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Examining the Birthdates Distribution of Beijing Olympic Athletes

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Abstract

The aim of this study was to examine the birthdate distribution of the entire population of athletes who participated in the 2008 Olympic Games,considering independently and simultaneously the effect of the following factors: (i) gender, (ii) sport category, (iii) continent, and (iv)performance outcome.The sample included 10.900 athletes whose birthdates were gathered into quartiles and then inspected with chi-square test. The analyses performed to compare birthdates distribution considering each sport category (Individual, Combat, Net/Wall, Invasion/Team, Combined, Field/Run, Target and Early Specialization sports) separately by each continent and performance outcome.No differences were found in the birthdates distribution for gender ($p > .05$).However, the results revealed significant differences in Asian males of Combat sports ($\chi^2=12.2$ $p < .01$), South American males of Invasion/Team sports ($\chi^2=9.7$ $p < .05$), Asian females of target sports ($\chi^2=9.1$ $p < .05$) and Asian females of Early specialization sports ($\chi^2=8.4$ $p < .05$), with a tendency to be born earlier in the year calendar. However, the North American females of Invasion/Team sports ($\chi^2=13.9$ $p < .01$) showed a trend to born more frequently in the middle of the year calendar. Our data were not entirely consistent with previous work, adding new insights to the relative age effects research. The influence of different levels of environmental constraints on athletes' birthdate distribution is proposed as the theoretical explanation for the encountered findings.

Keywords: relative age, talent development, sports performance

Introduction

Sports success may be influenced by player's birthdate. The differences between individuals born earlier and lately in the same year in sports have been matter of extensive research in the last three decades.Supposedly, traditional age grouping potentiates inequal opportunities in the sport development. Moreover, suchstructuredoes not seem to be sensitive enough to prevent a bias in the performers' birthdate distributions tending to the first months after the cut-off date. That bias has been known as the Relative Age Effects (RAEs) (Andronikos, Elumaro, Westbury, & Martindale, 2015; Deaner, Lowen & Cobley, 2013;Leite, Borges, Santos & Sampaio, 2013).

The factors that have been suggested to explain these inequalities on athletes' birthdate distribution were first examined by Musch and Hay(1999)and revised by Cobley, Baker, Wattie and McKenna in 2009. It is noteworthy that earlier development and maturation in anthropometric variables and physical fitness seem to provide performance advantages which may increase the probability to be selected(Carling, Bloomfield, Nelsen, & Reilly, 2008; Lovell et al., 2015; Malina, Bouchard, & Bar-Or, 2004; Malina, Ribeiro, Aroso, & Cumming, 2007). Therefore, it is not surprising that sports coaches tend to select earlier developers(Furley & Memmert, 2016; Helsen, Starkes, & Van Winckel, 1998; Hirose, 2009; Sherar, Baxter-Jones, Faulkner, & Russell, 2007), who then will benefit from higher quality coaching and experience at more advanced levels. Besides, evidence arising from the literature, also suggests that a year of differencemay be positively reflected in cognitive skills and psychological/emotional maturity(Andronikos et al., 2015; Helsen, Starkes, & Van Winckel, 2000; Philippaerts et al., 2006).

Despite the important advances in this research domain, limited information about the potential existence of

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a birthdate distribution effect on Olympic athletes is available. This fact may be due to the methodological restrictions associated with this type of samples. However, the limited work carried out with international samples produced interesting results that may even encourage more research in this area. For example, Musch and Hay(1999) observed identical RAEs in German and Brazilian soccer players, using the same selection cut-off date criterion (August 1st). The fact that these countries, located in different hemispheres with opposing climatic seasonal cycles, identical RAEs strongly suggests that seasonal conditions were not responsible for attainment inequalities. In fact, RAEs shifts to reflect advantages for those who born earlier, even using different cut-off date criterions (e.g., Helsen et al., 2000; Musch & Hay, 1999).

Previously, Baker, Schorer, Cobley, Schimmer and Wattie(2009) examined the consistency of birthdate effects in Olympic athletes participating in Athens 2004 (summer) and Torino 2006 (winter) games. Results showed no evidence for birthdate biases, what largely contrasts with previous research, and were explained by limitations due to the inclusion of all Olympic athletes in a single dataset. Data consistently support the presence of RAEs but may not be robust across all sports mainly in elite samples (Albuquerque, Lage, da Costa, et al., 2012; Baker, Schorer, Cobley, et al., 2009).While several studies indicated a robust RAE in some sports, others studies present a moderate effect for the same sports as well (for refs see Rees et al., 2016). In spite of these limitations, recent evidence arising from literature suggests this advantage may reduce or even disappearas level of performanceincreases, usually named the *reversal of advantage*(see McCarthy, Collins, & Court, 2015; Ostojicab, Castagnac, Calleja-Gonzálezad, Jukicae, Idrizovicaf&Stojanovicab. 2014; Gibbs, Jarvis &Dufur, 2011).Nevertheless, the presence of RAEs were identified among adult members of the Shootingsports French Federation (Delorme &Raspaud, 2009), as well as in ice-hockey, baseball, cricket, tennis, football and rugby union (Cobley, Baker, Wattie& McKenna2009; Côté, MacDonald, Baker&Abernethy, 2006; Musch&Grondin, 2001)indicating several inconsistencies. The authors suggested that further qualitative research is needed to clarify which factors might contribute to this asymmetric distribution of birth dates in this type of sports.

Despite the abundant and controversial literature in this field, the impact of gender on this phenomenon remains neglected by most researchers. The results of the scarce literature dedicated to examine differences between genders can be summarized as follows: in activities where RAEs arise, those effects are less important among females. However, studies conducted with female athletes(Delorme, Boiche, & Raspaud, 2010; Delorme & Raspaud, 2009; Vincent & Glamser, 2006) confirmed the inconsistency of the results and calls for more research on this population. We hypothesized that this apparent difficulty to clearly prove this effect on female samples may be due to differences in the potential of development of particular phenotype characteristics such as body mass, maximum strength and speed compared to male athletes.

The influence of macro-environmental constraints like the continent of birth on talent identification and selection programs of elite athletes could provide a better understanding of the effects of these birthdate biases. Factors aforementioned like the characteristics of north and south hemispheres (e.g. temperature and sunlight exposure during gestation), climatic seasonal, sociocultural factors, talent development systems and its implications could also have a meaningful impact on athletes' birthdate distributions. Neverthless, the existing research has been focusing mainly on the influence of the birthplace (Ishigami, 2016; Turnnidge, Hancock, &Côté, 2014; Baker, & Logan, 2007), playing position (Romann, &Fuchslocher, 2013) and competition (Schorer et al., 2015) on RAEs. We have no knowledge of published papers focusing on the relationship between birthdate biases and other environmental factors.

Finally, to our knowledge this phenomenon that seems to benefits the relatively older athletes has not been studied according to the achieved level of performance. The relation between the level of performance obtained and the RAEs entails an interesting question that remains unanswered in literature. Therefore, we want to contribute to address some information.Thus, the aim of this study was to examine the birthdate distribution of the entire population of athletes who participated in the 2008 Olympic Games at Beijing. First, we hypothesized that there is a biased distribution of birthdates considering independently: (i) gender, (ii) sport category, (iii) continent, and (iv) performance outcome. We also hypothesized that there is a biased distribution of birthdates considering simultaneously the previous factors.

Methods

Participants

The study comprised the entire population of 10.900 athletes who participated in the *Beijing 2008 Olympic Games*. Archival data, including gender, date of birth, nationality and sport, was gathered by specialized trained technicians and obtained from the official internet site of the *Beijing 2008 Olympic Games* (http://en.beijing2008.cn).Despite the *London 2012 Olympic Games*' data being more recent, at the time the present research was elaborated we did not have access to a dataset as complete as the one used from the Beijing Olympics. Therefore, we decided to privilege the data quality. Besides, as Baker and colleagues (2009) found no evidence for birthdate biases in the Athens 2004 (summer) and Torino 2006 (winter) Games, it seemed relevant to evaluate if such tendency was kept in the 2008 Olympics.

Procedures

To examine the birthdates distribution, athletes were included into four quarters of three months each (equivalent of the quarters of the year) according to their date of birth. The first quarter (Q1) comprised January, February and March, the second quarter (Q2) included April, May and June, the third quarter (Q3) included July, August and September and the fourth quarter (Q4) comprised October, November and December. In order to test the hypothesis of a biased birthdate distribution, the theoretical expected distributions were calculated based on the assumption of an even distribution of birth throughout each quarter of the year. Nevertheless, we are aware that this procedure may receive some criticism as pointed by Delorme and colleagues(2010). Although the cut-off dates can vary (i) between countries included in the same continent; (ii) between sports included in the same sport category; and (iii) may also vary across sports in the same country (e.g.,-Musch & Hay, 1999), the heterogeneity of the decades in which the athletes were born (from 1941 to 1995) limited the procedures used in the definition of the quartiles. Due the absence of control for the cut-off dates, we assumed it as an uncontrolled random effect. Although aware of the potential limitations that can be attributed to our analyses, we consider that the novelty of a deeper understanding into the birthdate distribution of Olympic athletes and its contribution to the talent identification and long-term athlete development programs could be noticeable.

To examine the continent of birth, athletes were grouped in six continents as follows: Africa, Asia, Europe, North America, South America and Oceania. The sports were categorized using the sports classification model of Almond(1986) as follows: Invasion/Team (basketball,

handball, hockey, soccer, water polo), Net/Wall (badminton, beach volleyball, table tennis, tennis, volleyball), Field/Run scoring (softball, baseball), Target (archery, shooting), Individual (athletics, canoe/kayak, cycling, diving, equestrian, rowing, sailing, weightlifting), Early Specialization (gymnastics, swimming, trampoline), Combat/Fight (boxing, fencing, judo, taekwondo, wrestling) and Combined sports (modern pentathlon, triathlon). The inclusion of a sport category labelled as Early Specialization is linked with the theoretical framework of the Long Term Athlete Development (LTAD) model (see Ford et al., 2011 for further details). The Ethics Committee at the Research Center in Sport Sciences, Health and Human Development of University of Trás-os-Montes and Alto Douro provided institutional approval for this study.

Table 1.
Birthdate index and percentage of sample for each trimester in male and females' athletes according to the final classification.

			Trimester				
Gender	**Medal**		**Jan-Mar**	**Apr-Jun**	**Jul-Sep**	**Oct-Dec**	**Total**
Males	Yes	Count	270	294	246	221	1031
		%	26.2%	28.5%	23.9%	21.4%	
	No	Count	1490	1316	1259	1196	5261
		%	28.3%	25.0%	23.9%	22.7%	
Females	Yes	Count	222	199	224	196	841
		%	26.4%	23.7%	26.6%	23.3%	
	No	Count	1054	901	935	877	3767
		%	27.9%	23.9%	24.8%	23.3%	
Total		Count	3036	2710	2664	2490	10900
		%	27.9%	24.9%	24.4%	22.8%	

Analysis

Chi-square tests were performed on the birthdates according to the four quarters of the calendar year to identify deviations from the equally theoretical expected distribution of birthdates in each quarter(Vincent & Glamser, 2006). Afterwards, frequencies of birthdates in each quarter of year were tabulated according to gender, continent of birth, sport category and final classification. Data was entered into SPSS version 14.0 (SPSS Inc, Chicago, IL). Statistical significance was set at $p \leq .05$.

Results

The distribution of the birthdates across quartiles indicates that the athletes marginally tended to born in the first semester of the year (53.6% for males and 51.8% for females; $p>.05$). This tendency to early borns was confirmed in male

athletes classified in the top three positions (gold, silver and bronze medals) where 54.7% were born in Q1 and Q2, particularly the unexpected larger number of cases born in Q2 (28.5%, see Table 1).

No differences were found in the independent analyses of birthdates distribution for gender (χ^2=5.5,p>.05), continent (χ^2=20.3,p>.05), sport category (χ^2=16.4, p>.05) and performance outcome (χ^2=4.7,p>.05). However, chi-square tests performed to compare birthdates distribution considering each sport category, separately for each continent and according to the performance outcome revealed significant differences for Asian males in Combat/Fight sports (χ^2=12.2,p<.01), South American males in Invasion/Team sports (χ^2=9.7p<.05), North American females in Invasion/Team sports(χ^2=13.9,p<.01), Asian females in Target sports (χ^2=9.1,p<.05) and Asian females in Early Specialization sports (χ^2=8.4,p<.05). The following tables synthesize all the analyzed data. Thus, tables 2 and 3 refer to male athletes' information according to the type of sport practiced, and tables 4 and 5 to female athletes.

Discussion

The present study examined the birthdate distributions of the athletes who participated in the 2008 Olympic Games. Previous studies pointed no evidence or small effects for birthdate bias in Olympic athletes(Baker et al., 2009; Vincent & Glamser, 2006).Nonetheless, a limitation associated to the inclusion of all athletes into a single dataset was suggested. Conversely, in the current study the analyses performed were twofold. First, we examined the birthdates distribution independently by gender, continent, sport category and performance outcome, in which the results revealed also no evidence for birthdate biases. However, when we tested the birthdate distributions considering simultaneously the previous factors, differences were found in the sports categories of Combat/Fight, Invasion/Team, Target and Early Specialization sports, depending on the continent of birth and gender.Thus, the findings encountered in this study add important insights to the literature, especially about the intertwined influence of a myriad of environmental constraints acting on different environmental scales.

The majority of the previous studies propose physical differences (i.e., greater chronological age and likelihood of more advanced physical characteristics) as being primarily responsible for RAEs(Cobley et al., 2009;Lovell et al., 2015). Additionally, on sports where body size, strength and power convey advantages, elite junior athletes have been identified as above average for height and weight when compared with age-matched normative data (e.g. soccer)(Brewer, Balsom, Davis, & Ekblom, 1992; Memmert & Furley, 2015).Cobleyand colleagues(2009) using meta-analytical methods generated a broad picture of RAEs prevalence in sport by re-examining the numerous studies carried out in various sport contexts. Their findings suggest that the relatively youngest sport participants were less likely to become an elite athlete in the several sport contexts examined. Moreover, it seems that athletes participating in Invasion games such as basketball, soccer and ice

Table 2.
Birthdate index and percentage of sample for each trimester in male athletes according to the continent of birth and final classification in Individual, Combat, Net/Wall and Invasion/Team sports.

Sport Category	Continent	Classification	Males				χ^2	p
			Q1	Q2	Q3	Q4		
Individual	Asia	Medal	25.0	28.6	25.0	21.4	1.1	.765
		Other	33.0	25.8	18.6	22.6		
	Europe	Medal	28.0	32.4	19.3	20.3	3.9	.268
		Other	27.8	26.4	23.4	22.4		
	North America	Medal	22.9	34.3	17.1	25.7	6.7	.082
		Other	26.4	20.8	26.4	26.4		
	South America	Medal	25.0	12.5	37.5	25.0	0.95	.814
		Other	27.6	25.7	27.6	19.1		
	Africa	Medal	18.8	37.5	18.8	25.0	2.1	.552
		Other	32.7	23.8	20.8	22.8		
	Oceania	Medal	24.1	20.7	27.6	27.6	0.2	.981
		Other	25.5	23.4	24.8	26.3		

Sport Category	Continent	Classification	Males				χ^2	p
			Q1	Q2	Q3	Q4		
Combat	Asia	Medal	17.7	40.3	24.2	17.7	12.2	.007
		Other	34.6	21.2	21.6	22.5		
	Europe	Medal	20.7	20.7	25.6	32.9	3.8	.285
		Other	27.9	24.3	24.3	23.5		
	North America	Medal	23.8	19.0	33.3	23.8	0.5	.929
		Other	28.7	19.5	26.4	25.3		
	South America	Medal	0.0	50.0	50.0	0.0	1.6	.663
		Other	24.1	27.6	27.6	20.7		
	Africa	Medal	50.0	0.0	25.0	25.0	.14	.704
		Other	31.3	21.7	28.7	18.3		
	Oceania	Medal	-	-	-	-		
		Other	10.3	34.5	13.8	41.4		
Net/Wall	Asia	Medal	40.0	15.0	25.0	20.0	3.8	.288
		Other	20.0	30.0	28.3	21.7		
	Europe	Medal	33.3	33.3	33.3	0.0	2.9	.408
		Other	19.4	30.1	28.2	22.3		
	North America	Medal	0.0	100.0	0.0	0.0	4.7	.194
		Other	15.0	25.0	30.0	30.0		
	South America	Medal	0.0	0.0	100.0	0.0	2.6	.466
		Other	18.8	31.3	25.0	25.0		
	Africa	Medal	-	-	-	-		
		Other	11.8	23.5	29.4	35.3		
	Oceania	Medal	-	-	-	-		
		Other	50.0	16.7	8.3	25.0		
Invasion/Team	Asia	Medal	-	-	-	-		
		Other	32.7	19.4	28.1	19.9		
	Europe	Medal	26.2	23.8	31.7	18.3	2.3	.504
		Other	29.4	24.6	25.1	21.0		
	North America	Medal	33.3	25.6	23.1	17.9	1.7	.620
		Other	24.2	36.4	19.7	19.7		
	South America	Medal	33.3	34.9	14.3	17.5	9.7	.040
		Other	14.8	25.9	37.0	22.2		
	Africa	Medal	18.8	18.8	18.8	43.8	4.8	.184
		Other	24.7	38.2	16.9	20.2		
	Oceania	Medal	17.6	29.4	29.4	23.5	1.1	.778
		Other	29.9	23.4	24.7	22.1		

Table 3.
Birthdate index and percentage of sample for each trimester in male athletes according to the continent of birth and final classification in Combined, Field/Run, Target and Early Specialization sports.

Sport Category	Continent	Classification	Males				χ^2	*p*
			Q1	Q2	Q3	Q4		
Combined	Asia	Medal	-	-	-	-		
		Other	0.0	45.5	18.2	36.4		
	Europe	Medal	25.0	25.0	50.0	0.0	2.3	.515
		Other	33.3	27.8	20.4	18.5		
	North America	Medal	0.0	100.0	0.0	0.0	1.5	.676
		Other	18.2	36.4	27.3	18.2		
	South America	Medal	-	-	-	-		
		Other	0.0	33.3	33.3	33.3		
	Africa	Medal	-	-	-	-		
		Other	50.0	0.0	0.0	50.0		
	Oceania	Medal	100.0	0.0	0.0	0.0	5.0	.082
		Other	0.0	50.0	50.0	0.0		
Field/Run	Asia	Medal	20.8	29.2	33.3	16.7	1.5	.680
		Other	23.9	18.3	33.8	23.9		
	Europe	Medal						
		Other	20.8	20.8	33.3	25.0		
	North America	Medal	31.3	31.3	22.9	14.6	2.3	.512
		Other	33.3	16.7	25.0	25.0		
	South America	Medal	-	-	-	-		
		Other	-	-	-	-		
	Oceania	Medal	-	-	-	-		
		Other	-	-	-	-		
Target	Asia	Medal	23.1	15.4	30.8	30.8	1.8	.615
		Other	40.3	8.3	22.2	29.2		
	Europe	Medal	31.6	47.4	10.5	10.5	3.2	.355
		Other	27.8	30.8	22.6	18.8		
	North America	Medal	75.0	25.0	0.0	0.0	3.2	.351
		Other	34.4	21.9	18.8	25.0		
	South America	Medal	-	-	-	-		
		Other	25.0	12.5	12.5	50.0		
	Africa	Medal	-	-	-	-		
		Other	50.0	30.0	20.0	0.0		
	Oceania	Medal	0.0	100.0	0.0	0.0	2.3	.515
		Other	22.2	27.8	22.2	27.8		

Early Specialization	Asia	Medal	50.0	30.0	20.0	0.0	1.1	.763
		Other	0.0	100.0	0.0	0.0		
	Europe	Medal	22.2	27.8	22.2	27.8	3.6	.301
		Other	50.0	30.0	20.0	0.0		
	North America	Medal	0.0	100.0	0.0	0.0	4.2	.244
		Other	22.2	27.8	22.2	27.8		
	South America	Medal	50.0	30.0	20.0	0.0	3.9	.264
		Other	0.0	100.0	0.0	0.0		
	Africa	Medal	22.2	27.8	22.2	27.8	3.9	.273
		Other	50.0	30.0	20.0	0.0		
	Oceania	Medal	0.0	100.0	0.0	0.0	1.1	.770
		Other	22.2	27.8	22.2	27.8		

Table 4.
Birthdate index and percentage of sample for each trimester in female athletes according to the continent of birth and final classification in Individual, Combat, Net/Wall and Invasion/Team sports.

Sport Category	Continent	Classification	Females				χ^2	*p*
			Q1	Q2	Q3	Q4		
Individual	Asia	Medal	34.5	20.7	13.8	31.0	2.1	.551
		Other	30.4	23.8	23.3	22.5		
	Europe	Medal	28.2	24.2	26.8	20.8	2.5	.474
		Other	25.8	24.7	23.1	26.3		
	North America	Medal	23.4	17.0	23.4	36.2	2.9	.392
		Other	24.8	20.9	29.8	24.4		
	South America	Medal	0.0	33.3	0.0	66.7	5.3	.151
		Other	35.9	24.4	21.8	17.9		
	Africa	Medal	6.7	40.0	20.0	33.3	3.5	.321
		Other	23.8	23.0	23.8	29.5		
	Oceania	Medal	17.6	17.6	29.4	35.3	2.0	.570
		Other	26.1	27.3	23.9	22.7		
Combat	Asia	Medal	27.6	17.2	24.1	31.0	2.1	.549
		Other	30.4	13.9	35.4	20.3		
	Europe	Medal	27.3	24.2	33.3	15.2	1.5	.680
		Other	30.7	18.9	27.6	22.8		
	North America	Medal	38.9	11.1	16.7	33.3	6.7	.080
		Other	21.4	42.9	21.4	14.3		
	South America	Medal	40.0	20.0	20.0	20.0	0.8	.836
		Other	28.0	20.0	40.0	12.0		
	Africa	Medal	0.0	0.0	100.0	0.0	2.3	.515
		Other	31.7	22.0	29.3	17.1		
	Oceania	Medal	-	-	-	-		
		Other	50.0	18.8	6.3	25.0		

Net/Wall	Asia	Medal	15.8	42.1	21.1	21.1	5.2	.157
		Other	41.4	22.4	22.4	13.8		
	Europe	Medal	0.0	20.0	60.0	20.0	3.4	.338
		Other	29.4	24.4	26.9	19.3		
	North America	Medal	0.0	50.0	50.0	0.0	1.5	.677
		Other	35.7	21.4	35.7	7.1		
	South America	Medal	-	-	-	-		
		Other	14.3	28.6	42.9	14.3		
	Africa	Medal	-	-	-	-		
		Other	37.5	25.0	25.0	12.5		
	Oceania	Medal	-	-	-	-		
		Other	75.0	8.3	16.7	0.0		
Invasion/Team	Asia	Medal	21.7	23.9	30.4	23.9	2.7	.435
		Other	34.1	22.4	24.1	19.4		
	Europe	Medal	25.0	22.6	29.8	22.6	1.2	.760
		Other	27.3	26.4	24.8	21.4		
	North America	Medal	17.9	33.9	35.7	12.5	**13.9**	**.003**
		Other	31.5	20.4	14.8	33.3		
	South America	Medal	32.6	19.6	32.6	15.2	1.2	.764
		Other	26.8	19.6	30.4	23.2		
	Africa	Medal	-	-	-	-		
		Other	24.6	37.7	17.4	20.3		
	Oceania	Medal	28.0	32.0	24.0	16.0	3.7	.298
		Other	24.2	19.4	21.0	35.5		

Table 5.
Birthdate index and percentage of sample for each trimester in female athletes according to the continent of birth and final classification in Combined, Field/Run, Target and Early Specialization sports.

Sport Category	Continent	Classification	Females				χ^2	*p*
			Q1	Q2	Q3	Q4		
Combined	Asia	Medal	-	-	-	-		
		Other	27.3	27.3	9.1	36.4		
	Europe	Medal	50.0	25.0	25.0	0.0	0.9	.802
		Other	35.4	20.8	25.0	18.8		
	North America	Medal	-	-	-	-		
		Other	28.6	21.4	21.4	28.6		
	South America	Medal	-	-	-	-		
		Other	33.3	0.0	33.3	33.3		
	Africa	Medal	-	-	-	-		
		Other	25.0	25.0	25.0	25.0		
	Oceania	Medal	0.0	50.0	50.0	0.0	0.9	.646
		Other	0.0	60.0	20.0	20.0		

Field/Run	Asia	Medal	33.3	13.3	20.0	33.3	0.8	.844
		Other	30.0	23.3	13.3	33.3		
	Europe	Medal	-	-	-	-		
		Other	13.3	26.7	20.0	40.0		
	North America	Medal	26.7	26.7	26.7	20.0	1.4	.711
		Other	13.3	33.3	40.0	13.3		
	South America	Medal	-	-	-	-		
		Other	13.3	53.3	26.7	6.7		
	Oceania	Medal	26.7	0.0	26.7	46.7		
		Other						
Target	Asia	Medal	45.5	36.4	0.0	18.2	**9.1**	**.028**
		Other	32.7	9.1	30.9	27.3		
	Europe	Medal	25.0	8.3	33.3	33.3	1.6	.666
		Other	21.8	24.1	28.7	25.3		
	North America	Medal	0.0	33.3	66.7	0.0	3.7	.295
		Other	18.8	31.3	18.8	31.3		
	South America	Medal	-	-	-	-		
		Other	12.5	50.0	25.0	12.5		
	Africa	Medal	-	-	-	-		
		Other	12.5	37.5	37.5	12.5		
	Oceania	Medal	-	-	-	-		
		Other	0.0	33.3	44.4	22.2		
Early Specialization	Asia	Medal	50.0	10.5	21.1	18.4	**8.4**	**.038**
		Other	28.3	29.1	25.2	17.3		
	Europe	Medal	22.8	33.3	29.8	14.0	5.2	.156
		Other	28.8	23.0	24.6	23.6		
	North America	Medal	17.4	26.1	8.7	47.8	5.0	.171
		Other	31.3	21.9	20.3	26.6		
	South America	Medal	-	-	-	-		
		Other	26.7	28.9	26.7	17.8		
	Africa	Medal	0.0	0.0	100.0	0.0	3.1	.381
		Other	30.2	20.9	23.3	25.6		
	Oceania	Medal	25.0	25.0	18.8	31.3	0.4	.940
		Other	19.4	22.2	25.0	33.3		

hockey was more vulnerable to RAEs, especially mid to late adolescents (15-18 years). The unequal distribution of the month of birth of high-level athletes is explained by the joint action of two mechanisms. On the one hand, the youngest players participate less and are more likely to stop taking part in sports that require strong physical attributes. Otherwise, the oldest players are able to enter more easily into the elite training programmes. Our study showed also that relatively older athletes seem to be over-represented in several groups tested especially South-American males that obtained a medal in Invasion/Team sports and Asian females that achieved a medal in Target and Early Specialization sports.

The differences encountered in the Asian females specialized in Target sports, where fine precision movements and not rough physical capabilities are extremely important, seems to somehow contradict the results obtained by Delorme and Raspaud(2009). The authors tested the presence of a RAEs among male (n=119.715) and female (n=12.823) members of the French shooting sports federation and their results revealed no effects in females' athletes,

which in some sense contradict our data. The differences could be attributed to the distinctskill levelof the samples.

One interesting finding of this study is that in Early Specialization sportsthis over-representation of early borns seems to persist even in the athletes that did not achieved a medal.In activities such as gymnastics, where physical maturity and growth do not seem to be as important to performance, or even possibly disadvantageous, the RAEsdoes not exert a significant influence as previously indicated in a Baker, Janning, Wong, Cobley, and Schorer (2014) study. Despite that, our results identified a biased tendency for female Early Specialization athletes had born mainly in the first quarter of the year. These data can add important contributions to the debate on the effectiveness of the selection procedures in early highly specialized sports such as swimming(Fraser-Thomas, Cote, & Deakin, 2008) or gymnastics(Weiss, Weiss, & Amorose, 2010).

Due to the novelty of our approach, further investigation should focus on the key variables influencing the bias to early borns. At this level, this research showed how the confluence of some environmental constraints led to identify biased distributions in athletes' birthdates(Andronikos et al., 2015). Generally, the findings should promote the debate on the effectiveness of talent identification systems, since the predominance of early borns in some examined sport categories was always the outcome of systematic selection procedures. These developmental policies could explain some of the results of our study in Early Specialization sports like gymnastics or swimming, where a larger frequency of relatively younger athletes has been reported in high performance contexts(Ste-Marie, Starkes, Cronin, & Fletcher, 2000).The eradication of RAEs was attributed tocontrollable features, along with careful consideration of thedevelopment environment structure. Is required a focus on the priorisationof thelong-term developmental journey instead of searching forshort-term results. Still, is necessary theeducation of all sport stakeholders and athletes' parentsabout the issues surrounding the RAEs(Hancock, Adler, & Côté, 2013; McCarthy et al., 2015).However, it is important consider that these findings did not provide a consistent generalization but maybe will help the stakeholders to understand a progressive tendency in sports systems.

Ultimately, whether we are looking to understand or avoid birthdate effects on sport, it is acknowledgeable that this phenomenon is causing the premature sport departwithout opportunity to nurture their skills and inherent interest, leading to a reduction of the talent pool(Hollings, Hume, & Hopkins, 2014).Thus, the discussion about the influence of different environmental constraints such as gender, continent of birth, sport category and level of performance on athletes' birthdate distribution should impact in coaching and scouting staffs.

Examen de la distribución de las fechas de nacimiento de los atletas olímpicos de Beijing

Resumen

El objetivo de este estudio fue examinar la distribución de la fecha de nacimiento de todos los atletas que participaron en los Juegos Olímpicos de 2008,considerando independiente y simultáneamente lo effecto de los seguientes factores: (i) género, (ii) categoría de deporte, (iii) continente; y (iv) rendimiento deportivo. La muestra incluyó a 10.900 atletas cuyas fechas de nacimiento se reunieron en cuartiles y luego fueron inspeccionados con la prueba de chi-cuadrado. No se encontraron diferencias en la distribución de las fechas de nacimiento por género ($p > .05$). El análisis realizado para comparar la distribución de las fechas de nacimiento considerando las diferentes categorías de deporte(Individual, Combate, Red/Pared, Invasión/Equipo, Combinados, Campo/Pista, Precisióny Especialización Temprana)separadamente por cada continente y rendimiento reveló diferencias significativas en los hombres asiáticos de deportes de lucha ($c^2=12.2$ $p < .01$), hombres de américa del sur de deportes de Invasión/Equipo ($c^2=9.7$ $p < .05$), mujeres asiáticas de los deportes de Precisión ($c^2=9.1$ $p < .05$) y las mujeres asiáticas de deportes de Especialización Temprana ($c^2=8.4$ $p < .05$), con una tendencia a nacer temprano en el año civil. No obstante, las mujeres de américa delnorte de los deportes de Invasión/Equipo ($c^2=13.9$ $p < .01$)demostraron una tendencia a nacer con más frecuencia en el medio del año civil. Nuestros datos no fueron totalmente coherentes con trabajos anteriores, añadiendo nuevos puntos de vista a la investigación de efecto de la edad relativa. La influencia de diferentes niveles de los condicionamientos medio-ambientales en la distribución de la fecha de nacimiento de los atletas se propone como la explicación teórica por los resultados encontrados.

Palabras clave: edad relativa, desarrollo del talento, rendimiento deportivo

Análise da Data de Nascimentos dos Atletas dos Jogos Olímpicos de Pequim

Resumo

O objetivo deste estudo foi examinar a distribuição da data de nascimento dos atletas que participaram dos Jogos Olímpicos de 2008, considerando independente e simultaneamente o efeito dos seguintes fatores: (i) género, (ii) tipo de desporto, (iii) continente; e (iv) performance desportiva. A amostra incluiu 10.900 atletas cujas datas de nascimento foram agrupadas em quartis e, em seguida, foram analisadas com recurso ao teste do qui-quadrado. Não foram identificadas diferenças

na distribuição em função do género (p> 0,05). A análise efetuada considerando os diferentes tipos de desportos (individual, combate, rede/parede, invasão/coletivo, combinado, campo/pista, precisão e especialização precoce) separadamente para cada continente e nível de performance desportiva evidenciou diferenças significativas em homens asiáticos de desportos de combate(c^2=12.2 p < .01); homens da américa do sul de desportos de invasão/coletivos (c^2=9.7 p < .05); mulheres asiáticas de desportos de precisão (c^2=9.1 p < .05);mulheres asiáticas de desportos de especialização precoce (c^2=8.4 p < .05), com uma prevalência para aqueles que nasceram nos primeiros meses do ano civil. Os nossos resultados não foram inteiramente consistentes com trabalhos anteriores, acrescentando novas perspetivas de investigação do efeito da idade relativa. A influência de diferentes fatores ambientais na participação em competições internacionais de alto rendimento pode explicar alguns dos factos anteriormente apresentados.

Palavras chave: idade relativa, desenvolvimento do talento, rendimento desportivo

References

Albuquerque, R., Lage G., da Costa V.et al. (2012). Relative age effect in Olympic taekwondo athletes. *Perceptual Motor Skills. 114(2)*:461–8. doi:10.2466/05.25.Pms.114.2.461-468.

Almond, L. (1986). A Games Classification. In Thorpe, R., Bunker, D., Almond, L., eds. *Rethinking games teaching*, 71-73.

Andronikos, G., Elumaro, A., Westbury, T., and Martindale, R. (2016). Relative age effect: implications for effective practice. *Journal of Sports Sciences*, 34(12):1124-31. doi: 10.1080/02640414.2015.1093647

Baker, J., Janning, C., Wong, H., Cobley, S., and Schorer, J. (2014). Variations in relative age effects in individual sports: Skiing, figure skating and gymnastics. *European Journal of Sport Science, 14 Suppl 1*, S183-190. doi: 10.1080/17461391.2012.671369

Baker, J., Schorer, J., Cobley, S., Schimmer, G., and Wattie, N. (2009). Circumstantial development and athletic excellence: The role of date of birth and birthplace. *European Journal of Sport Science, 9*(6), 329-339. doi: 10.1080/17461390902933812

Brewer, J., Balsom, P., Davis, J., and Ekblom, B.(1992). The influence of birthdate and physical development on the selection of a male junior international soccer squad. *Journal of Sports Sciences, 10*, 561-562.

Carling, C., Bloomfield, J., Nelsen, L., and Reilly, T. (2008). The role of motion analysis in elite soccer contemporary performance measurement techniques and work rate data. *Sports Medicine, 38*(10), 839-862.

Cobley, S., Baker, J., Wattie, N., and McKenna, J. (2009). Annual age-grouping and athlete development a meta-analytical review of relative age effects in sport. *Sports Medicine, 39*(3), 235-256.

Côté, J., Macdonald, D., Baker,J. andAbernethy B. (2006). When «where» is more importantthan «when»: Birthplace and birthdate effects on the achievement of sporting expertise,*Journal of Sports Sciences, 24(10)*, 1065-1073. doi 10.1080/02640410500432490

Deaner, R..,Lowen, A. and Cobley, S. (2013). Born at the wrong time: Selection bias in the NHL Draft. Plos One 8(2): e57753. doi:10.1371/journal.pone.0057753

Delorme, N., Boiche, J., and Raspaud, M. (2010). Relative age and dropout in French male soccer. *Journal of Sports Sciences, 28*(7), 717-722. doi: 10.1080/02640411003663276

Delorme, N., and Raspaud, M. (2009). Is there an influence of relative age on participation in non-physical sports activities? The example of shooting sports. *Journal of Sports Sciences, 27*(10), 1035-1042. doi: 10.1080/02640410902926438

Ford, P., De Ste Croix, M., Lloyd, R., Meyers, R., Moosavi, M., Oliver, J., and Williams, C. (2011). The Long-Term Athlete Development model: Physiological evidence and application. *Journal of Sports Sciences, 29*(4), 389-402. doi: 10.1080/02640414.2010.536849

Fraser-Thomas, J., Cote, J., and Deakin, J. (2008). Understanding dropout and prolonged engagement in adolescent competitive sport. *Psychology of Sport and Exercise, 9*(5), 645-662. doi: 10.1016/j.psychsport.2007.08.003

Furley, P., and Memmert, D. (2016). Coaches' implicit associations between size and giftedness: implications for the relative age effect. *Journal of Sports Sciences, 34*(5), 459-466. doi: 10.1080/02640414.2015.1061198

Gibbs, G., Jarvis, A. and Dunfur, M. (2011). The rise of the underdog? The relative age effect reversal among Canadian-born NHL hockey players: A reply to Nolan and Howell. *International Review for the Sociology of Sport, 1–6*. doi 10.1177/1012690211414343

Hancock, D., Adler, A., and Côté, J. (2013). A proposed theoretical model to explain relative age effects in sport. *European Journal of Sport Science, 13*(6), 630-637. doi: 10.1080/17461391.2013.775352

Helsen, W. F., Starkes, J. L., and Van Winckel, J. (1998). The influence of relative age on success and dropout in male soccer players. *American Journal of Human Biology, 10*(6), 791-798.

Helsen, W. F., Starkes, J. L., and Van Winckel, J. (2000). Effect of a change in selection year on success in male soccer players. *American Journal of Human Biology, 12*(6), 729-735.

Hirose, N. (2009). Relationships among birth-month distribution, skeletal age and anthropometric characteristics in adolescent elite soccer players. *Journal of Sports Sciences, 27*(11), 1159-1166. doi: 10.1080/02640410903225145

Hollings, S. C., Hume, P. A., and Hopkins, W. G. (2014). Relative-age effect on competition outcomes at the World Youth and World Junior Athletics Championships. *European Journal of Sport Science, 14 Suppl 1*, S456-461. doi: 10.1080/17461391.2012.713007

Leite N., Borges J., Santos S. and Sampaio J. (2013). The relative age effect in school and federative sport in basketball.*Revista de Psicología del Deporte*, *22(1),* 219-223.

Lovell, R., Towlson, C., Parkin, G., Portas, M., Vaeyens, R., and Cobley, S. (2015). Soccer player characteristics in English lower-league development programmes: The relationships between relative age, maturation, anthropometry and physical fitness. *PLoS One, 10*(9), e0137238. doi: 10.1371/journal.pone.0137238

Malina, R. M., Bouchard, C., and Bar-Or, O. (2004). *Growth, maturation and physical activity* (2nd ed.): Champaign, IL: Human Kinetics.

Malina, R. M., Ribeiro, B., Aroso, J., and Cumming, S. P. (2007). Characteristics of youth soccer players aged 13-15 years classified by skill level. *British Journal of Sports Medicine, 41*(5), 290-295. doi: 10.1136/bjsm.2006.031294

McCarthy, N., Collins, D., and Court, D. (2015). Start hard, finish better: further evidence for the reversal of the RAE advantage. *Journal of Sports Sciences*, 1-5. doi: 10.1080/02640414.2015.1119297

Musch, J., and Hay, R. (1999). The relative age effect in soccer: Cross-cultural evidence for a systematic discrimination against children born late in the competition year. *Sociology of Sport Journal, 16*(1), 54-64.

Musch, J., and Grondin, S. (2001). Unequal competition as animpediment to personal development: A review of the relativeage effect in sport. *Developmental Review*, 21, 147-167.

Ostojicab, SM., Castagna, C., Calleja-Gonzálezad, J., Jukicae, I., Idrizovicaf, K. and Stojanovicab, M. (2014). The Biological Age of 14-year-old Boys and Success in AdultSoccer: Do Early Maturers Predominate in the Top-level Game?, *Research in Sports Medicine: AnInternational Journal*, *22:4,* 398-407, doi: 10.1080/15438627.2014.944303

Philippaerts, R. M., Vaeyens, R., Janssens, M., Van Renterghem, B., Matthys, D., Craen, R., and Malina, R. M. (2006). The relationship between peak height velocity and physical performance in youth soccer players. *Journal of Sports Sciences, 24*(3), 221-230. doi: 10.1080/02640410500189371

Rees, T., Hardy, L., Güllich, A., Abernethy, B., Côté, J., Woodman, T., andWarr, C. (2016). The great British medalists project: A review of current knowledge on the development of the world's best sporting talent. *Sports Medicine*, 1-18. doi: 10.1007/s40279-016-0476-2

Reilly, T., Bangsbo, J., and Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *Journal of Sports Sciences, 18*(9), 669-683.

Sherar, L. B., Baxter-Jones, A., Faulkner, R., and Russell, K. (2007). Do physical maturity and birth date predict talent in male youth ice hockey players? *Journal of Sports Sciences, 25*(8), 879-886. doi: 10.1080/02640410600908001

Ste-Marie, D., Starkes, J., Cronin, A., and Fletcher, H. (2000). The relative age effect: A «flip-flop» phenomenon in gymnasts. *Proceedings of the Canadian Society for Psychomotor Learning & Sport Psychology Conference*, Waterloo, Canada.

Vincent, J., and Glamser, F. D. (2006). Gender differences in the relative age effect among US Olympic Development Program youth soccer players. *Journal of Sports Sciences, 24*(4), 405-413. doi: 10.1080/02640410500244655

Weiss, W., Weiss, M., and Amorose, A. (2010). Sport commitment among competitive female athletes: Test of an expanded model. *Journal of Sports Sciences, 28*(4), 423-434. doi: 10.1080/02640410903536442