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Original Article

RELATIVE AGE EFFECT ON COMPETITIVE PERFORMANCE IN JUDO ATHLETES

EFEITO DA IDADE RELATIVA NO DESEMPENHO COMPETITIVO EM ATLETAS DE JUDÔ

Eduardo Victor Ramalho Lucena[1], Pedro Pinheiro Paes[1], Gustavo Augusto Fernandes Correia[1], Bruna Giovana Correia de Souza[1], Mayllane Pereira da Silva Sousa[1] and **Hugo Augusto Alvares da Silva Lira[1]**

[1]Federal University of Pernambuco, Recife-PE, Brazil.

RESUMO

A diferença da idade cronológica em uma faixa etária é chamada de Idade Relativa (IR) e suas consequências no desempenho de atletas é chamada de Efeito da Idade Relativa (EIR). Acredita-se que o EIR entre atletas pode afetar o sucesso competitivo de diversas maneiras, até mesmo na idade adulta. Dessa forma, o objetivo do presente estudo foi investigar o EIR em todos os competidores de judô das competições nacionais do ano de 2013, fazendo-se a diferenciação por categorias etárias e o desempenho competitivo. Fizeram parte da presente investigação 862 atletas do sexo masculino e 637 do sexo feminino. O qui-quadrado foi empregado para comparar os valores observados e esperados entre quartis, adotando-se significância como $p < 0,05$. Uma análise post hoc de Bonferroni foi utilizada para identificar onde estavam as diferenças significativas (p ajustado < 0,00417). Os resultados mostraram diferença significativa nas categorias sub-15 masculino (Q2 em G1: VO = 17; VE = 9,7; p = 0,001) e sub-23 masculino (Q1 em G3: VO = 37; VE = 10,1; $p < 0,0001$). Em conclusão, o EIR foi identificado apenas em atletas do sexo masculino. Contudo, houve grande discrepância entre atletas nascidos no primeiro semestre e atletas nascidos no segundo semestre.

Palavras-chave: Efeito idade. Atletas. Artes marciais. Grupos etários. Desempenho atlético.

ABSTRACT

Differences in chronological age within an age group are known as Relative Age (RA), and their consequences to athletic performance are referred to as Relative Age Effect (RAE). The RAE among athletes is believed to affect their competitive success in several ways, even in adulthood. Thus, the objective of the present study was to investigate the RAE on all judo fighters competing nationally in 2013, by age category and competitive performance. A total of 862 male and 637 female athletes participated in this research. The chi-squared test was used for comparing observed and expected values among quartiles, adopting $p < 0.05$ as significance. A Bonferroni post hoc analysis was employed to identify where significant differences were (adjusted $p < 0.00417$). Results showed significant differences in the male under-15 category (Q2 in G1: OV = 17; EV = 9.7; p = 0.001) and male under-23 category (Q1 in G3: OV = 37; VE = 10.1; $p < 0.0001$). In conclusion, RAE was identified only in male athletes. However, there were major discrepancies between athletes born in the first semester and those born in the second semester.

Keywords: Age effect. Athletes. Martial Arts. Age groups. Athletic Performance.

Introduction

Judo is a sports modality characterized by non-cyclical movements and intermittent context, with a predominantly anaerobic energy system[1-3]. Fights last between 2 and 4 minutes (depending on the age category), are highly intense and have short rest periods; physical aspects need to be developed, so one must work on not only their fight-specific skills, but also on their physical capabilities[4,5]. Thus, physical fitness is directly related to better performance, from sports initiation to high performance.

Judo training for youths depends on numerous variables, from genetic predisposition to environmental conditions that favor their development and help them stand out among so many others aiming for high performance[6-8]. This is one of the factors that make all fight modalities be categorized by age group and weight, having as main concern for this type of classification to level competitions[9].

Considering age as a criterion for categorizing judo competitions, the Gregorian calendar is used as reference, with the year starting on January 1st and ending on December 31. Specifically in judo, age categories are divided as follows: under-13 (11 to 12 years old), under-15 (13 to 14 years old), under-18 (15 to 17 years old), under-21 (15 to 20 years old), under-23 (15 to 22 years) and senior (15 to 35 years old).

In this classification, differences can be found between two athletes of up to 365 days in chronological age, born in the same year and competing in the same category[10]. Undoubtedly, a difference of 365 days between two athletes born in the same year, even though they have the same biological age, leads to differences in chronological age that can influence their motor development[10,11].

Chronological-age difference in one same age group within a category of a certain sports modality is called Relative Age (RA), and its consequences on the performance of athletes is known as Relative Age Effect (RAE)[12].

The difference in chronological age within each category of young athletes corresponds to at least 24 months, thus creating more disadvantages to those born at the lower limit of these categories[13]. Consequently, growth, motor and cognitive development, in addition to biological maturation show that RAE among young athletes can affect their competitive success in several ways, even in adulthood[14-17]. In high-performance sports modalities, the RAE tends to decrease from childhood to late adolescence because physical maturation becomes less variable over time[18-20].

Data show that athletes born in the first quarter of the year (January to March) have considerable advantages over those born in the last quarter (October to December) in many team and individual sports modalities[10,21,22], and in different countries[23,25], including judo[26-28]. However, there is no evidence on national judo competitions as to beginner and elite categories. This study has its conduction justified for providing a more in-depth investigation of not only adult athletes, but also children and adolescents, which makes up an interesting database on the theme at national level for the modality in question.

Our theoretical investigation revealed that all studies relating RAE to competitive performance, especially in individual modalities, including judo, have had as premise to analyze RAE by collecting data on chronological age only for the best ranked in each competition, ignoring the other subsequent competitors on the ranking board. Thus, the objective of the present study was to investigate the RAE on all judo fighters competing nationally in 2013, by age category and competitive performance.

Methods

Participants

The present investigation counted with all 1,501 athletes, of both sexes, participating in the Brazilian judo championship. They were split into 6 categories, with each category having a specific competition date and place throughout 2013 (Table 1).

Table 1. Participants' demographic data

Brazilian Championships	N (M/F)	Age (Mean ± SD)	Competition dates and places	Birth year
Under-13	147/105	11.93 ± 0.56/ 11.88 ± 0,57	03 to 04/08/13 - JP/PB	2001 and 2002
Under-15	139/112	13.94 ± 0.58/ 13.84 ± 0,55	21 to 22/09/13 - PV/RO	1999 and 2000
Under-18	154/133	16.45 ± 0.76/ 15.95 ± 0,86	25 to 26/05/13 - FO/CE	1996 to 1998
Under-21	145/108	18.35 ± 1.17/ 17.77 ± 1,51	18 to 19/05/13 - SF/BA	1993 to 1998
Under-23	149/106	19.60 ± 1.94/ 18.57 ± 2,23	23 to 24/08/13 - MA/RJ	1991 to 1998
Senior	128/75	24.63 ± 4.63/ 23.68 ± 5,31	05 to 06/10/13 - MA/AM	Before 1998

Note: N = Number of athletes, M/F = Male/Female
Source: The authors

Procedures

These championships were held on specific dates between May and October of each year, established by the CBJ in the year that preceded the event. The age categories are subdivided into eight weight categories, determined by the CBJ. The athletes who won the qualifying rounds in their weight categories, in their state of origin, made it to the Judo Brazilian Championship. Fight time differs from one age category to another and increases (under-13: 2 min; under-15: 3 min) until the under-18, when it is set at four minutes, being equivalent for higher categories (under-21, under-23, and senior).

The research was divided into two moments: classification of all participants by performance rank and, afterwards, collection and analysis of birth dates. All these data were sourced from CBJ's official website. Group categorization took into account the performance of all participants, at the end of each competition, published on a summary statement at CBJ's official page. Said statement ranks competitors as follows: i) group 1 (G1) is the group of medal winners, with the first, the second and the two third places; ii) group 2 (G2) comprises the two five and the two seven places, and iii) group 3 (G3) goes from the ninth place on.

After the stage above, the athletes were grouped into quartiles, according to their respective birth dates. Those born in January, February and March were classified into quartile 1 (Q1), those born in April, May and June, into quartile 2 (Q2), those born in July, August and September, into quartile 3 (Q3), and those born in October, November and December were classified into quartile 4 (Q4). This classification is founded on previously used methodologies[28,34,35].

Statistical Analysis

The athletes' birth dates were divided into quartiles, which were described by means of absolute and relative frequencies. The chi-squared test (χ^2) was employed to compare observed and expected values for both sexes, according to the division by category and age, adopting $p < 0.05$ as significance. A post hoc analysis with multiple comparison test was applied so that the alpha levels were adjusted by the Bonferroni method, thus identifying where significant differences were, as per recommendations38,39. This analysis changed the p value, which was adjusted to $p < 0.00417$. The statistical program used was SPSS 20.0

Results

By the chi-squared test, comparing observed and expected values, no significant difference ($p < 0.00417$) was found in the male under-13, under-18, under-21 and senior categories (Table 2). As for the male under-15 category, in its turn, Q2 in G1 (best ranked group) obtained an observed value significantly higher than the expected value (OV = 17; EV = 9.7; $p = 0.001$).

Table 2. Frequencies, Chi-squared values, adjusted residuals, and p value for subgroups by quartile for males' birth dates

		Under-13						**Under-15**				
		Q1	Q2	Q3	Q4	Total		Q1	Q2	Q3	Q4	Total
G1	OV	14	7	8	3	32	G1	11	17	1	3	32
	OV%	43.8	21.9	25	9.4	100		34.4	53.1	3.1	9.4	100
	EV	13.3	6.7	8.3	3.7	32		10.6	9.7	5.3	6.4	32
	EV%	41.6	20.9	25.9	11.6	100		33.1	30.3	16.6	20.0	100
	AR	0.3	0.1	-0.1	-0.4			0.2	3.2	-2.3	-1.7	
	x²	0.09	0.02	0.02	0.19			0.03	10.35	5.42	3	
	p	0.77	0.9	0.9	0.66			0.86	0.001*	0.02	0.08	
G2	OV	11	8	8	5	32	G2	9	10	8	5	32
	OV%	34.4	25	25	15.6	100		28.1	31.2	25	15.6	100
	EV	13.3	6.7	8.3	3.7	32		10.6	9.7	5.3	6.4	32
	EV%	41.6	20.9	25.9	11.6	100		33.1	30.3	16.6	20.0	100
	AR	-0.9	0.6	-0.1	0.7			-0.7	0.1	1.5	-0.7	
	x²	0.85	0.38	0.02	0.66			0.46	0.02	2.15	0.53	
	p	0.36	0.54	0.9	0.42			0.5	0.88	0.14	0.47	
G3	OV	36	16	22	9	83	G3	26	15	14	20	75
	OV%	43.4	19.3	26.5	10.8	100		34.7	20	18.7	26.7	100
	EV	34.4	17.5	21.5	9.6	83		24.8	22.7	12.4	15.1	75
	EV%	41.4	21.1	25.9	11.6	100		33.1	30.3	16.5	20.1	100
	AR	0.5	-0.6	0.2	-0.3			0.4	-2.8	0.7	2.1	
	x²	0.28	0.38	0.04	0.1			0.18	8.06	0.53	4.31	
	p	0.6	0.54	0.84	0.76			0.67	0	0.47	0.04	
		Under-18						**Under-21**				
		Q1	Q2	Q3	Q4	Total		Q1	Q2	Q3	Q4	Total
G1	OV	13	7	6	6	32	G1	11	12	3	6	32
	OV%	40.6	21.9	18.8	18.8	100		34.4	37.5	9.4	18.8	100
	EV	12.7	8.1	5.2	6	32		8.1	9.5	7	7.4	32
	EV%	39.7	25.3	16.3	18.8	100		25.3	29.7	21.9	23.1	100
	AR	0.1	-0.5	0.4	0.0							
	x²	0.09	0.02	0.02	0.19			1.79	1.21	3.74	0.46	
	p	0.77	0.9	0.9	0.66			0.18	0.27	0.05	0.5	
G2	OV	15	8	5	4	32	G2	4	8	7	9	28
	OV%	46.9	25	15.6	12.5	100		14.3	28.6	25	32.1	100
	EV	12.7	8.1	5.2	6	32		7.1	8.3	6.1	6.5	28
	EV%	39.7	25.3	16.3	18.8	100		25.4	29.6	21.8	23.2	100
	AR	0.9	0.0	-0.1	-1.0			1.0	-1.0	0.2	-0.1	
	x²	0.85	0.38	0.02	0.66			2.28	0.02	0.22	1.58	
	p	0.36	0.54	0.9	0.42			0.13	0.88	0.64	0.21	
G3	OV	33	24	14	19	90	G3	20	21	20	17	78
	OV%	36.7	26.7	15.6	21.1	100		25.6	26.9	25.6	21.8	100
	EV	35.6	22.8	14.6	16.9	90		19.8	23.2	17	18.1	78
	EV%	39.6	25.3	16.2	18.8	100		25.4	29.7	21.8	23.2	100
	AR	-0.9	0.5	-0.3	0.9			1.0	-0.6	-0.8	0.3	
	x²	0.28	0.38	0.04	0.1			0.01	0.67	1.61	0.2	
	p	0.6	0.54	0.84	0.76			0.93	0.41	0.21	0.66	

Table 2 continues...

		Under-23							Senior				
		Q1	Q2	Q3	Q4	Total			Q1	Q2	Q3	Q4	Total
G1	OV	4	9	6	13	32	G1	OV	10	8	7	7	32
	OV%	12.5	28.1	18.8	40.6	100		OV%	31.2	25	21.9	21.9	100
	EV	10.1	7.7	6.7	7.5	32		EV	8	8.3	6.8	9	32
	EV%	31.6	24.1	20.9	23.4	100		EV%	25.0	25.9	21.3	28.1	100
	AR	-2.6	0.6	-0.3	2.6			AR	0.9	-0.1	0.1	-0.9	
	x²	6.84	0.35	0.1	6.66			x²	0.89	0.01	0.02	0.82	
	p	0.01	0.55	0.75	0.01			p	0.35	0.91	0.9	0.36	
G2	OV	6	7	12	7	32	G2	OV	6	7	11	8	32
	OV%	18.8	21.9	37.5	21.9	100		OV%	18.8	21.9	34.4	25	100
	EV	10.1	7.7	6.7	7.5	32		EV	8	8.3	6.8	9	32
	EV%	31.6	24.1	20.9	23.4	100		EV%	25.0	25.9	21.3	28.1	100
	AR	-1.8	-0.3	2.6	-0.2			AR	-0.9	-0.6	2.1	-0.5	
	x²	3.09	0.12	6.89	0.06			x²	0.89	0.34	4.52	0.21	
	p	0.08	0.73	0.01	0.81			p	0.35	0.56	0.03	0.65	
G3	OV	37	20	13	15	85	G3	OV	16	18	9	21	64
	OV%	43.5	23.5	15.3	17.6	100		OV%	25	28.1	14.1	32.8	100
	EV	26.8	20.5	17.7	20	85		EV	16	16.5	13.5	18	64
	EV%	31.5	24.1	20.8	23.5	100		EV%	25.0	25.8	21.1	28.1	100
	AR	3.6	-0.2	-1.9	-1.9			AR	0.0	0.6	-1.9	1.2	
	x²	13.17	0.04	3.65	3.76			x²	0	0.37	3.8	1.39	
	p	0.001*	0.84	0.06	0.05			p	1	0.54	0.05	0.24	

Note: OV = Observed Value, OV% = Observed value in percentage, EV = Expected Value, EX% = Expected value in percentage, AR = Adjusted Residuals, X2 = Chi-squared test score; *p<0.00417
Source: The authors

In the male under-23 category, significant difference was found by comparing observed and expected values in the 1st quartile of G3 (group eliminated in the first fights) (OV = 37; EV = 10.1; $p < 0.0001$). As for the females, no significant difference was found in any of the age categories (Table 3).

Table 3. Frequencies, Chi-squared values, adjusted residuals, and p value for subgroups by quartile for females' birth dates

		Under-13							Under-15				
		Q1	Q2	Q3	Q4	Total			Q1	Q2	Q3	Q4	Total
G1	OV	12	7	8	5	32	G1	OV	12	9	7	4	32
	OV%	37.5	21.9	25	15.6	100		V%	37.5	28.1	21.9	12.5	100
	EV	13.1	7.9	6.7	4.3	32		EV	10.3	7.7	8.9	5.1	32
	EV%	40.9	24.7	20.9	13.4	100		EV%	32.2	24.1	27.8	15.9	100
	AR	-0.5	-0.5	0.7	0.5			AR	0.8	0.6	-0.9	-0.7	
	x²	0.23	0.21	0.46	0.21			x²	0.59	0.4	0.75	0.42	
	P	0.63	0.65	0.5	0.65			p	0.44	0.53	0.39	0.52	
G2	OV	13	8	5	6	32	G2	OV	8	7	11	6	32
	OV%	40.6	25	15.6	18.8	100		OV%	25	21.9	34.4	18.8	100
	EV	13.1	7.9	6.7	4.3	32		EV	10.3	7.7	8.9	5.1	32
	EV%	40.9	24.7	20.9	13.4	100		EV%	32.2	24.1	27.8	15.9	100
	AR	0.0	0.0	-0.9	-1.1			AR	-1.0	-0.3	1.0	0.5	
	x²	0.002	0.001	0.79	1.17			x²	1.05	0.12	1	0.24	
	P	0.96	0.97	0.37	0.28			p	0.31	0.73	0.32	0.63	

Table 3 continues...

		Q1	Q2	Q3	Q4	Total			Q1	Q2	Q3	Q4	Total
G 3	OV	18	11	9	3	41	**T**	OV	16	11	13	8	48
	OV%	43.9	26.8	22	7.3	100		OV%	33.3	22.9	27.1	16.7	100
	EV	16.8	10.2	8.6	5.5	41		EV	15.4	11.6	13.3	7.7	48
	EV%	41.0	24.9	21.0	13.4	100		EV%	32.1	24.2	27.7	16.0	100
	AR	0.5	0.4	0.2	-1.5			AR	0.2	-0.3	-0.1	0.1	
	x²	0.24	0.15	0.04	2.11			x²	0.05	0.07	0.01	0.02	
	p	0.62	0.69	0.84	0.15			p	0.82	0.8	0.9	0.88	
Under-18							**Under-21**						
		Q1	Q2	Q3	Q4	Total			Q1	Q2	Q3	Q4	Total
G 1	OV	12	9	7	4	32	G 1	OV	11	5	7	9	32
	OV%	37.5	28.1	21.4	12.5	100		OV%	34.4	15.6	21.9	28.1	100
	EV	8.4	8.2	9.1	6.3	32		EV	8.4	8.2	9.1	6.3	32
	EV%	26.3	25.6	28.4	19.7	100		EV%	26.3	25.6	28.4	19.7	100
	AR	1.6	0.4	-1.0	-1.2			AR	1.3	-1.5	-1.4	1.9	
	x²	2.72	0.15	0.93	1.33			x²	2.72	0.15	0.93	1.33	
	p	0.1	0.7	0.34	0.25			p	0.1	0.7	0.34	0.25	
G 2	OV	4	7	13	8	32	G 2	OV	7	13	10	2	32
	OV%	12.5	21.4	40.6	25	100		OV%	21.9	40.6	31.3	6.3	100
	EV	8.4	8.2	9.1	6.3	32		EV	8.4	8.2	9.1	6.3	32
	EV%	26.3	25.6	28.4	19.7	100		EV%	26.3	25.6	28.4	19.7	100
	AR	-2.0	-0.5	1.7	0.9			AR	-0.5	2.1	0.1	-1.9	
	x²	4.15	0.3	3	0.8			x²	4.15	0.3	3	0.8	
	p	0.04	0.58	0.08	0.37			p	0.04	0.58	0.08	0.37	
G 3	OV	19	18	18	14	69	G 3	OV	10	9	17	8	44
	OV%	27.5	26.1	26.1	20.3	100		OV%	22.7	20.5	38.6	18.2	100
	EV	18.2	17.6	19.7	13.5	69		EV	18.2	17.6	19.7	13.5	69
	EV%	26.4	25.5	28.6	19.6	100		EV%	26.4	25.5	28.6	19.6	100
	AR	0.3	0.1	-0.7	0.2			AR	-0.7	-0.6	1.2	0.0	
	x²	0.11	0.02	0.43	0.05			x²	0.11	0.02	0.43	0.05	
	p	0.74	0.89	0.51	0.82			p	0.74	0.89	0.51	0.82	
Under-23							**Senior**						
		Q1	Q2	Q3	Q4	Total			Q1	Q2	Q3	Q4	Total
G 1	OV	11	7	9	5	32	G 1	OV	8	7	8	9	32
	OV%	34.4	21.9	28.1	15.6	100		OV%	25	21.9	25	28.1	100
	EV	8.2	7.5	9.7	6.6	32		EV	8.1	6.8	8.5	8.5	32
	EV%	25.6	23.4	30.3	20.6	100		EV%	25.3	21.3	26.6	26.6	100
	AR	1.4	-0.3	-0.3	-0.9			AR	-0.1	0.1	-0.3	0.2	
	x²	1.91	0.07	0.09	0.73			x²	0.003	0.01	0.08	0.06	
	p	0.17	0.79	0.76	0.39			p	0.95	0.92	0.78	0.81	
G 2	OV	5	10	11	6	32	G 2	OV	9	7	7	6	29
	OV%	15.6	31.3	34.4	18.8	100		OV%	31	24.1	24.1	20.7	100
	EV	8.2	7.5	9.7	6.6	32		EV	7.3	6.2	7.7	7.7	29
	EV%	25.6	23.4	30.3	20.6	100		EV%	25.2	21.4	26.6	26.6	100
	AR	-1.5	1.2	0.6	-0.3			AR	0.9	0.5	-0.4	-0.9	
	x²	2.34	1.49	0.38	0.11			x²	0.81	0.22	0.15	0.86	
	P	0.13	0.22	0.54	0.74			p	0.37	0.64	0.69	0.35	
G 3	OV	11	8	12	11	42	G 3	OV	2	2	5	5	14
	OV%	26.2	19	28.6	26.2	100		OV%	14.3	14.3	35.7	35.7	100
	EV	10.7	9.9	12.7	8.7	42		EV	3.5	3	3.7	3.7	14
	EV%	25.5	23.6	30.2	20.7	100		EV%	25.0	21.4	26.4	26.4	100
	AR	0.1	-0.9	-0.3	1.1			AR	-1.1	-0.7	0.8	0.8	
	x²	0.02	0.79	0.09	1.25			x²	1.11	0.51	0.72	0.72	
	P	0.89	0.37	0.77	0.26			p	0.29	0.48	0.4	0.4	

Note: OV = Observed Value, OV% = Observed value in percentage, EV = Expected Value, EX% = Expected value in percentage, AR = Adjusted Residuals, X2 = Chi-squared test score; *p<0.004
Source: The authors

Discussion

The objective of the present study was to investigate RAE among all judo national competitions held in 2013, with differentiation by age and competitive performance. To do so, an analysis was run using the birth quarters of all federate and confederate judo athletes participating in their respective competitions over the season. Results show statistically significant differences, confirming RAE in two age categories (under-15 and under-23). Said results coincide with different findings on team sports modalities[23-25,29-31]. Moreover, RAE is also present during the training stage in some studies conducted with individual-modality athletes[22,32,33].

The consulted literature did not contain any study conducted with judo athletes and investigating all athletes participating in each one of the studied competitions. Analyses have been run in studies on individual modalities; according to Pacharoni et al.[32], who carried out a research with 600 young tennis players in order to investigate RAE occurrence, more specifically in the under-12, under14, under-16 and under-18 age categories, found said occurrence in all categories, reinforcing the findings of the present study.

It is possible to notice an asymmetric distribution in the birth quartiles among the young judo athletes, with Q1 and Q2 in G1, G2 and G3 being greater compared to Q4 in G3, which thus reveals that, in this age category (under-15), athletes born from January to June are more likely to be medal winners. Corroborating with this finding, Ferreira et al.34 developed a study that sought to find out whether RAE is present among males and females in the under-15 category, all medal winners in the 2014 and 2015 Youth School Games, aged on average 13.55 ± 0.59 and 14.00 ± 1.04, respectively; results showed significant differences among males (X^2 = 10.000; p = 0.01), and no significant differences among females. It is worth remembering that the sample of this study is composed of judo athletes who are the best in each age category in their states, selected back when they won state championships and state qualifying rounds, evidencing that the RAE is present in individuals who represent the national judo elite in their categories, and can manifest itself in several weight categories.

The present findings are also aligned with a research conducted by Albuquerque et al.[26], which aimed to investigate RAE in different weight categories among judo athletes; it analyzed 1,738 individuals who competed in the Olympic Games, finding significant results for RAE in heavier athletes and coming to the conclusion that RAE and combat sports must be investigated in weight categories for a better data analysis. In another study published by the same author[27], which assessed RAE in judo athletes who fought in the 1964-2012 Olympic Games, with a sample of 1,762 male athletes and 665 female athletes, concluded that there is a RAE for those at a higher competitive level (medal winners) among male individuals. It is worth stressing that these studies were conducted with athletes in the same individual and combat modality, in addition to having used other premises.

The results of these studies clash with those of previous investigations, such as the one conducted by Albuquerque et al.[35], which analyzed RAE by comparing Taekwondo Olympic athletes in many Olympic games; it analyzed 291 athletes who competed in Atlanta, Sydney and Beijing, both sexes, and found non-significant differences, confirming that the RAE is not present in this modality and in the studied Olympics. The authors reported no RAE during the studied Olympics because, perhaps, many years are necessary for it to manifest itself. However, we emphasize that the present study proposes analyzing all athletes, just as the abovementioned study, but separated into groups by their rank at the end of each studied championship, as well as into various categories.

Just as in a recent study developed by Silva et al.[36], which aimed to verify the influence of RAE on the tactical performance of football players in the under-13 age category,

with 56 athletes, and found RAE to have no such influence. It is worth pointing out that these studies involved male football players, which thus may show differences as to the characteristics of the present investigation.

A recent review with meta-analyis[37] identified 57 studies containing 308 samples in 25 sports; they were divided into subgroups and had the RAE analyzed by competition level, sport type, sport context and study quality, comprehending 1984 to 2016, among female athletes. The findings in all women's sports context revealed a RAE of small significance, but all subgroups presented a RAE in pre-adolescents (11 years old) and adolescents (12 to 14 years old) at higher competition levels. RAE was also found in team and individual sports in contexts associated with sports of high physiological demands.

Thus, it is possible to observe diverging results between studies relating RAE and athletic performance in competitions, which may derive from the peculiarities of each sports modality, as well as different studied countries.

It is important to highlight that, although few significant differences were found, a great difference in the number of athletes among the quartiles can be seen. For instance, out of the 862 male athletes, 510 were born in the 1st semester (118 out of which were medal winners) against 352 born in the 2nd semester (74 medal winners). As for females, out of the 639 athletes, 344 were born in the 6 first months of the year (with 110 medal winners), whereas 293 were born in the last 6 months (82 medal winners).

This study has as favorable point the fact that it investigated all participants, including the best and worst ranked. Nevertheless, further investigation is necessary, especially taking into account difference by sex, in addition to including other fight modalities, using a similar methodology and analyzing different years. As a possible application of these results, instead of being classified biannually or even quadrennially, the age categories should be classified annually. It is important to underscore that the present study presents a limitation when it comes to RAE in the athletes' maturational phase, since RA may not correspond to the individual's maturational age[14].

Conclusions

It is possible to conclude that RAE was identified only in male judo athletes participating in the Brazilian Judo Championship, 2013 season, both younger (under-15 category) and older (under-23 category). However, there is a clear discrepancy between those born in the first semester and in the second semester, for both sexes. This calls for a better comprehension of the factors related to the competitive context of judo athletes and a search for the reasons that may cause this major difference between medal winners born in the first half of the year and those born in the second half. Furthermore, another proposal is to reconsider the effectiveness of the current division system by age category.

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Authors' ORCID:
Eduardo Victor Ramalho Lucena: https://orcid.org/0000-0001-6807-4100
Pedro Pinheiro Paes: https://orcid.org/0000-0002-6765-5672
Gustavo Augusto Fernandes Correia: https://orcid.org/0000-0002-7914-6840
Bruna Giovana Correia de Souza: https://orcid.org/0000-0002-0526-8597
Mayllane Pereira da Silva Sousa: https://orcid.org/0000-0002-1316-9556
Hugo Augusto Alvares da Silva Lira: https://orcid.org/0000-0001-5906-6838

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Correspondence address: Eduardo Victor Ramalho Lucena. Av. Jornalista Aníbal Fernandes s/n, Cidade Universitária, Recife - PE, CEP: 50730-120. E-mail: edu.personal.judo@gmail.com