ORIGINAL ARTICLE

Weight categories do not prevent athletes from Relative Age Effect: an analysis of Olympic Games wrestlers

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B Data Collection
C Statistical Analysis
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Abstract

Background & Study Aim: Relative Age Effects (RAE) refer to the effects of age differences among individuals who have been grouped together. This study aimed is knowledge about RAE in Olympic Games wrestlers to analyse its effects on all athletes, styles, and medallists, considering males and females separately.

Material & Methods: The names and birthdates of the Olympic wrestlers were collected from open-access websites. In this study, we analysed male and female competitors separately.

Results: The main results of this investigation were the presence of RAE in all styles, freestyle medallists, and freestyle main medalling countries, only in male athletes.

Conclusions: Thus, in a selected group of wrestlers who had participated at the highest competitive level, RAE were in all styles, only in male athletes. In addition, our data suggest that RAE cannot be eliminate only by weight categories.

Keywords: freestyle wrestling • Greco-Roman athletes • Olympic athletes • sport psychology

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Introduction

Sport psychology – is an interdisciplinary science that draws on knowledge from many related fields including biomechanics, physiology, kinesiology and psychology. It involves the study of how psychological factors affect performance and how participation in sport and exercise affect psychological and physical factors [35]

Wrestling – sport in which two contestants fight by gripping each other using special holds, each trying to force the other's shoulders onto a mat [36]

Freestyle wrestling – is a style of amateur wrestling that is practiced throughout the world. Along with Greco-Roman, it is one of the two styles of wrestling contested in the Olympic games

Freestyle – *adjective* used for describing events in such sports as figure skating, surfing and downhill skiing in which any manoeuvre can be performed, with the contestants judged on their athleticism, technique and artistry [36]

Many sports use a cut-off criterion to group youth participants into age categories. The primary propose is to provide appropriate development, fair competition, and equal opportunity [1]. In a system with a cut-off date of January 1st, a child who was born in January 1st is grouped with children born in December 31st. However, children who were born on January 1st may have an advantage of up to 364 days in cognitive and physical development when compared to other children who were born on December 31st, as both groups would be placed in the same age category [2]. These differences in age between individuals who have been grouped together for some performance activity have been extensively investigated in sports sciences literature and are called Relative Age Effects (RAE) [3].

During adolescence, there is considerable variation in the growth and biological maturity of individuals within the same chronological age [4]. Meanwhile, the effects tend to decline from childhood to the end of adolescence, since physical maturation varies less in early adulthood [5]. Although the differences between individuals decrease with time, the consequences of relative age effects in young athletes seem to continuously affect the development of athletes in older categories [6], as several studies have reported relative age effects in professional athletes [7, 8].

Additionally, other important aspects seem to be involved in relative age effects. For example, athletes that are offered more opportunities to participate in sports competitions can enhance their psychological, technical and tactical abilities, which are important characteristics in athletic development. Furthermore, they will receive more resources during their careers, which will result in enhanced success at the highest competitive levels. Thus, younger athletes (i.e., those who were born closer to December 31st) may be less developmentally mature, which may be a disadvantage in terms of functional capacities when compared to more developmentally mature athletes (i.e., those who were born closer to January 1st). Such differences in younger individuals seem to continuously affect the development of athletes in older categories [7, 9, 10].

Some authors [1, 11, 12] have suggested the elimination of relative age effects. The proposal to eliminate relative age effects is based on a competitive class based on weight categories, especially in the youth categories. Thus, for Musch and Grondin [1], Albuquerque et al. [11], and Delorme [13], combat sports are an interesting model to explore the mechanisms that explain relative age effects, with the primary purpose of seeking new alternatives to eliminate this effect.

To the best of our knowledge, only the following three studies have specifically investigated this topic in combat sports: Albuquerque et al. [10] investigated taekwondo athletes; Delorme [13] analysed amateur and professionals boxers; and Albuquerque et al. [9] analysed judo athletes from different weight categories. Albuquerque et al. [11] and Delorme [13] did not find relative age effects in Olympic taekwondo athletes and amateur and professionals boxers, respectively, including in analyses that were separately conducted for male and female athletes. The major hypothesis proposed to explain the absence of relative age effects in taekwondo was based on appropriate criteria (age, level or belt and body mass), which grouped young participants into competitive categories [11], while Delorme [13] attributed this result to the weight categories criteria. Musch and Grondin [1] and Delorme [13] argued that in wrestling and boxing, competitive classes based on weight categories turn out to be a sensible solution to prevent relative age effects in these sports. Nevertheless, Albuquerque et al. [9] found relative age effects in Olympic judo athletes, but only in heavier athletes. In this case, the hypothesis proposed by Albuquerque et al. [11], Musch and Grondin [1] and Delorme [13] about combat sports (weight categories) was not applicable to the judo athletes from the heavyweight category. The explanation for these results is based on the physical demands required by heavy judo athletes during the combat and by the absence of an upper body mass limit in this weight category, which may result in bigger, more matured and stronger athletes being in advantage.

In addition, Musch and Grondin [1] suggested that relative age effects exist in almost every competitive sport. Competitiveness is influenced by the number of athletes available to participate in the sport, which is dependent on the sports' popularity in a given country. In this line, Albuquerque et al. [11] argued that taekwondo is a relatively new Olympic sport and a growing number of countries and athletes will increase the level of competition. Although judo, taekwondo and wrestling are similar in several aspects, including the selection processes (chronological age, and weight categories), judo and wrestling participation in the Olympic Games is longer, compared to taekwondo. Thus, the hypothesis that the increased selection competition is a necessary condition to the occurrence of

relative age effects [1] emerged as a hypothesis to explain the different results found in judo and taekwondo Olympic athletes [9, 11].

Wrestling is a Olympic combat sport which goal is winning by fall or by achieving lead according to the technical points scored [14]. Nowadays, two wrestling styles are included in Olympic Games: Greco-Roman, in which only upper body attacks are allowed, and freestyle, in which upper and lower body techniques are used [14]. Furthermore, wrestling has been described as an intermittent physical combat sport based on a weight class system, which relies on great strength and muscle power demands on both the upper and lower body, with high anaerobic energy metabolism requirements [15, 16]. In addition, wrestling is a sport combat sports which provide the most direct contact with an opponent [17].

Thus, wrestling seems to be an interesting model to explore the mechanisms that explain relative age effects in combat sports, as they according to Delorme et al. [18], relative age effects has been observed in sports where physical attributes such as body mass, height, and strength are highly important. Also, Delorme et al. [19] believed that in high contact sports (e.g. soccer and handball) where physical attributes are strong determinants of success the relative age effects could be observed. Hence, this study aimed is knowledge about RAE in Olympic Games wrestlers to analyse its effects on all athletes, styles, and medallists, considering males and females separately.

Material and methods

Data Collection

The names and birthdates of the Olympic wrestlers were collected from open-access Internet websites and there were no ethical issues involved in the analysis and interpretation of the data used, as these data were obtained in secondary form and were not obtained by experimentation. The use of open-access or Internet data in relative age effects studies has previously been described in other studies [7,9,11,20]. In addition, the athletes' personal identification was replaced by a code to ensure anonymity and confidentiality. A total of 3,938 Olympic wrestlers were included in this study, and their birth date information was collected. Several athletes had participated in more than one Olympic Games edition and, in some cases, had competed in different weight categories. In this study, we chose to use the athlete's first participation in the Olympic Games to avoid repeated data. In addition, due to the numerous changes occurred in wrestling weight categories over time in Olympic Games, there were no conditions to analyse these data.

Procedure

A traditional approach to investigate relative age effects is to use four quarters (Q1 – January to March; Q2 – April to June; Q3 – July to September and Q4 – October to December) for data analysis [2, 7, 9, 11, 21] .

Statistical analyses

Chi-square tests were performed on the birthdates of each athlete within each quarter to determine the significance of the deviations from the expected number. Condon and Scaglion [22] demonstrated that the births are not evenly distributed along the year and are affected by environmental zones and cultural factors. However, similar to other studies on relative age effects [7, 9, 11, 21, 23], the sample consisted of international (from different cultural and environmental zones) athletes, and the expected values were calculated on the basis of the assumption of an even distribution of births throughout each half of the year because "this strategy was frequently used when the research concerns an international sample" [21].

Odds ratio (OR) analyses were also performed in order to determine the probability of relative age effects occurrence. OR and 95% confidence intervals (CI) were calculated by comparing quarters to Q4 (i.e. Q1 versus Q4, Q2 versus Q4, and Q3 versus Q4). These procedures are effective in showing participation inequalities and the probability of relative age effects occurrence [12, 13].

These tests were used to identify where relative age effects became established. Statistical significance was set at $P < 0.05$ for all tests.

Results

The Chi-square goodness-of-fit test showed that the observed distribution in all females was not statistically different (Table 1). However, the observed distribution of birthdates was statistically different from the expected distribution in male freestyle wrestling athletes ($\chi^2_{(3)} = 20.260$; $p < 0.001$), and in medallists ($\chi^2_{(3)} = 8.405$; $p = 0.038$) (Table 2).

In the Greco-Roman athletes, the Chi-square goodness-of-fit test showed that the observed distribution of birthdates was statistically different from the expected distribution only in male Greco-Roman athletes ($\chi^2_{(3)} = 15.310$; $p = 0.002$) (Table 3).

Table 1: Chi-Square values and related probabilities between the observed and expected age frequencies for female freestyle athletes

	Q1	Q2	Q3	Q4	Total	χ^2	p	OR(CI) Q1 vs Q4	OR(CI) Q2 vs Q4	OR(CI) Q3 vs Q4
All Athletes	37 (25.34%)	33 (22.60%)	43 (29.45%)	33 (22.60%)	146	1.84	.607	1.12 (0.58-2.16)	1.00 (0.51-1.95)	1.30 (0.68-2.48)
Medallists	7 (26.29%)	5 (19.23%)	7 (26.29%)	7 (26.29%)	26	0.46	.927	1.00 (0.22-4.53)	0.71 (0.15-3.47)	1.00 (0.22-4.53)

Table 2: Chi-Square values and related probabilities between the observed and expected age frequencies for male freestyle athletes.

	Q1	Q2	Q3	Q4	Total	χ^2	p	OR(CI) Q1 vs Q4	OR(CI) Q2 vs Q4	OR(CI) Q3 vs Q4
All Athletes	559 (29.33%)	428 (22.45%)	462 (24.24%)	457 (23.98%)	1,907	20.26	< .001	1.22 (1.02-1.46)	0.94 (0.78-1.12)	1.01 (0.84-1.21)
Medallists	104 (30.95%)	67 (19.94%)	85 (25.30%)	80 (23.81%)	336	8.41	.38	1.30 (0.85-1.98)	0.84 (0.54-1.31)	1.06 (0.69-1.63)

p< 0.05

Table 3: Chi-Square values and related probabilities between the observed and expected age frequencies for male Greco-Roman athletes.

	Q1	Q2	Q3	Q4	Total	χ^2	p	OR(CI) Q1 vs Q4	OR(CI) Q2 vs Q4	OR(CI) Q3 vs Q4
All Athletes	543 (28.80%)	435 (23.06%)	445 (23.69%)	463 (24.55%)	1,886	15.31	.002	1.17 (0.98-1.40)	0.94 (0.78-1.13)	0.96 (0.80-1.15)
Medallists	86 (28.85%)	73 (24.48%)	67 (22.48%)	72 (24.16%)	298	2.64	.450	1.19 (0.76-1.87)	1.01 (0.64-1.60)	0.93 (0.59-1.48)

p< 0.05

Discussion

In previous combat sports studies [9, 11], the results were not consistent. Albuquerque et al. [11] and Delorme [13] did not find relative age effects in taekwondo and boxing athletes, respectively. However, Albuquerque et al. [9] reported relative age effects in heavyweight judo athletes. The explanation proposed by the authors was the relationship between the specific technical characteristics in the heavyweight category. Van Rossum [24] argued that the absence of relative age effects may be explained by the more important role of technical skills related to physical demand. Thus, the major results reported by Albuquerque et al. [9] demonstrated that in combat sports, weight categories were required to be separately investigated. Unfortunately, due to the numerous changes that have occurred in wrestling weight categories over the years in Olympic Games, it was not possible to analyze the data of the present study considering the different weight categories. Despite this limitation, our study showed that the wrestling styles, which do not have different physical characteristics [25-28] seem to affect relative age effects. Delorme et al. [18] hypothesised that relative age effects is observed in sports in which physical attributes such as body mass, height, and strength play a key role. Several previous studies [15, 16, 29] have demonstrated that wrestling is an intermittent physical event that requires great strength and muscle power demands on both the upper and lower body, with high anaerobic energy demand. Thus, in previous combat sports studies, the results were not consistent. One possible explanation is based on the physical attributes in each sports activity. For example, wrestling and judo are grappling combat sports and seem to require more glycolytic contribution and static strength than striking combat sports such as taekwondo and boxing [30-33]. Thus, higher maximal strength and body mass are considered more important for grappling combat sports than for striking combat sports, in which speed and muscle power seem to be more important for competitive performance. Additionally, the study conducted by Delorme [13] investigated mostly young athletes. At this life stage, the most mature are being selected but relative age effects is not detectable yet, as the better opportunities these athletes are receiving will be noticeable during adulthood.

According to Musch and Grondin [1], the strongest evidence for relative age effects exists in the most competitive sports when the sport's popularity in a given

country is high, which consequently leads to increased competitiveness. Thus, in countries where the competitive level is high, relative age effects preventive care should be intensified, mainly in male athletes.

In addition, Albuquerque and his colleagues [11] argued that taekwondo is a relatively new Olympic sport and a growing number of countries and athletes will increase the competitiveness level. Although judo, wrestling, boxing and taekwondo are similar in several aspects, including the selection processes (chronological age and weight categories), judo and wrestling have been included in the Olympic Games earlier than taekwondo, especially for male athletes, who have presented relative age effects. Moreover, female wrestling and judo competitions are relatively new Olympic sports [11] and no relative age effects was found.

Another assumption can be made to explain the absence of relative age effects in female athletes, besides the fact that this is a relatively new Olympic sport. The earlier and lower variability in the maturity status in girls, when compared to boys, may be an important mechanism to explain the lack of relative age effects in females [34]. Most likely, the paths taken by individuals of both sexes during the athletic development process are different. Thus, relative age effects seems to have stronger effect on male wrestlers.

Finally, similarly to other studies whose data were obtained from a variety of different countries, the limitation of the present study is related to its sample. Thus, the other expected distributions could not be used [21]. This adjustment is important because the births are never evenly distributed along the year and are affected by environmental zones and cultural factors.

Conclusions

The relative age effects phenomenon was found at least to some degree in almost all sports. The contradictory results obtained in the studies involving combat sports participants show that the current knowledge on the mechanisms explaining the presence or absence of relative age effects in combat sports still needs to be improved. Considering that competitiveness is probably a major factor in the development of relative age effects and that weight-categorized sports turned out to be a sensible solution to eliminate the relative age effects effect [11,13] and reduce the number of disadvantages of athletes in younger categories, our data suggest that relative age effects cannot be eliminated only by the addition of weight categories, at least in wrestling, which classifies athletes according to their body mass.

References

1. Musch J, Grondin S. Unequal Competition as an Impediment to Personal Development: A Review of the Relative Age Effect in Sport. Dev Rev 2001; 21(2): 147-167
2. Delorme N, Chalabaev A, Raspaud M. Relative age is associated with sport dropout: evidence from youth categories of French basketball. Scand J Med Sci Sports 2011; 21(1): 120-128
3. Barnsley RH, Thompson AH. Birthdate and success in minor hockey: The key to the NHL. Can J Behav Sci 1988; 20(2): 167-176
4. Malina RM, Eisenmann JC, Cumming SP et al. Maturity-associated variation in the growth and functional capacities of youth football (soccer) players 13–15 years. Eur J Appl Physiol 2004; 91(5-6): 555-562
5. Papalia DE, Olds SW, Feldman RD. Human Development. New York: McGraw Hill Companie Incs; 2007
6. Jiménez IP, Pain MTG. Relative age effect in Spanish association football: Its extent and implications for wasted potential. J Sport Sci 2008; 26(10): 995-1003
7. Côté J, MacDonald DJ, Baker J et al. When "where" is more important than "when": Birthplace and birthdate effects on the achievement of sporting expertise. J Sport Sci 2006; 24(10): 1065-1073
8. Mujika I, Vaeyens R, Matthys SPJ et al. The relative age effect in a professional football club setting. J Sport Sci 2009; 27(11): 1153–1158
9. Albuquerque MR, Tavares V, Lage GM, et al. Relative age effect in Olympic Judo athletes: A weight category analysis. Sci Sport 2013; 28(3): e59–e61
10. Sherar LB, Baxter-Jones ADG, Faulkner RA et al. Do physical maturity and birth date predict talent in male youth ice hockey players? J Sport Sci 2007; 25(8): 879-886
11. Albuquerque MR, Lage GM, Costa VT et al. Relative Age Effect in Olympic Taekwondo Athletes. Percept Motor Skill 2012; 114(2): 1-8
12. Cobley S, Baker J, Wattie N et al. Annual Age-Grouping and Athlete Development: A Meta-Analytical Review of Relative Age Effects in Sport. Sports Med 2009; 39(3): 235-256
13. Delorme N. Do weight categories prevent athletes from relative age effect? J Sports Sci 2014; 32(1): 16-21
14. Czerniak U, Bręczewski G, Kaiser A et al. Polish National Cadet Wrestling Team for 2010 Youth Olympic Games (YOG) – social, somatic and psychological characteristics. Arch Budo Sci Martial Art Extreme Sport 2013; 9: 61-68
15. Farzad B, Gharakhanlou R, Agha-Alinejad H et al. Physiological and performance changes from the addition of a sprint interval program to wrestling training. J Strength Cond Res 2011; 25(9): 2392-2399
16. Garcia-Pallares J, Lopez-Gullon JM, Muriel X et al. Physical fitness factors to predict male Olympic wrestling performance. Eur J Appl Physiol 2011; 111(8): 1747-1758
17. Tomczak M, Bręczewski G, Sokołowski M et al. Personality traits and stress coping styles in the Polish National Cadet Wrestling Team. Arch Budo 2013; 9(3): 161-168
18. Delorme N, Boiche J, Raspaud M. Relative age effect in female sport: a diachronic examination of soccer players. Scand J Med Sci Sports 2010; 20(3): 509-515
19. Delorme N, Boiche J, Raspaud M. The relative age effect in elite sport: the French case. Res Q Exercise Sport 2009; 80(2): 336-344
20. Medic N, Starkes JL, Weir PL et al. Relative age effect in masters sports: replication and extension. Res Q Exercise Sport 2009; 80(3): 669-675
21. Delorme N, Boiche J, Raspaud M. Relative age effect in elite sports: Methodological bias or real discrimination? Eur J Sport Sci 2010; 10(2): 91-96
22. Condon RG, Scaglion R. The ecology of human birth seasonality. Hum Biol 1982; 10(4): 495-511
23. Edgar S, O´Donoghue P. Season of birth distribution of elite tennis players. J Sport Sci 2005; 23(10): 1013-1020
24. Van Rossum JH. Relative age effect revisited: findings from the dance domain. Percept Motor Skill 2006; 102(2): 302-308
25. Sokołowski M, Kaiser A, Czerniak U et al. Wrestlers' health – biological, behavioural and axiological aspects. Arch Budo 2012; 8(1): 37-43

26. Horswill CA, Miller JE, Scott JR et al. Anaerobic and aerobic power in arms and legs of elite senior wrestlers. Int J Sports Med 1992; 13(8): 558-561
27. López-Gullón JM, Muriel X, Torres-Bonete MD et al. Physical fitness differences between Freestyle and Greco-Roman elite wrestlers. Arch Budo 2011; 7(4): 217-225
28. Rezasoltani A, Ahmadi A, Nehzate-Khoshroh M et al. Cervical muscle strength measurement in two groups of elite Greco-Roman and free style wrestlers and a group of non-athletic subjects. Brit J Sport Med 2005; 39(7): 440-443
29. Gabbett TJ, Jenkins DG, Abernethy B. Influence of wrestling on the physiological and skill demands of small-sided games. J Strength Cond Res 2012; 26(1): 113-120
30. Campos FA, Bertuzzi R, Dourado AC et al. Energy demands in taekwondo athletes during combat simulation. Eur J Appl Physiol 2012; 112(4): 1221-1228
31. Franchini E, Nunes AV, Moraes JM et al. Physical Fitness and Anthropometrical Profile of the Brazilian Male Judo Team. J Physiol Anthropol 2007; 26(2): 59-67
32. Yoon J. Physiological Profiles of Elite Senior Wrestlers. Sports Med 2002; 32(4): 225-233
33. Arseneau E, Mekary S, Leger LA. VO(2) requirements of boxing exercises. J Strength Cond Res 2011; 25(2): 348-359
34. Goldschmied N. No Evidence for the Relative Age Effect in Professional Women's Sports. Sports Medicine [Letter] 2011; 41(1): 87-88
35. Weinberg RS, Gould D. Foundations of Sport and Exercise Psychology. Champaign, IL: Human Kinetics; 2010
36. Dictionary of Sport And Exercise Science. London: A. & C. Black; 2006

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