; 0.79]
13	10	1278	281 (21.99)	386 (30.2)	381 (29.81)	230 (18.0)	55.39	***	1.28	**	[1.2 ; 1.37]
14	10	1514	428 (28.27)	450 (29.72)	392 (25.89)	244 (16.12)	68.26	***	2.05	**	[1.73 ; 2.43]
15	10	1412	426 (30.17)	416 (29.46)	342 (24.22)	228 (16.15)	70.95	***	2.24	**	[1.86 ; 2.7]

Table 1: Distribution by birth quarters with respect to age groups and level of competitiveness

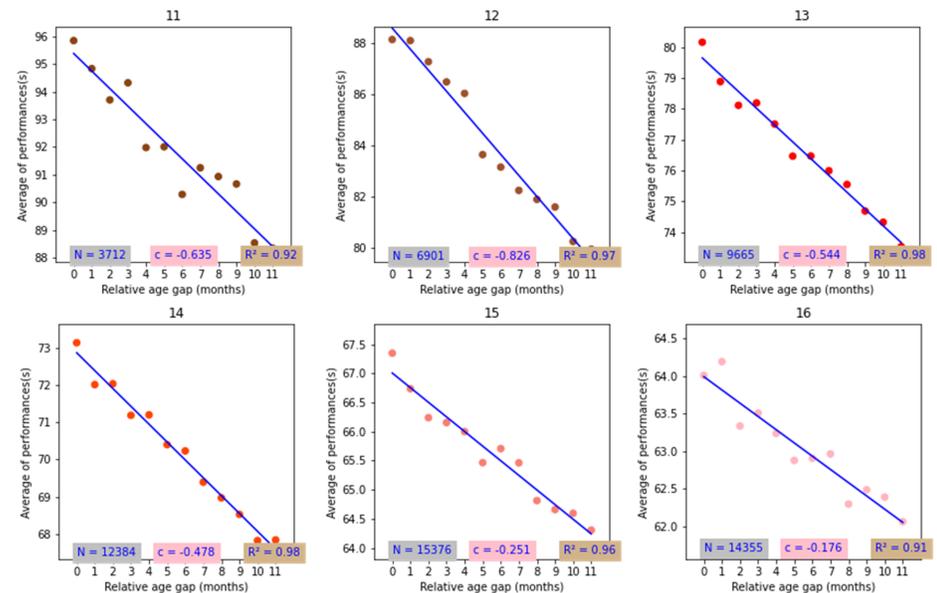


Figure 1: Average of performances (in seconds) by relative age gap (in months)

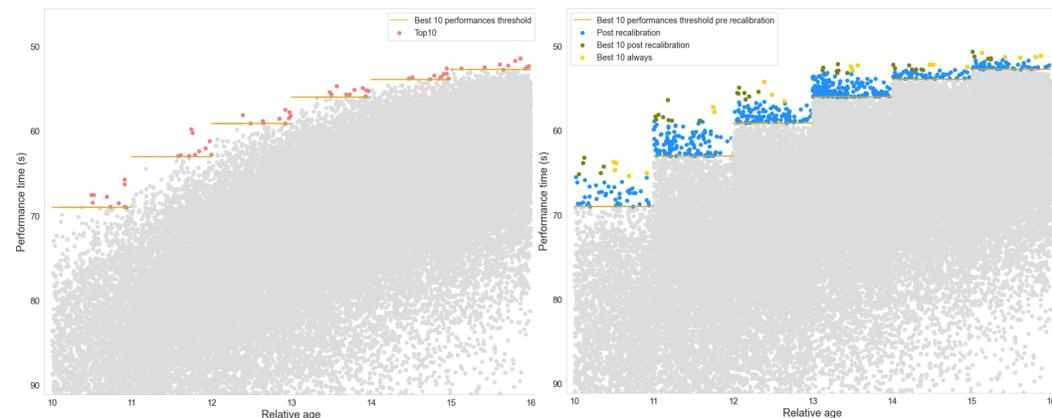


Figure 2: Pre-rebalanced performances VS Post-rebalanced performances

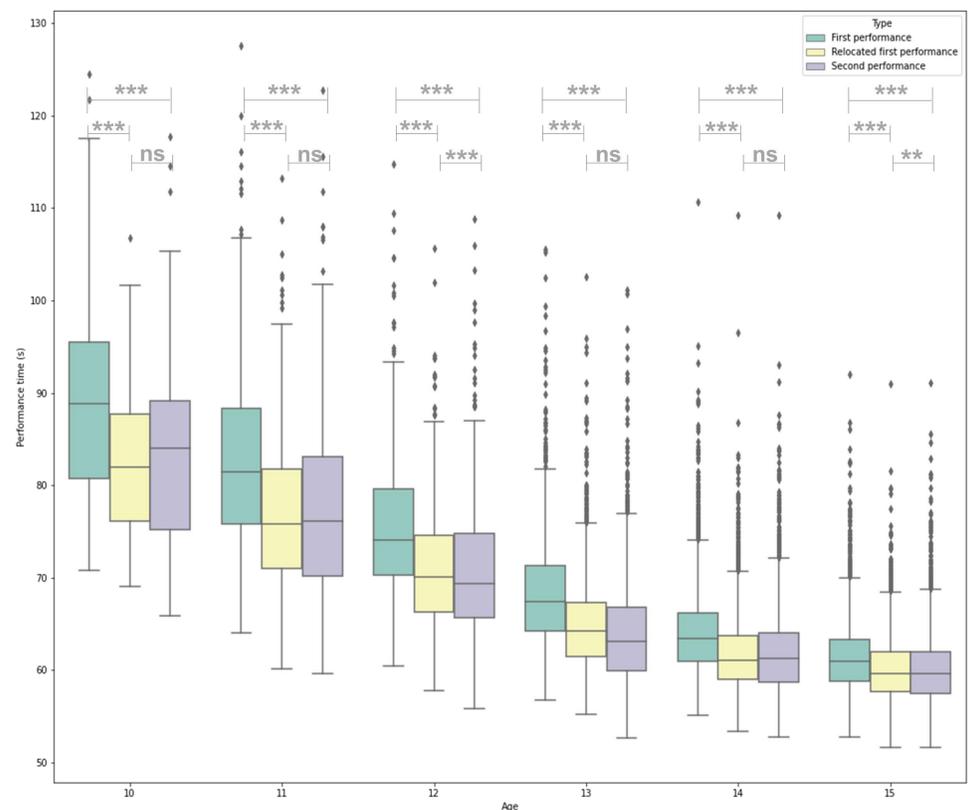


Figure 3: Boxplots of first, rebalanced and second performances by age

## Conclusion and Discussion :

- First study to demonstrate the **relative age effect among French swimmers**, particularly among males' 100m Freestyle in 50m pools.
- **RAE increases** when the level of competitiveness increases.
- Thanks to the rebalancing method, it is possible to **objectify swimmers' performances** in relation to their exact age in order to **better appreciate their potential and improve talent identification processes**.
- To go further, other variables as maturity could be included and improve the method.