Rev Bras Cineantropom Desempenho Hum

original article

https://doi.org/10.1590/1980-0037.2023v25e90990

Relative age in Brazilian swimmers and para swimmers

Idade relativa em nadadores e paranadadores brasileiros

Karla de Jesus[1]
https://orcid.org/0000-0002-7710-9843
Geovani Messias da Silva[2,3]
https://orcid.org/0000-0001-8724-7441
Vitória Miranda dos Santos[1]
https://orcid.org/0000-0001-9187-3429
Kelly de Jesus[1]
https://orcid.org/0000-0001-5516-4756
Alexandre Igor Araripe Medeiros[2,3]
https://orcid.org/0000-0002-0447-353X

1 Federal University of Amazonas. Faculty of Physical Education and Physiotherapy. Human Performance Studies Laboratory. Manaus, AM. Brazil.

2 Federal University of Ceara. Institute of Physical Education and Sports. Research Group in Biodynamic Human Movement. Fortaleza, CE. Brazil.

3 Federal University of Ceara. Master Program in Physiotherapy and Functioning. Fortaleza, CE. Brazil.

Abstract - This study aimed to analyze the relationships between swimming competitive events, functional classification and relative age and to detect if the relative age affects performance in Brazilian swimmers and para swimmers. Data were retrieved from public databases and birth dates were classified in four quartiles (Q1 = January-March; Q2 = April-June; Q3 = July-September; Q4 = October-December). Descriptive statistics, Chi-square tests and ANOVA were used. The 50 m freestyle is the competitive event with 2349 swimmers, followed by 100 m (n = 1817) and 200 m freestyle (n = 905), and 200 m butterfly with 42 swimmers. Para swimmers are mainly distributed to S14, S6 and S5 functional classes (n = 140, 87 and 45), and individual medley events were less represented at SM3, SM9 and SM11 (n = 1 swimmer). Most of swimming events (86.36%) and para swimming functional classes (51.43%) are represented by swimmers and para swimmers born in the first and second quartiles. Moderate associations between functional classification and relative age were observed ($p < 0.0001$, Cramer's V = 0.277). No effects of relative age on swimmers and para swimmers' performance were noticed ($p > 0.05$). The great functional class seems to be related to great para swimmers' relative age. Quartiles distribution shows the advantage of being born in the first months of the year to be registered among the most talented Brazilian swimmers and para swimmers.

Key words: Athletic performance; Birth cohort; Swimming.

Resumo - *Este estudo teve como objetivo analisar as relações entre eventos competitivos de natação, classificação funcional e idade relativa e detectar se a idade relativa afeta o desempenho em nadadores e paranadadores brasileiros. Os dados foram recuperados de bancos de dados públicos e as datas de nascimento foram classificadas em quatro quartis (Q1 = janeiro-março; Q2 = abril-junho; Q3 = julho-setembro; Q4 = outubro-dezembro). Utilizou-se estatística descritiva, teste Qui-quadrado e ANOVA. Os 50 m livre é a prova competitiva com 2.349 nadadores, seguido de 100 m (n = 1.817) e 200 m livre (n = 905), e 200 m borboleta com 42 nadadores. Os paranadadores estão distribuídos principalmente nas classes funcionais S14, S6 e S5 (n = 140, 87 e 45), e as provas individuais de medley foram menos representadas em SM3, SM9 e SM11 (n = 1 nadador). A maioria das provas de natação (86,36%) e classes funcionais de paranatação (51,43%) são representadas por nadadores e paranadadores nascidos no primeiro e segundo quartis. Associações moderadas entre classificação funcional e idade relativa foram observadas (p < 0,0001, V de Cramer = 0,277). Não foram observados efeitos da idade relativa no desempenho de nadadores e paranadadores (p > 0,05). A grande classe funcional parece estar relacionada com a idade relativa dos grandes paranadadores. A distribuição por quartis mostra a vantagem de ter nascido nos primeiros meses do ano para ser registrado entre os mais talentosos nadadores e paranadadores brasileiros.*

Palavras-chave: *Coorte de nascimento; Desempenho atlético; Natação.*

Received: September 19, 2022
Accepted: February 15, 2023

How to cite this article
Jesus K, Silva GM, Santos VM, Jesus K, Medeiros AIA. Relative age in Brazilian swimmers and para swimmers. Rev Bras Cineantropom Desempenho Hum 2023, 25:e90990. DOI: http://doi.org/10.1590/1980-0037.2023v25e90990

Corresponding author
Alexandre Igor Araripe Medeiros.
Research Group in Biodynamic Human Movement, Institute of Physical Education and Sports, Federal University of Ceará
Av. Mister Hull, S/N, Parque Esportivo – Bloco 320, CEP: 60455-760, Bairro Campus do Pici, Fortaleza (CE), Brazil.
E-mail: alexandremedeiros@ufc.br

INTRODUCTION

Whether considered from an athlete development or public health perspective, the dynamic factors influencing sport participation and achievement are of key interest to researchers, policy makers, sports organizations and their practioners[1]. In terms of athlete development, relative age has emerged as a consistent influence on both immediate sport participation and longer-term attainment[1-3]. The relative age can be defined as the chronological age difference that occurs among athletes of the same age group and the consequences of this birthdate difference are commonly referred to as the relative age effect[2,4]. The relative age effects can reflect outcomes from an interaction between participants' birth dates and the dates used for chronological age grouping[2] and being relatively older within an age grouping is associated with consistent attainment and selection advantages, including an increased likelihood of selection to access further resources with athlete development systems[2,5]. Indeed, relatively older athletes obtain higher levels of sporting success in the short term, while the long-term trend is balanced and even reversed[2,6,7]. Competition performance on short or long-term in individual and team sports seems to be influenced by, among other factors, the relative age[6,7] and the body of scientific literature is smaller in individual than team sports[1,8,9] and males was pointed out as the predominantly studied population[3].

Competitive swimming, like other sports disciplines[6], is organized according to standard[1] year-old categories, based on participant's chronological age[9,10] and the prevalence of the relative age effects has been greatly observed[9,10], with a high-perceived precocity in elite competition[2], detected more often in younger ages, males and some specific events[7]. The different determinants of swimming performance according to the event are related to the different anthropometric characteristics described in elite swimmers, according to the competitive level, specialty, and / or distance event[7,9]. For example, great muscular endurance and low active drag forces would be required for athletes in middle-distance or distance events compared with swimmers' specialists in short distance events[7,9]. Those factors suggest that a great prevalence of the relative age effects could be expected in competitive swimming, but the impact of the relative age on performance could be dependent on the event type (i.e. distance and swimming technique). Consequently, this might have implications on the strength demands and the propulsive forces applied[7]. According to Bezuglov et al.[11] similar effects are reported in Athletics disciplines, which creates discrimination against late-born and late-maturing children.

There is a scarcity of studies considering the relative age on para-athletes, which might be related to the small number of athletes engaged in para sports. Most of the available studies are limited to swimmers' samples when analyzing the relative age, which provides an incomplete picture of the whole phenomenon on athletes and para athletes. Para swimming is one of the most popular Paralympic sports and comprises sport classes based on physical, vision and intellectual impairments[12]. It is possible that para swimmers with impairment progress differently compared to non-disabled swimmers because of differences in training and performance characteristics, and the possibility that they start training at older ages after being impaired[13]. The relative age showed its greatest impact in the years associated with growth and maturational status and after that, its influence faded away[7].

Whether considered from a public health or athlete development perspective, addressing factors that highlight health behaviours, such as sport participation in children and adolescence, are of interest to policy-makers, sports organisations and practitioners alike[2]. This study aimed to analyze the relationships between swimming competitive events, functional classification, and relative age and to detect if the relative age affects performance in Brazilian swimmers and para swimmers. We hypothesized that: (i) relative age would share variation with swimming competitive events, and the opposite would be noticed in the functional classification in Brazilian swimmers and para swimmers; (ii) quartiles distribution would affect swimmer's performance. Despite the significant previous relative age findings in swimming, this study might contribute to update the relative age analysis in swimmers and para swimmers performance considering a large amount of swimming events and functional classes, and guide coaches and competitive institution bodies to review the training, competition and talent selection process.

METHODS

Participants

The present study is based on a short cohort database collected from the Brazilian Aquatic Sports Confederation from 2018 to 2020 and the Brazilian Paralympic Committee in 2021. Data collection was quite straightforward, and no specific hindrances were encountered. Swimmers registered in these public databases were added in the analysis. For the purposes of this study, 11.601 valid samples were considered. Swimmers with foreign backgrounds registered in the birth region were excluded from the analysis.

Relative Age Effect (RAE)

Databases included gender, birth month and place, competitive events and respective times, club affiliation and functional class. To analyze RAE, swimmers and para swimmers' birth month was assigned in birth quartiles. Thus, the first quartile (Q1) comprised sample born in January, February and March; the second (Q2), sample born in April, May and June; the third (Q3), sample born in July, August and September; the fourth (Q4) encompassed those who were born in October, November and December.

Classification of para swimmers

Para swimmers were selected if they met the classification conditions employed by the International Paralympic Committee or the sport's governing body. In swimming, the functional classification occurs as follows: physical-motor - S1 to S10, SB1 to SB9 and SM1 to SM10; visual - S11 to S13 or B11 to B13, SB11 to SB13 or B11 to B13 and SM11 to SM11 or BM11 to BM13; intellectual; S14, SB14 and SM1416. Regarding to data collection, the para swimmers' samples were included in all functional classes.

Statistical procedures

Median, interquartile range (IQR), minimum, maximum and percentiles were presented as Brazilian swimmers and para swimmers' descriptive statistics samples. The non-parametric chi squarechi-square of independence (expected values equal or more than five in at least 0.8 of the cells) or maximum likelihood ratio chi-square tests (expected values less than five in more than 0.2 of the cells) were used to determine associations between the relative age, swimming event and functional classification in swimmers and para swimmers. X^2 for each cell was calculated to show the direction of difference. The association between nominal variables relied on Cramer's V coefficient and the strength of association was characterized characterized as follows: 0 to 0.1 - little if any association; 0.1 to 0.3 - low association; 0.3 to 0.5 - moderately strong association and > 0.5 - very strong association[14].

Two-way independent measures analysis of variance (ANOVA) was used to verify the interaction between quartiles and competitive event or functional classification effects on performance. Q-Q plots were checked for approximately normal distribution. We also performed a Robust ANOVA (RA) with 20% trimmed mean for dealing with outliers, unequal variance and non-normal distribution. To respect the data independence, athletes were included only once for each event participated. Partial eta squared (η^2p) quantified the effect size and was interpreted as 0.01–0.06 (small), 0.06–0.14 (moderate), and > 0.14 (large[15]). Simple main effects were used to verify the effect of one independent variable for each level of another independent variable. Only main events and functional classification with sufficient samples for analyzes were included in ANOVA. We set the alpha level at 0.05 and all statistical procedures were conducted in the software JASP 0.16.3.0 and Jamovi 2.3.

RESULTS

The freestyle is a competitive event with a high number of registered swimmers considering the short and middle-distance events. There is an overrepresentation of swimmers born in the second quartiles considering the official competitive events. Para swimmers are mainly distributed in the S14, S6 and S5 functional classification groups. There is an underrepresentation of swimmers born in the third and fourth quartiles.

Table 1 shows the association between the official competitive events and the relative age of swimmers, with no association identified. Expected values represent the distribution if quartiles are not associated with swimming stroke. X^2 for each cell figure in the parentheses.

Table 2 shows the association between the functional classification in paralympic swimming and the relative age, with an association identified with small magnitude.

Table 3 presents show the simple main effects of quartile for each main event. But there was no effect of quartile and swimming interaction in event time (Two-way ANOVA: df = 57; F = 0.692; p = 0.963; η^2p = 0.004; RA: Q: 75.693; p = 0.1340).

Table 4 shows the simple main effects of quartile for each functional classification. However, there was no effect of quartile and functional classification interaction in swimming events time (df = 27; F = 0.847; p = 0.688; η^2p = 0.055; RA: Q: 59.116; p = 0.1210).

Table 1. Chi-square test between quartiles and main events in swimmers.

Swimming stroke		Quartiles					X2	df	p-value	Cramer's V
		1	2	3	4	Total				
100 butterfly	Count	47 (0.267)	48 (0.102)	38 (0.153)	41 (0.434)	174.000	75.565	63	0.133	0.051
	Expected count	50.680	45.833	40.493	36.994	174.000				
100 backstroke	Count	95 (0.895)	76 (0.05)	70 (0.018)	55 (1)	296.000				
	Expected count	86.214	77.968	68.885	62.933	296.000				
100 freestyle	Count	519 (0.198)	489 (0.226)	416 (0.111)	393 (0.116)	1817.000				
	Expected count	529.229	478.609	422.850	386.312	1817.000				
100 medley	Count	36 (0.851)	18 (3.525)[a]	28 (0.45)	24 (0.095)	106.000				
	Expected count	30.874	27.921	24.668	22.537	106.000				
100 breaststroke	Count	163 (0.167)	144 (0.011)	129 (0.065)	106 (0.74)	542.000				
	Expected count	157.866	142.766	126.134	115.235	542.000				
1500 freestyle	Count	35 (0.361)	35 (0)	37 (1.182)a	26 (0.183)	133.000				
	Expected count	38.738	35.033	30.952	28.277	133.000				
200 butterfly	Count	10 (0.408)	15 (1.401)a	8 (0.322)	9 (0.001)	42.000				
	Expected count	12.233	11.063	9.774	8.930	42.000				
200 backstroke	Count	19 (1.221)a	22 (0.001)	26 (2.13)a	17 (0.041)	84.000				
	Expected count	24.466	22.126	19.548	17.859	84.000				
200 freestyle	Count	254 (0.349)	254 (1.023)a	206 (0.101)	191 (0.01)	905.000				
	Expected count	263.595	238.382	210.611	192.412	905.000				
200 medley	Count	78 (0.029)	71 (0.012)	68 (0.314)	56 (0.072)	273.000				
	Expected count	79.515	71.910	63.532	58.043	273.000				
200 breaststroke	Count	63 (0.916)	78 (2.933)a	57 (0.001)	46 (0.666)	244.000				
	Expected count	71.069	64.271	56.783	51.877	244.000				
25 butterfly	Count	3 (0.163)	2 (0.592)	7 (5.223)a	1 (1.126)a	13.000				
	Expected count	3.786	3.424	3.025	2.764	13.000				
25 backstroke	Count	11 (0)	14 (1.591)a	9 (0.003)	4 (2.059)	38.000				
	Expected count	11.068	10.009	8.843	8.079	38.000				
25 freestyle	Count	25 (0.902)	17 (0.155)	22 (1.816)a	7 (4.341)a	71.000				
	Expected count	20.680	18.702	16.523	15.095	71.000				
25 breaststroke	Count	14 (3.169)a	9 (0.153)	6 (0.138)	1 (4.535)a	30.000				
	Expected count	8.738	7.902	6.982	6.378	30.000				
400 freestyle	Count	192 (0.508)	184 (0.008)	178 (1.684)a	140 (0.386)	694.000				
	Expected count	202.138	182.804	161.507	147.551	694.000				
400 medley	Count	19 (0.794)	21 (0)	15 (0.703)	25 (3.754)a	80.000				
	Expected count	23.301	21.072	18.618	17.009	80.000				
50 butterfly	Count	97 (1.954)a	59 (3.852)a	64 (0.158)	69 (0.929)	289.000				
	Expected count	84.176	76.124	67.256	61.444	289.000				
50 backstroke	Count	134 (0.759)	122 (0.573)	111 (0.17)	129 (5.257)a	496.000				
	Expected count	144.468	130.649	115.429	105.455	496.000				

Note. Df: degrees of freedom. [a]X^2 more than 1; X^2 figure in the parentheses.

Table 2. Likelihood ratio between quartiles and functional classification in para swimmers.

Class		Quartiles 1	2	3	4	Total	Likelihood ratio	df	p-value	Cramer's V
S2	Count	2.000	6.000	3.000	4.000	15.000	181.992	102	<0.0001	0.277
	Expected count	3.185	4.812	4.021	2.982	15.000				
S3	Count	4.000	4.000	9.000	1.000	18.000				
	Expected count	3.822	5.774	4.825	3.578	18.000				
S4	Count	7.000	5.000	4.000	8.000	24.000				
	Expected count	5.096	7.699	6.434	4.771	24.000				
S5	Count	5.000	11.000	12.000	17.000	45.000				
	Expected count	9.556	14.435	12.063	8.946	45.000				
S6	Count	23.000	23.000	28.000	13.000	87.000				
	Expected count	18.474	27.908	23.322	17.295	87.000				
S7	Count	9.000	12.000	8.000	5.000	34.000				
	Expected count	7.220	10.907	9.114	6.759	34.000				
S8	Count	0.000	23.000	13.000	6.000	42.000				
	Expected count	8.919	13.473	11.259	8.349	42.000				
S9	Count	10.000	12.000	11.000	2.000	35.000				
	Expected count	7.432	11.227	9.383	6.958	35.000				
S10	Count	9.000	18.000	14.000	0.000	41.000				
	Expected count	8.706	13.152	10.991	8.151	41.000				
S11	Count	1.000	2.000	5.000	9.000	17.000				
	Expected count	3.610	5.453	4.557	3.380	17.000				
S12	Count	2.000	10.000	6.000	1.000	19.000				
	Expected count	4.035	6.095	5.093	3.777	19.000				
S13	Count	4.000	4.000	6.000	0.000	14.000				
	Expected count	2.973	4.491	3.753	2.783	14.000				
S14	Count	33.000	38.000	34.000	35.000	140.000				
	Expected count	29.729	44.910	37.530	27.831	140.000				
SB3	Count	2.000	2.000	0.000	3.000	7.000				
	Expected count	1.486	2.245	1.877	1.392	7.000				
SB4	Count	0.000	3.000	1.000	3.000	7.000				
	Expected count	1.486	2.245	1.877	1.392	7.000				
SB5	Count	5.000	3.000	2.000	4.000	14.000				
	Expected count	2.973	4.491	3.753	2.783	14.000				
SB6	Count	3.000	3.000	1.000	1.000	8.000				
	Expected count	1.699	2.566	2.145	1.590	8.000				
SB7	Count	0.000	2.000	1.000	2.000	5.000				
	Expected count	1.062	1.604	1.340	0.994	5.000				
SB8	Count	1.000	3.000	1.000	0.000	5.000				
	Expected count	1.062	1.604	1.340	0.994	5.000				
SB9	Count	4.000	3.000	3.000	0.000	10.000				
	Expected count	2.123	3.208	2.681	1.988	10.000				

Df: degrees of freedom

Table 2. Continued...

Class		Quartiles					Likelihood ratio	df	p-value	Cramer's V
		1	2	3	4	Total				
SB11	Count	1.000	1.000	0.000	0.000	2.000				
	Expected count	0.425	0.642	0.536	0.398	2.000				
SB12	Count	1.000	3.000	1.000	1.000	6.000				
	Expected count	1.274	1.925	1.608	1.193	6.000				
SB13	Count	1.000	1.000	0.000	0.000	2.000				
	Expected count	0.425	0.642	0.536	0.398	2.000				
SB14	Count	6.000	6.000	5.000	7.000	24.000				
	Expected count	5.096	7.699	6.434	4.771	24.000				
SM3	Count	0.000	0.000	0.000	1.000	1.000				
	Expected count	0.212	0.321	0.268	0.199	1.000				
SM4	Count	1.000	0.000	1.000	2.000	4.000				
	Expected count	0.849	1.283	1.072	0.795	4.000				
SM5	Count	0.000	0.000	1.000	1.000	2.000				
	Expected count	0.425	0.642	0.536	0.398	2.000				
SM6	Count	2.000	2.000	0.000	0.000	4.000				
	Expected count	0.849	1.283	1.072	0.795	4.000				
SM7	Count	1.000	0.000	1.000	0.000	2.000				
	Expected count	0.425	0.642	0.536	0.398	2.000				
SM8	Count	0.000	4.000	1.000	0.000	5.000				
	Expected count	1.062	1.604	1.340	0.994	5.000				
SM9	Count	1.000	0.000	0.000	0.000	1.000				
	Expected count	0.212	0.321	0.268	0.199	1.000				
SM10	Count	0.000	2.000	3.000	0.000	5.000				
	Expected count	1.062	1.604	1.340	0.994	5.000				
SM11	Count	0.000	0.000	0.000	1.000	1.000				
	Expected count	0.212	0.321	0.268	0.199	1.000				
SM12	Count	0.000	0.000	1.000	1.000	2.000				
	Expected count	0.425	0.642	0.536	0.398	2.000				
SM14	Count	3.000	7.000	2.000	4.000	16.000				
	Expected count	3.398	5.133	4.289	3.181	16.000				
Total	Count	141.000	213.000	178.000	132.000	664.000				
	Expected count	141.000	213.000	178.000	132.000	664.000				

Df: degrees of freedom

Table 3. Simple main effects of quartiles for each main event.

Main events	Sum of Squares	df	Mean Square	F	p-value
100 butterfly	795.622	3	265.207	0.129	0.943
100 backstroke	2014.081	3	671.360	0.326	0.807
100 freestyle	3417.172	3	1139.057	0.553	0.646
100 medley	2110.413	3	703.471	0.342	0.795
100 breaststroke	5216.843	3	1738.948	0.844	0.469
1500 freestyle	16025.204	3	5341.735	2.593	0.051
200 butterfly	2952.034	3	984.011	0.478	0.698
200 backstroke	1398.372	3	466.124	0.226	0.878
200 freestyle	9260.287	3	3086.762	1.499	0.213
200 medley	4070.074	3	1356.691	0.659	0.577
200 breaststroke	4897.079	3	1632.360	0.793	0.498
25 backstroke	81.300	3	27.100	0.013	0.998
25 freestyle	163.239	3	54.413	0.026	0.994
400 freestyle	2665.096	3	888.365	0.431	0.731
400 medley	5302.936	3	1767.645	0.858	0.462
50 butterfly	143.699	3	47.900	0.023	0.995
50 backstroke	373.879	3	124.626	0.061	0.981
50 freestyle	25565.179	3	8521.726	4.137	0.006
50 breaststroke	616.180	3	205.393	0.100	0.960
800 freestyle	11767.580	3	3922.527	1.904	0.127

Df: degrees of freedom

Table 4. Simple main effects of quartiles for each functional classification.

Class	Sum of Squares	df	Mean Square	F	p-value
S2	10870.737	3	3623.579	0.326	0.806
S4	31585.776	3	10528.592	0.948	0.417
S5	19029.076	3	6343.025	0.571	0.634
S6	40782.827	3	13594.276	1.225	0.300
S7	102861.613	3	34287.204	3.089	0.027
S9	15730.555	3	5243.518	0.472	0.702
S14	18137.988	3	6045.996	0.545	0.652
SB5	6725.505	3	2241.835	0.202	0.895
SB14	3728.607	3	1242.869	0.112	0.953
SM14	19962.361	3	6654.120	0.599	0.616

Df: degrees of freedom

DISCUSSION

The key findings of the present study showed that most of swimmers and para swimmers born in the 1st and 2nd quartiles and most swimmers were registered in the short and middle-distance freestyle events and the 200m butterfly was the less representative. Moderate associations were just noticed on para swimmers, which were partially in agreement with our hypotheses. No effect of quartile was noticed in swimmers and para swimmers' performance to refute our hypothesis. Despite the prevalence of the relative age effects in swimming has been previously reported, this is the first study that used national swimmers and para swimmers' public databases to identify shared variance and effects of relative age in performance in both groups.

The meaningful swimmer's representation, who were born in the 2nd quartile and the less amount of para swimmers who were born in the 3nd and 4nd quartiles of the year seem to evidence a discrimination against relatively younger children solely because they were born in certain months of the year[11,16,17] and corroborate with previous studies[6,9,18]. In fact, swimming is a sport in which the greatest prevalence of the relative age effects has been observed, with increased participation in championships for those born in the first quartiles[9,10] and a high perceived precocity in elite competition[1]. The increased proportion of swimmers in the 2nd quartile was already noticed in previous studies and this trend can be explained using different aspects (e.g., cultural importance of sports[19]. It would be logical to think that athletes born in the first months of selection year would be highly representative[1,4], with a greater chance of reaching the highest professional sport level[5,6,20]. To reduce and eliminate relative age effects related inequalities, direct policy, organisational and practioner interventions are required[1], since the relative age can only emerge from the simultaneous interaction of an age grouping policy and an individual's birth date[3]. In a sense our results add weight to that assumption for both, swimmers, and para swimmers, although further studies are needed to investigate whether early swimming dropout could be a circumstance somehow related to the inevitable differences in maturational development of young athletes, which can expose them to failure and frustration resulting in lower personal expectations of success and higher likelihood of quitting[1,7,20].

Swimming event distance and type revealed no associations with relative age, which has also not affected swimmers' performance. Previous studies mentioned that the impact of the relative age on each swimming event was inconsistent and was only visible in 100 m women butterfly after 12-years old10. Lorenzo-Calvo et al.[7] noticed differences in the influence of the relative age effects depending on the event technique and distance, as medley and butterfly swimming events and shorter event performances seemed to be most affected, contrarily to Brustio & Boccia[21] that found greater relative age effects in events with greater emphasis on metabolic requirements. Abbot et al.[10] revealed that the relative age affected performance times and the use of its raw values criteria to identify talented swimmers may be problematic. According to Brustio et al.[6], when the level of competitiveness increased the effect size of the relative age effects also increased, suggesting that different trends in quartile distribution can be observed when considering corrected performances, minimizing or at least reducing the possible bias provided to those born near the selection data. Despite the absence of clear association between competitive swimming events and relative age, the influence of task constraints (i.e., strokes or distance) on the relative age effects should also be considered when designing an intervention with young developing athletes[7]. Because most swimmers rapidly specialize in a particular swimming technique, analysing the relative age in each competitive event is much more accurate than the analysis of the relative age effects on mean swimming performance[9]. The non-effects of quartiles in swimming events performance registered in the present study might be related to data grouping and respective variations in each swimming event.

Moderate association was noticed between functional classification and relative age, which has also not affected para swimmers' performance. Previous studies revealed that the most successful para swimmers can continue training and improving performance in their mid - to late twenties[12]. These ages of peak performance are older than those previously reported in non-disabled swimmers and tend to decrease as the event duration increases[22]. In the long-term, studies suggest that the relative age effects-related and maturation inequalities may be temporary and transient[1,2,6], but definitive explanations for why they reduce and even reverse at the elite adult stage remain somewhat speculative and deserving of further attention[1]. Since previous studies have shown that classification broadly describes the type and severity of impairment and influences the relationship between age and competitive swimming performance[12], it seems necessary to analyze the relative age effects of each class with a larger sample size.

This study is pioneer in presenting data of registered Brazilian swimmers and para swimmers in recent years and has reinforced some of the previous evidence noticed when analysing the relative age distribution in swimmers and has also clarified the absence of data on this topic in para swimmers. However, some limitations should be observed such as the number of swimmers per swimming event and para swimmers per classification, which hampers deep statistical analysis. Further longitudinal studies are recommended to analyze the influence of relative age combined to training-related and socio-economic-cultural factors available in public databases on performance using linear and non-linear modelling approaches.

CONCLUSIONS

The present study findings indicated that most of Brazilian swimmers and para swimmers were born in the 1st and 2nd quartiles. A moderate association between relative age and functional classification was noticed. There was no quartile effect noticed in swimmers and para swimmers' performance. Further studies should predict swimmers and para swimmers' performance through linear and non-linear modelling using beyond the relative age, the environment and task constraints data accessible in large public databases.

ACKNOWLEDGEMENTS

This work was supported by the Amazonas Research Support Foundation for Research Support of the State of Amazonas (FAPEAM), Infrastructure Program for Young Researchers – First Project Program PPP, no. 004/2017 under grant (062.01554/2018. Funders had no role in study design, data collection and analysis, decision to publish, or manuscript preparation.

COMPLIANCE WITH ETHICAL STANDARDS

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. This study was funded by the Amazonas Research Support Foundation (FAPEAM), Infrastructure Program for Young Researchers - First Project Program (PPP) Nº 004/2017 under grant number 062.01554/2018.). The present work also had the support of the National Council for Scientific and Technological Development (CNPq) for funding the Scientific Initiation Scholarship (PIB-S/0055/2022).

Ethical approval

This research is in accordance with the standards set by the Declaration of Helsinki.

Conflict of interest statement

The authors have no conflict of interests to declare.

Author Contributions

Conceived and designed experiments: KJ, KJ, AIAM; Performed experiments: KJ, KJ, VMS, AIAM; Analyzed data: KJ, GMS, VMS, KJ, AIAM; Contributed with reagents/materials/analysis tools: KJ, GMS, VMS, KJ, AIAM; Wrote the paper: KJ, GMS, VMS, KJ, AIAM.

REFERENCES

1. Smith KL, Weir PL, Till K, Romann M, Cobley S. Relative age effects across and within female sport contexts: a systematic review and meta-analysis. Sports Med 2018;48(6):1451-78. http://dx.doi.org/10.1007/s40279-018-0890-8. PMid:29536262.
2. Cobley S, Abbott S, Dogramaci S, Kable A, Salter J, Hintermann M, et al. Transient relative age effects across annual age groups in national level Australian swimming. J Sci Med Sport 2018;21(8):839-45. http://dx.doi.org/10.1016/j.jsams.2017.12.008. PMid:29398369.
3. Wattie N, Schorer J, Baker J. The relative age effect in sport: a developmental systems model. Sports Med 2015;45(1):83-94. http://dx.doi.org/10.1007/s40279-014-0248-9. PMid:25169442.
4. Sandercock GRH, Ogunleye AA, Parry DA, Cohen DD, Taylor MJD, Voss C. Athletic performance and birth month: is the relative age effect more than just selection bias? Int J Sports Med 2014;35(12):1017-23. http://dx.doi.org/10.1055/s-0034-1368725. PMid:24886927.
5. Nagy N, Földesi G, Sós C, Ökrös C. Talent selection and management in view of relative age: the case of swimming. Phys Cult Sport Stud Res 2018;80(1):57-67. http://dx.doi.org/10.2478/pcssr-2018-0023.
6. Brustio PR, Lupo C, Ungureanu AN, Frati R, Rainoldi A, Boccia G. The relative age effect is larger in Italian soccer top-level youth categories and smaller in Serie A. PLoS One 2018;13(4):e0196253. http://dx.doi.org/10.1371/journal.pone.0196253. PMid:29672644.
7. Lorenzo-Calvo J, Rubia A, Mon-López D, Hontoria-Galán M, Marquina M, Veiga S. Prevalence and impact of the relative age effect on competition performance in swimming: a systematic review. Int J Environ Res Public Health 2021;18(20):10561. http://dx.doi.org/10.3390/ijerph182010561. PMid:34682307.
8. Riaza AR, Calvo JL, Mon-López D, Lorenzo A. Impact of the relative age effect on competition performance in basketball: a qualitative systematic review. Int J Environ Res Public Health 2020;17(22):8596. http://dx.doi.org/10.3390/ijerph17228596. PMid:33228103.
9. Costa AM, Marques MC, Louro H, Ferreira SS, Marinho DA. The relative age effect among elite youth competitive swimmers. Eur J Sport Sci 2013;13(5):437-44. http://dx.doi.org/10.1080/17461391.2012.742571. PMid:24050459.
10. Abbott S, Moulds K, Salter J, Romann M, Edwards L, Cobley S. Testing the application of corrective adjustment procedures for removal of relative age effects in female youth

swimming. J Sports Sci 2020;38(10):1077-84. http://dx.doi.org/10.1080/02640414.2020.1741956. PMid:32202222.

11. Bezuglov E, Shoshorina M, Emanov A, Semenyuk N, Shagiakhmetova L, Cherkashin A, et al. The relative age effect in the best track and field athletes aged 10 to 15 years old. Sports 2022;10(7):101. http://dx.doi.org/10.3390/sports10070101. PMid:35878112.

12. Hogarth L, Nicholson V, Payton C, Burkett B. Modelling the age-related trajectory of performance in para swimmers with physical, vision and intellectual impairment. Scand J Med Sci Sports 2021;31(4):925-35. http://dx.doi.org/10.1111/sms.13910. PMid:33345411.

13. Fulton SK, Pyne DB, Hopkins WG, Burkett B. Training characteristics of paralympic swimmers. J Strength Cond Res 2010;24(2):471-8. http://dx.doi.org/10.1519/JSC.0b013e3181c09a9e. PMid:20072051.

14. Nawacki Ł, Matykiewicz J, Stochmal E, Głuszek S. Splanchnic vein thrombosis in acute pancreatitis and its consequences. Clin Appl Thromb Hemost 2021;27:10760296211010260. http://dx.doi.org/10.1177/10760296211010260. PMid:33887991.

15. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale: Lawrence Erlbaum Associates; 1988.

16. Barnsley R, Thompson A, Barnsley P. Hockey success and birthdate: the relative age effect. J Can Assoc Health Phys Educ Recreation 1985;51:23-8.

17. Gil SM, Bidaurrazaga-Letona I, Larruskain J, Esain I, Irazusta J. The relative age effect in young athletes: a countywide analysis of 9–14-year-old participants in all competitive sports. PLoS One 2021;16(7):e0254687. http://dx.doi.org/10.1371/journal.pone.0254687. PMid:34270609.

18. Allen SV, Vandenbogaerde TJ, Hopkins WG. Career performance trajectories of olympic swimmers: benchmarks for talent development. Eur J Sport Sci 2014;14(7):643-51. http://dx.doi.org/10.1080/17461391.2014.893020. PMid:24597644.

19. Baker J, Janning C, Wong H, Cobley S, Schorer J. Variations in relative age effects in individual sports: skiing, figure skating and gymnastics. Eur J Sport Sci 2014;14(Suppl 1):S183-90. http://dx.doi.org/10.1080/17461391.2012.671369. PMid:24444205.

20. Ferriz-Valero A, Martínez SG, Olaya-Cuartero J, García-Jaén M. Sustainable Sport development: the influence of competitive-grouping and relative age on the performance of young triathletes. Sustainability 2020;12(17):6792. http://dx.doi.org/10.3390/su12176792.

21. Brustio PR, Boccia G. Corrective procedures remove relative age effect from world-class junior sprinters. J Sports Sci 2021;39(22):2603-10. http://dx.doi.org/10.1080/02640414.2021.1947618. PMid:34210248.

22. International Paralympic Committee. World para swimming classification rules and regulations. Bonn: International Paralympic Committee; 2017.