

Relative age effect in international ski jumping: analysis of FIS World Cup and FIS Junior World Ski Championships

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Abstract

The aim of the current investigation was to examine whether the relative age effect was present within the elite-level category of international ski jumping and, for the first, time assess the relative age effect at the junior level of international ski jumping. Male and female athletes who placed among the top fifty in the overall World Cup rankings from 1999 to 2019 and the top fifty male and female athletes in the Junior World Championships each year between 2009 and 2019 were selected for analysis. The birthdates of senior (n = 409) and junior (n = 507) athletes were collected from open access websites and analyzed by chi-square statistics to determine the occurrence of relative age effect in juniors and seniors and by sex. When compared with the actual live birth distributions from the European Union and Japan, the distribution of ski jumpers birthdates does not show any statistically significant relative age effect for either sex at any level. The results show that being relatively older than competitors does not drive performance development in elite ski jumping. The primary performance characteristic in ski jumping is technique rather than physical strength, and this is suggested as the foremost explanation for the lack of any significant relative age effect in international ski jumping. Furthermore, low body weight is a performance advantage in this sport; thus, it is not an advantage to be physically larger than opponents. These results show that the relative age effect in competitive sports is affected by the typical performance characteristics of a given activity.

Key Words: talent development; skiing; birth distribution; youth sports; performance development

Introduction

The relative age effect (RAE) indicates that athletes who are born earlier in the selection year are overrepresented in competitive sports owing to the physical, psychological, and maturational advantages of being relatively older than their competitors. Since the early documentation of RAE in professional ice hockey (Barnsley, Thompson, & Barnsley, 1985), the phenomenon has been explored and documented across a variety of sport settings (Musch & Grondin, 2001; Copley, Baker, Wattie, & McKenna, 2009; Smith, Weir, Till, Romann, & Copley, 2018; Bozděch, Agricola, & Zháněl, 2019). RAE is most prominent in youth sports where selection and competition are based on chronological age (Helsen, van Winckel, & Williams, 2005); typically, athletes who are born early in the calendar year are more likely to be selected for talent development programs (Gómez-López, Granero-Gallegos, Molina & Ríos, 2017). RAE improves physical performance already at the preschool stage (Cupeiro et al., 2020). The occurrence of RAE increases with age from the child category to adolescent age and then declines at the senior level (Copley et al., 2009).

In winter sports, RAE has been reported in alpine skiing (Müller et al., 2012; Müller, Hildebrandt, & Raschner, 2015), cross-country, ski jumping and Nordic combined (Baker, Janning, Wong, Copley, & Schorer, 2014). Ski jumping and Nordic combined displayed RAE at the world cup level for males but not for females. These results indicate that being relatively older than competitors is advantageous for ski jumping performance; however, the examined sample is comprised of all athletes registered in the FIS database and is, therefore, less suitable for discussing the effect of relative age among the very best ski jumpers. In alpine skiing, RAE is documented among male elite skiers and is defined as athletes placing among the top 50 in overall world cup rankings, in speed disciplines (downhill and super-G) but not in technical disciplines (giant slalom and slalom) (Bjerke, Lorås, & Pedersen, 2016). It is suggested that in sport settings where performance is more reliant on motor skills and technical proficiency than physical strength and power, RAE is not prominent (van Rossum & de Vries, 1998; van Rossum, 2006; Baker et al., 2014). Furthermore, the association with RAE is typically lower in sports that utilize weight regulations (Albuquerque et al., 2012; Smith et al., 2018) because the advantages of being larger than opponents are adjusted for. Ski jumping is a technically dependent sport (Schwameder, 2008), and it is also a weight-sensitive sport; thus, lower body weight is advantageous for performance (Schmölzer & Müller, 2002; Müller, Groschl, Müller, & Sudi, 2006). The advantage of low body weight still exists even after

the introduction of BMI regulations (Virmavirta & Kivekäs, 2019), which define a lower limit for the athlete's body mass index. Thus, RAE should be less evident in ski jumping because being physically larger does not automatically improve performance. However, the cognitive development and maturation advantages of being relatively older also provides benefits for sports performance and the general trainability of young athletes (Martin, Foels, Clanton, & Moon, 2004). Maturation could be mistaken for "talent", and relatively older athletes being valued as such, earning more coaching, attention, and appraisal than relatively younger competitors (Wattie, Cobley, & Baker, 2008). This might explain the occurrence of RAE in sporting activities that are not physically driven such as shooting (Delorme & Raspaud, 2009).

To the author's knowledge, RAE has not been examined at the junior level (16–20 years old) in international ski jumping; however, in the youth category (14–18 years old) of winter sport athletes, RAE is less prominent in sports defined as technique-related including ski jumping (Müller, Hildebrandt, Schnitzer, & Raschner, 2016). Typically, RAE is expected to be most prominent at the highest competitive level of age-regulated competitions (Cobley et al., 2009); therefore, this group of athletes should be examined further.

The occurrence of RAE in the female sport context has been reported to be different from male sports (Schorer, Cobley, Büsch, Bräutigam, & Baker, 2009; Goldschmied, 2011; Romann & Fuchslocher, 2014; Baker et al., 2014), and it has been proposed that the depth of competition affects the existence and strength of RAE. Even so, RAE is prevalent in the female sport context (Smith et al., 2018); however, similar to male sports, individual sports and less physically demanding sports display lower RAE. International ski jumping competitions for women have only recently been sanctioned by the International Ski Federation (FIS) (Laurendeau & Adams, 2010) and are developing. This makes the context of women's ski jumping an interesting case for investigation and continuous monitoring for signs of RAE.

The aim of this investigation was to examine whether RAE was present within the elite-level category of international ski jumping (which is defined as athletes placing among the top fifty in overall world cup standings) and for the first time assess RAE at the junior level in ski jumping. Considering the technical demands of ski jumping and the benefits of low body mass, there is reason to assume that RAE is not a driving force in performance and, therefore, expected to be less prominent at the elite level compared to what has been previously reported by Baker et al. (2014). If present, RAE is expected to be of lower magnitude for female ski jumpers; on the basis of findings from other sporting domains (Cobley et al., 2009), it is expected that RAE would be more pronounced at the junior level in international ski jumping.

Materials and methods

Participants

For the current investigation, elite senior ski jumpers were those athletes who placed among the top 50 in the overall world cup standings each year from 1999 to 2019. The first world cup competitions for women were held during the 2011/2012 season; thus, female athletes were sampled from the Continental cup, which at the time was the highest level of competition for each year from 2005 to 2011. Prior to 2005, FIS did not organize international competitions for women. The current sample consists of 161 female and 248 male ski jumpers. Elite junior ski jumpers were defined as the athletes who placed among the top 50 in the FIS Junior World Championship (JWSC) rankings each year from 2009 to 2019. The sample of junior ski jumpers is comprised of 196 females and 311 males. Several athletes occurred repeatedly, both in the junior world championships and in the world cup, and were entered in to the dataset only at their first appearance.

Procedure

The data were collected from the FIS online database (fis-ski.com) and included athletes' birthdates and nationality for males and females. For athletes missing birthdate information in the database, these data were collected from other websites such as Facebook and Wikipedia. To examine the occurrence of RAE, the data were analyzed in two steps. First, the athletes' birthdates were categorized into two groups representing the first and second 6 months of the year, according to the cutoff date of January 1, which is determined by FIS as the cutoff date for international youth competitions (FIS, 2018). This distribution generates the categories *semester one* (consisting of athletes born between January and June) and *semester two* (consisting of athletes born between July and December), which is similar to the approach used in previous investigations on RAE (Edgar & O'Donoghue, 2005; Albuquerque et al., 2015). Furthermore, the birthdates were categorized into four quartiles representing the calendar year. Thus, *Quartile 1* consists of athletes born between January and March, *Quartile 2* – April to June, *Quartile 3* – July to September, and *Quartile 4* – October to December, which is the traditional categorization used in the literature to assess RAE (Barnsley et al., 1985; Musch & Grondin, 2001; Baker et al., 2014).

Statistical analysis

Chi-square tests (χ^2) were used to calculate differences among relative age quartiles and semesters by comparing the observed distributions of athletes birthdates to distributions of live births in the European Union (Eurostat, 2018) and Japan (UNdata, 2018). This comparison sample consists of registered live births in The European Union (28 countries, 52.5 million births) and Japan (10.4 million births). Effect sizes were calculated

with Cramer's V (ϕ). The Chi-square analysis was used to assess the gender and level of competition-specific differences in RAEs, and odds ratios (OR) and 95% confidence intervals (95% CIs) were calculated according to different categorizations. All statistical analyses were performed in SPSS (Version 25.0, IBM, Chicago, IL, USA). The level of statistical significance was set at $p = .05$.

Results

Elite ski jumpers

When assessing the distribution of athletes categorized as those born in the first and second semester, there is an overrepresentation of athletes born in the first six months of the year (Figure 1); however, it is not statistically significant, $X^2(3, n = 409) = 3.44, p = 0.064$. The birthdates for elite ski jumpers do not show a statistically significant different quarterly distribution compared with the distribution of live births in the European Union and Japan, $X^2(3, n = 409) = 3.71, p = 0.294$.

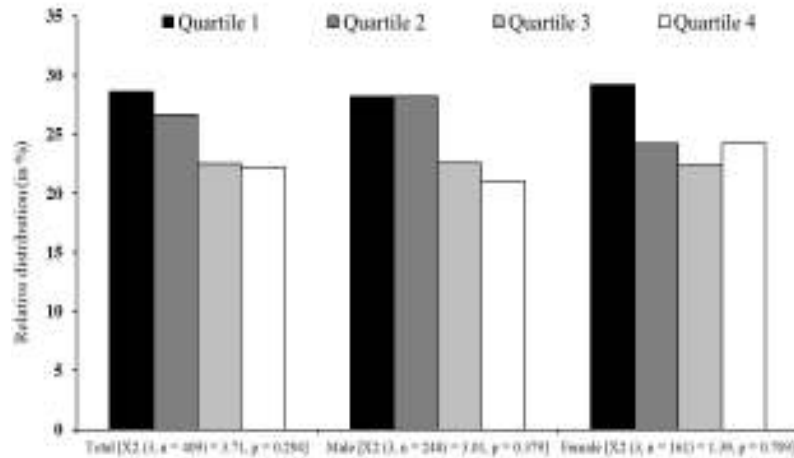


Fig. 1: Relative age (quartile) distribution of all senior athletes and differentiated by sex

When analyzing male elite ski jumpers according to the first and second semester, the results do not show a statistically significant RAE, $X^2(1, n = 248) = 3.08, p = 0.079$. The quarterly distribution of birthdates for male elite ski jumpers is not statistically different from live birth distributions in the European Union and Japan, $X^2(3, n = 248) = 3.01, p = 0.379$. The birth distributions of female athletes do not statistically differ from live birth distributions when analyzed by semesters, $X^2(1, n = 161) = 0.70, p = 0.403$, nor when analyzed by quartiles, $X^2(3, n = 161) = 1.39, p = 0.709$, although descriptive trends (Figure 1) indicate RAE for both sexes.

Junior ski jumpers

The distribution of JWSC athlete's birthdates indicate an overrepresentation of relatively older athletes (Figure 2); however, the analysis does not identify statistically significant differences compared with the distribution of live births in the European Union and Japan. This was true for the birthdate distribution categorized by semester, $X^2(1, n = 507) = 0.95, p = 0.33$, and for the quarterly distribution, $X^2(3, n = 507) = 1.51, p = 0.681$.

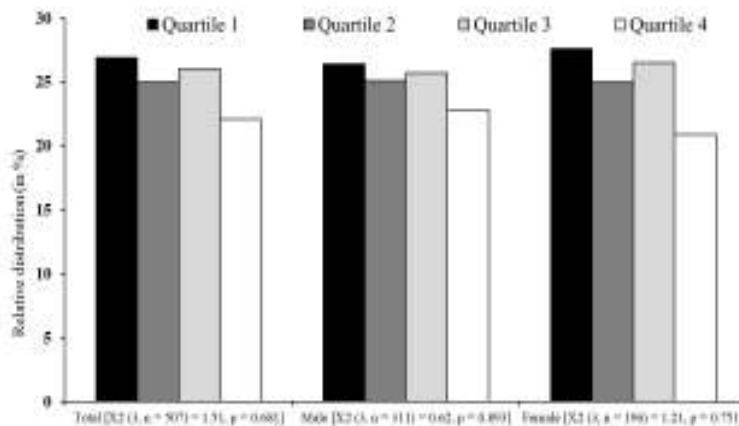


Fig. 2: Relative age (quartile) distribution of all junior athletes and differentiated by sex

Additional analyses by sex do not show a significant difference between the distribution of birthdates for male, $X^2(1, n = 311) = 0.46, p = 0.496$, or female junior ski jumpers, $X^2(1, n = 196) = 0.65, p = 0.419$, compared with live birth distribution in the European Union and Japan when categorized by semesters. The quarterly birthdate distribution of male, $X^2(3, n = 311) = 0.62, p = 0.893$, and female junior ski jumpers, $X^2(3, n = 196) = 1.21, p = 0.751$, does not display any significant RAE.

Table 1. Descriptive ORs and corresponding X^2 values and effect sizes (ϕ) across all relative age quarters and semesters for competition level and differentiated by gender

Level	Gender	Statistics	Q1:Q2	Q1:Q3	Q1:Q4	Sem1:Sem2	
Senior	Total (n = 409)	X^2	0.22	2.77	2.01	3.44	
		p	>.05	>.05	>.05	>.05	
		ϕ	.023	.082	.070	.065	
		OR	0.91	0.72	0.76	0.77	
		(95% CI)	(0.62–1.34)	(0.49–1.06)	(0.51–1.11)	(0.59–1.02)	
		X^2	0.04	1.59	1.65	3.08	
	Male (n = 248)	p	>.05	>.05	>.05	>.05	
		ϕ	.004	.079	.082	.079	
		OR	0.98	0.73	0.72	0.73	
		(95% CI)	(0.61–1.60)	(0.44–1.19)	(0.434–1.19)	(0.51–1.04)	
		X^2	0.46	1.36	0.46	0.70	
		p	>.05	>.05	>.05	>.05	
Female (n = 161)	ϕ	.053	.091	.053	.047		
	OR	0.81	0.70	0.81	0.83		
	(95% CI)	(0.44–1.49)	(0.38–1.28)	(0.44–1.49)	(0.54–1.29)		
	Junior	Total (n = 507)	X^2	0.23	0.44	1.47	0.95
			p	>.05	>.05	>.05	>.05
			ϕ	.021	.029	.054	.031
OR			0.92	0.63	0.80	0.885	
(95% CI)			(0.65–1.30)	(0.79–1.26)	(0.565–1.14)	(0.692–1.13)	
X^2			0.11	0.32	0.55	0.46	
Male (n = 311)	p	>.05	>.05	>.05	>.05		
	ϕ	.019	.031	.043	.027		
	OR	0.93	0.88	0.84	0.90		
	(95% CI)	(0.59–1.44)	(0.57–1.37)	(0.54–1.32)	(0.66–1.23)		
	X^2	0.17	0.25	1.19	0.65		
	p	>.05	>.05	>.05	>.05		
Female (n = 196)	ϕ	.030	.035	.079	.041		
	OR	0.89	0.87	0.73	0.849		
	(95% CI)	(0.51–1.55)	(0.50–1.51)	(0.41–1.29)	(0.571–1.26)		

Discussion

The current study investigated the relative age effect in international ski jumping at the world cup and junior world championship level. The main results of this investigation were the absence of any statistically significant RAE in international ski jumping compared to the distribution of live births in the European Union and Japan. This was observed for both competition levels and genders, which differs from previous investigations of world cup ski jumping (Baker et al., 2014), where RAE was found for male ski jumpers. This result was obtained possibly because the current investigation focused on a sample comprised of elite athletes who placed among the top fifty in the overall world cup rankings, and RAE was not responsible for determining success amongst athletes who reached the world cup level in ski jumping.

The current study did not identify any significant RAE in female elite ski jumpers, which agrees with the previous study on RAE in female ski jumping (Baker et al., 2014) and reports that show RAE to be less prevalent in female sports (Cobley et al., 2009). It has been proposed that fewer participants reduce the depth of competition and, thereby, moderate the size and strength of RAE (Musch & Grondin, 2001; Schorer et al., 2009), which explains the absence of RAE in female elite ski jumpers. The first world cup competitions for women were held in 2011, and the number of participants is still far lower than that for male ski jumping. Furthermore, technique- and skill-based sports are typically not associated with RAEs in the same way as physically demanding sports (Smith et al., 2018). In fact, for sports where technical skills or aesthetics are more important than physical strength, there are reports of a reverse relative age effect in female athletes (Baker et al., 2014; Romann & Fuchslocher, 2014; Hancock, Starkes, & M. Ste-Marie, 2015). The earlier onset of puberty for girls makes the difference between early and late born athletes less pronounced, which may contribute to the different RAE patterns between sexes (Goldschmied, 2011).

The current investigation, for the first time, examined the prevalence of RAE at the junior level in international ski jumping. The results do not show any RAE for either sex, which differs from the proposed hypothesis and the reported pattern of RAE of generally being most prominent at the junior level (Cobley et al.,

2009). However, the results agree with the research on the youth category in winter technique-related sports, including ski jumping, which do not display RAE (Müller et al., 2016).

The absence of RAE in ski jumping confirms claims that sports emphasizing motor skills and technical proficiency will not display RAE (van Rossum & de Vries, 1998; van Rossum, 2006). Furthermore, ski jumping performance is positively affected by low body weight (Schmölzer & Müller, 2002) even after the introduction of BMI regulations (Virmavirta & Kivekäs, 2019). This can reduce the advantage of physical growth held by relatively older athletes and mitigate the occurrence of RAE in ski jumping.

Although not statistically significant, the descriptive trend of the current investigation indicates an overrepresentation of ski jumpers born early in the year, and coaches and officials working with young athletes and talent development programs should be aware of the possible bias towards rewarding older athletes. RAE in sport is attributed to not only physical strength advantages but general and psychological maturation. Baker et al. (2014) have suggested that cognitive maturation plays a role by enhancing decision-making, abstract thinking, and creativity that grant relatively older athletes better responses to training and coaching. Martin et al. (2004) have described how abilities in attention control, engaging in behavior when a goal is remote, and control of gross motor activity develop with chronological age and may influence performance. The psychosocial advantage and longer training time can increase performance in young athletes and be interpreted as talent, which may lead to several additional benefits such as better coaching and attention to relatively older participants (Wattie et al., 2008). These mechanisms may be relevant in the context of ski jumping and should be considered as important variables for future investigations.

Conclusions

The results obtained in this study illustrate that RAE is not present at the elite level in ski jumping. This supports the hypothesis that RAE is not determinant for performance at the highest level in ski jumping. Contrary to expectations, RAE is not present at the junior level in ski jumping for males or females. The main explanation is that the technical nature of the sport and the advantage of low body weight counteract some of the benefits held by relatively older athletes. Furthermore, the results of this study suggest that RAE is primarily caused by the physical advantages held by relatively older athletes; thus, in sports, where performance depends on technical and motor skill proficiency, RAE is typically less prominent. Coaches and officials involved in sporting environments that typically display RAE (e.g., team sports, strength and endurance sports) can possibly mitigate some of this effect by considering participants on the basis of their technical and motor skills.

Conflicts of interest: The authors declare no conflict of interest.

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