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RELATIVE AGE EFFECTS IN COMBAT SPORTS ATHLETES OF THE PARIS 2024 OLYMPIC GAMES

EFEITOS DA IDADE RELATIVA EM ATLETAS DE ESPORTES DE COMBATE DOS JOGOS OLÍMPICOS DE PARIS 2024

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ABSTRACT

The phenomenon of physical and physiological differences that provide a competitive advantage among individuals, which may occur due to differences in biological age, is called the relative age effect (RAE). This phenomenon is not well understood in combat sports. The study aimed to investigate the RAE in combat sports athletes who competed in the Paris 2024 Olympic Games. The study sample consisted of 1,309 athletes of both sexes from boxing, fencing, judo, taekwondo, and wrestling. The RAE was analyzed by dividing the year into quarters and grouping athletes by their birth date, separated by sex and each sport. No consistent RAE was observed among combat sports athletes.

Key words: martial arts; fight; relative age phenomenon; chronological age; biological age.

RESUMO

O fenômeno das diferenças físicas e fisiológicas que conferem vantagem competitiva entre indivíduos, podendo ocorrer em função de diferenças na idade biológica, é denominado efeito da idade relativa (RAE). Esse fenômeno ainda não é bem compreendido nos esportes de combate. O objetivo do estudo foi investigar o RAE em atletas de esportes de combate que competiram nos Jogos Olímpicos de Paris 2024. A amostra do estudo foi composta por 1.309 atletas de ambos os sexos das modalidades de boxe, esgrima, judô, taekwondo e wrestling. O RAE foi analisado por meio da divisão do ano em trimestres e do agrupamento dos atletas de acordo com a data de nascimento, separados por sexo e por modalidade esportiva. Não foi observado um RAE consistente entre os atletas de esportes de combate.

Palavras-chave: artes marciais; luta; fenômeno da idade relativa; idade cronológica; idade biológica.

INTRODUCTION

Sports modalities are generally categorized based on chronological age. This categorization aims to provide young athletes with equality during competitions. However, within the same age category, older athletes may have physical advantages over younger athletes, especially during puberty. This difference is primarily influenced by biological age. This difference between chronological and biological age and its possible advantages or disadvantages can be defined as the relative age effect (RAE) (Malina *et al*., 2004; Musch & Grondin, 2001).

Several studies have investigated the RAE, often segmenting birth years into quartiles and comparing those born early in the year with those born later in the year. The results indicate that the RAE is a phenomenon present in various sports, particularly in those where physical characteristics such as body size, strength, and speed play decisive roles in performance (Cobley *et al*., 2009; Delorme, 2014; Musch & Grondin, 2001). In addition to the biological factors influencing the RAE, social aspects are also described as contributing to these characteristics, such as the influence of parents, coaches, and even the athletes themselves (Hancock *et al*., 2013).

Studies investigating the RAE in combat sports do not reach a consensus in the literature (Albuquerque *et al.*, 2012, 2016; Campideli *et al.*, 2018; de Almeida-Neto *et al.*, 2023; van Rossum, 2006), as, unlike other modalities, combat sports use in addition to age, categorization by body mass (Albuquerque *et al.*, 2012; Cobley *et al.*, 2009), and in some modalities, even by grading systems (belts). Although we cannot say with certainty that these characteristics influence a lower RAE in combat sports, we can suggest that the dynamics might differ and that the phenomenon should be investigated in combat sports.

Considering that the RAE may or may not extend to the highest levels of sport, it is necessary to investigate it so that coaches can discuss better talent selection methods aimed at achieving better results, while also reducing exclusion and dropout rates in adolescent athletes. Therefore, this study aimed to investigate the potential RAE in combat sports athletes of both sexes who participated in the 2024 Paris Olympic Games.

MATERIALS AND METHODS

Sample

The birth dates of 1,309 athletes from combat sports, of both sexes, who participated in the 2024 Paris Olympic Games were analyzed. Considering both sexes, the sport of boxing had 249 athletes, fencing had 259, judo had 377, wrestling had 291, and taekwondo had 133 athletes. In the female group, 599 athletes were analyzed, with an average age of 26.7 ± 4.3 years. In the male group, 710 athletes were analyzed, with an average age of 27.0 ± 4.2 years. The individual characteristics of the athletes, separated by sex and sport, are presented in Table 1.

Data collection procedures

All data regarding the athletes, such as birth date, body mass, and nationality, were exported from the official website of the International Olympic Committee (https://olympics.com/en/paris-2024), which is publicly accessible. The data collection period occurred between September and October 2024. To maintain anonymity during data collection, athletes were identified by codes in the data spreadsheet.

After data collection, the birth dates of each athlete were categorized into quartiles (Q), using the annual calendar as a reference (start: January 1, end: December 31), where the 1st Q includes athletes born in January, February, and March; 2nd Q: April, May, and June; 3rd Q: July, August, and September; and 4th Q: October, November, and December. Thus, the number of athletes (n) was distributed into the quartiles corresponding to their birth dates.

Statistical analysis

Descriptive data such as age and body mass were presented as means and standard deviations. To analyze the interquartile comparison of the possible RAE for each combat sport modality, a chi-square test (X^2) or Fisher's exact test was applied when necessary. The data were analyzed using the software GraphPad Prism 8.0.2. In all cases, a significance level of $p<0.05$ was adopted.

RESULTS

Table 1 presents the individual characteristics of female and male athletes in Boxing, Fencing, Judo, Wrestling, and Taekwondo.

Table 1. Individual characteristics of combat sports athletes from the 2024 Paris Olympic Games.

Sex	Modality	N	Age (years old)
Female	Boxing	124	27.1 ± 4.1
	Fencing	129	27.3 ± 5.3
	Judo	186	26.8 ± 4.1
	Wrestling	96	25.9 ± 3.7
	Taekwondo	64	24.2 ± 3.4
Male	Boxing	125	25.3 ± 3.3
	Fencing	130	27.9 ± 5.0
	Judo	191	27.0 ± 3.8
	Wrestling	195	27.7 ± 4.1
	Taekwondo	69	24.3 ± 3.8

Legend: n = number of participants; kg = kilograms; cm = centimeters; data presented as mean ± standard deviation.

Tables 2 and 3 present the birth quartile results for female and male athletes in Boxing, Fencing, Judo, Wrestling, and Taekwondo.

Table 2. Birth quartiles of female combat sports athletes from the 2024 Paris Olympic Games, chi-square test.

Modality	1st Quartile n (%)	2nd Quartile n (%)	3rd Quartile n (%)	4th Quartile n (%)	X^2	P
Boxing	23 (18.5)	41 (33.1)*	37 (29.8)	23 (18.5)	8.516	0.0365*
Fencing	37 (28.7)	28 (21.7)	32 (24.8)	32 (24.8)	1.264	0.7378
Judo	50 (26.8)	39 (20.9)	48 (25.8)	49 (26.3)	1.656	0.6468
Wrestling	20 (20.8)	19 (19.8)	29 (30.2)	28 (29.1)	3.417	0.3317
Taekwondo	17 (26.5)	17 (26.5)	15 (23.4)	15 (23.4)	0.2500	0.9691

Legend: n = number of participants; % = percentage; * = statistically significant difference.

Tabela 3. Birth quartiles of male combat sports athletes from the 2024 Paris Olympic Games, chi-square test.

Modality	1st Quartile n (%)	2nd Quartile n (%)	3rd Quartile n (%)	4th Quartile n (%)	X^2	P

Boxing	32 (25.6)	25 (20.0)	30 (24.0)	38 (30.4)	2.776	0.4275
Fencing	23 (20.0)	33 (25.4)	38 (29.2)	36 (27.7)	4.092	0.2517
Judo	49 (25.6)	48 (25.1)	51 (26.7)	43 (22.5)	0.727	0.8667
Wrestling	52 (26.6)	48 (24.6)	41 (21.0)	54 (27.7)	2,026	0,5671
Taekwondo	10 (14.5)	14 (20.3)	26 (37.6)*	19 (27.5)	8,275	0,0407*

Legend: n = number of participants; % = percentage; * = statistically significant difference.

DISCUSSIONS

The aim of this study was to analyze the birth distribution by quartiles of Olympic athletes from combat sports who competed in the Paris 2024 Olympic Games to investigate a potential Relative Age Effect (RAE). Our results showed that the RAE is not consistent among combat sports athletes of both sexes. These findings are in line with part of the literature, particularly with studies that do not subdivide or consider weight categories.

A significant difference can be observed in females only in boxing, where the highest number of athletes were born in the 2nd quarter (April, May, and June). However, there is also a trend indicating many athletes (37) born in the 3rd quarter (July, August, and September). In males, a significant difference was observed only in taekwondo, where the 3rd quarter concentrated the highest number of athletes born in those months. In both results, it can be suggested that these patterns may be specific to the sport and gender.

The results of the present study corroborate the findings of Campideli et al., (2018), who investigated the RAE in combat sports athletes who competed in the 2012 and 2016 Olympic Games. They also did not find the RAE consistently in both editions. However, the authors observed a different quartile distribution, specifically in the second half of the year, where they identified an inverse RAE (higher birth rate in the last semester) in female judo athletes. Another difference to highlight is that the authors of the study did not perform the RAE analysis for fencing athletes, as was done in the present work.

The findings also corroborate the results of (Albuquerque et al., 2012), who conducted a study with male and female Taekwondo athletes who competed in the Sydney, Athens, and Beijing Olympic Games and found no RAE. In contrast, a study

with wrestlers who participated in the Olympic Games up to 2012, by Albuquerque et al., (2014), also did not observe RAE in female athletes, but the effect was observed in male athletes. Although these results differ from those of the present study, they reinforce the idea that RAE distributions may be influenced by gender and change over time.

As possible explanations for the absence of RAE in our results, it can be suggested that there may have been a disappearance of the RAE with age progression. Additionally, in combat sports, especially at the highest competitive level, technical skill may play a more determining role than physical demands in influencing the outcomes (Miarka et al., 2012). Some authors also describe the division by weight class as another factor contributing to the reduction of RAE; however, this is not a consensus in the literature.

Delorme (2014) investigated whether weight categories prevent young boxers from being exposed to RAE. The results showed an absence of RAE among French amateur and professional boxers. Another study on combat sports that analyzed RAE by body weight category, without considering gender, in judo athletes who participated in the Olympic Games up to 2012, observed RAE only in the heavyweight category (Albuquerque *et al.*, 2013).

To better understand the influence of weight categories, Albuquerque *et al.* (2016) conducted a meta-analysis aimed at evaluating whether weight categories could prevent RAE in combat sports. The results showed that RAE was present in both the combined male and female group and in the male-only group of senior combat sports athletes. Therefore, weight categories may not be sufficient to reduce RAE in athletes in general.

Another factor that may influence RAE is the athlete's age (de Almeida-Neto *et al.*, 2023; Fukuda, 2015; Kim *et al.*, 2024). Kim et al., (2024) found a higher prevalence of RAE in younger athletes compared to the senior group. RAE was more prominent in men compared to women, with the female group showing an inverse trend of RAE. De Almeida-Neto *et al.* (2023) analyzed elite athletes in Karate, Taekwondo, and Fencing in the sub-11 to sub-18 categories and found RAE in the sub-11, sub-12, sub-15, and sub-17 categories of fencing, with a higher prevalence in the female

categories. In Karate, RAE occurred in the sub-14 and sub-16 categories, with a higher prevalence in males. No RAE was found for the Kata modality in Karate or the Taekwondo categories. Fukuda (2015) evaluated 1,542 world judo championship winners (under 17) and observed that RAE is apparent in cadet and junior judo athletes. These studies show considerable variation in results when considering RAE by athlete age. Given that in our results, athletes from all combat sports are of similar ages, which correlates with the high competitive level of the Olympics, this factor should be considered in the interpretation of the findings.

Limitations

The authors acknowledge that the absence of descriptive information on most athletes, such as height, wingspan, and body mass, which could characterize the sample, is a limitation of the present study. However, this data was not available for access.

CONCLUSION

It can be concluded that the RAE was not consistently found in combat sports athletes who participated in the 2024 Paris Olympic Games. Studies that include biological and social analyses in young (adolescent) athletes are necessary to continue investigating the RAE in high-performance combat sports. Such results could contribute to better discussions in the talent selection process, aiming for improved performance and reduced exclusion and dropout from sports.

CONFLICT OF INTERESTS:

The authors declare no conflict of interest.

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