Original Article

Longitudinal relative age effects in youth soccer and youth Gaelic football in Ireland

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ABSTRACT

The purpose of the present study was to examine the presence and longitudinal trends of relative age effects (RAEs) in prominent Irish youth sports (soccer and Gaelic football) through a combination of cross-sectional, quasi-longitudinal, and longitudinal analyses. First, cross-sectional analyses of representative Irish youth soccer league squads (2015-2020) and youth Gaelic football inter-county development squads (2015-2020) in County Donegal, Ireland (*N* = 1519 athletes) confirmed the presence of RAEs across sport type and sex ($X^2_{[3,\ 1518]}$ = 59.96, *p* < .001, *w* = .20). Quasi-longitudinal examination confirmed the trend that in soccer and Gaelic football, relatively older athletes were more likely to be selected to teams. Longitudinally, the most prominent RAE trends increased in boys Gaelic football as the athletes aged and the squad numbers reduced (OR range Q1 vs. Q4 = 1.41-2.50). Smaller increases were demonstrated within boys soccer over time. Although, soccer which has an earlier/younger age selection at U11 with a smaller roster size retention onto talent development pathways exacerbated the initial RAEs compared to Gaelic football which has a delayed/older age selection at U14 with a larger roster size retention onto talent development pathways.
Keywords: Physical education; Youth sport; Relative age; Talent identification; Athlete development.

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INTRODUCTION

Through sport participation, youth athletes can acquire technical skills (Forsman et al., 2016), strength (Cumming et al., 2017), cardiorespiratory fitness (Harrison et al., 2015), tactics (Cumming et al., 2005), and character development (Agans et al., 2018). It is incumbent then for researchers to explore mechanisms that impede equal access to the benefits of sport. One such identified mechanism is the relative age effect (RAE; Barnsley et al., 1985). In sport, RAEs exist when one's birthdate leads to participation (e.g., earlier registration into sport; Hancock et al., 2013) or performance (e.g., selection to elite teams; Arrieta et al., 2015) (dis)advantages. Since most governing bodies divide youth sport divisions into one- or two-year age bands, seemingly minor age differences between youth athletes competing in the same age division are quite significant. Consider, for instance, an athlete who turns 6 years old on January 01 of a given year. This athlete would play in the same age division as an athlete who turns 6 years old on December 31 of the same year. Compared to the relatively younger athlete, the relatively older athlete has been alive nearly 20% longer, and by virtue of being alive longer, is likely to be taller, heavier, and stronger. Suffice to say that seemingly minor differences in relative age are exacerbated when such differences exist between youth athletes.

The prevalence of RAEs has been established across various sport, countries, ages, and in both sexes (see Cobley et al., 2009 for a review). Despite hundreds of published studies on RAEs in sport, the underpinning mechanisms to explain the existence of RAEs are not fully understood. This lack of clarity likely stems from the fact that there are many competing factors that influence RAEs. Musch and Grondin (2001) offered four mechanisms that could influence RAEs. First, RAEs are greater when the number of athletes competing for limited roster positions increases—known as *depth of competition*. Second, *physical development* contributes to RAEs, as relatively older athletes are frequently selected to team based on physical growth while relatively younger, less physically developed, and less mature athletes are deselected from sport (Cobley & Till, 2017). Third, *psychological factors* influence RAEs, with relatively older athletes being more likely to have advanced cognitive development that supports motivation (Práxedes et al., 2017) and hardiness (Jones et al., 2018). Fourth, *experience* has a role in RAEs, as was evident in the above example of the 6-year-old being nearly 20% older than their peers.

Contemporary research has offered more thorough explanations of RAEs, combining theory and evidence to create explanatory models of RAEs. Wattie et al. (2015), for instance, proposed a developmental systems model, positing that the model might be applied to specific sporting domains. This model attests that RAEs manifest due to the interactions of individual, task, and environmental constraints, with changes over time and relative age itself. Hancock et al. (2013) proposed a social agents model which contends that Matthew effects (Merton, 1968) explain the initial advantages afforded to relatively older athletes (e.g., early sport enrolment) and also states the self-fulfilling prophecy promotes RAEs via Pygmalion effects (i.e., expectations placed on athletes by coaches and parents; Rosenthal & Jacobson, 1968) and Galatea effects (i.e., athletes acting congruently with the greater expectations placed on them; Merton, 1957). Importantly, both models adopt an ecosystem approach where understanding RAEs involves multiple mechanisms that exert their influence over long periods of time. That is, the cumulative influence of constraints over time (Wattie et al., 2015) and the combined effect of social agents over time (Hancock et al., 2013).

Since the models used to explain RAEs both reflect changes over time, it is important that sport scientists respond with longitudinal research designs that can contribute to our understanding of RAEs (Schorer et al., 2020). In fact, the significant volume of evidence of RAEs prevalence has been criticised for its one-dimensional, cross-sectional nature (Smith et al., 2018). Some recent studies have adopted longitudinal approaches (e.g., de la Rubia et al., 2021; Jackson & Comber, 2020), but substantially more research is required to build a longitudinal body of evidence strong enough to truly add to the strength of the existing models. Thus, the purpose of the present study was to examine the presence and longitudinal trends of RAEs in prominent Irish youth sports (boys and girls soccer and Gaelic football) through a combination of cross-sectional, quasi-longitudinal, and longitudinal analyses. It was hypothesised that RAEs would be confirmed across the sample and permit comparisons between sport type and sex (Finnegan et al., 2017). The prevalence of RAEs in boys was expected to be greater than girls due to the disparity in physical maturation rates, which is supported by previous findings (Cumming et al., 2017). It was further hypothesised that the RAEs are more prominent in sports where the talent identification processes commence at a younger age, supporting calls for a more holistic, personal, and talent development approach within youth sports (Vaeyens et al., 2008). By exploring longitudinal trends of RAEs, the present research (along with past and future studies), might offer support of these models.

METHOD

Procedure

Ethical approval was granted by the lead author's University Research Ethics Committee. Requests were then made to the Inishowen League for boys and girls soccer, along with the Donegal Gaelic Athletic Association (GAA) and Ladies Gaelic Football Association for boys and girls Gaelic football to share birth cohort information for all representative squads between 2015-2020.

Participants

The sample (*N* = 1519 athletes) consisted of 1259 boys and 260 girls ranging in ages 11-17 years (*M* = 14.40, *SD* = 1.40). The soccer selection squads (373 boys and 62 girls) are typically much smaller than those in Gaelic football (886 boys and 198 girls). Despite the relatively small girls sample, the authors felt it important to include these findings in support of calls for additional studies of the girls cohort and to highlight the need for additional relevant information to permit further analysis (Smith et al., 2018).

Data analysis

Following the dates used by the governing bodies, participants' birth quartiles (Q) were categorized as: Q1 (Jan-Mar), Q2 (Apr-Jun), Q3 (Jul-Sep), and Q4 (Oct-Dec). The cross-sectional analysis explored RAEs in each squad, sport, and year. This was expanded upon across and within age groups to allow for a quasi-longitudinal assessment of patterns of RAEs within each sport and across the sexes. The longitudinal analysis examined the existence RAEs in athletes who were selected or deselected to squads from year-to-year. The data were analysed with SPSS 25.0. Chi-square goodness of fit tests (X^2) were conducted to compare the actual and expected birth date distributions. The level of significance was set at $p \leq .05$. Effect sizes (*w*) were calculated, with results of .10, .30, and .50 representing small, moderate, and large effect sizes, respectively (Cohen, 1992).

Birth quartile distribution analysis reflected actual birth rates based on national birth quartile distribution percentages retrieved from the Central Statistics Office (Vital Statistics Annual Report; Central Statistics Office, 2020). Odds ratios (OR) were used as post-hoc measures to gauge discrepancies in birth quartile distributions and are significant when the 95% confidence interval (CI) range remains above 1 (significantly more likely) or below 1 (significantly less likely). Inter-quartile comparisons were examined to determine the likelihood or odds of selection for athletes born in one quartile of the year over another (Q1 vs. Q4) and for a half yearly examination (H1 vs. H2).

Table 1. Cross-sectional analysis of RAEs in the Inishowen Youth Soccer League representative soccer squads and Donegal GAA Gaelic football youth development squads.

Sample	**N**	**Obs/ Expt**	**Q1 %**	**Q2 %**	**Q3 %**	**Q4 %**	**OR Q1 vs.Q4**	**(95% CIs)**	**OR Q2 vs. Q4**	**(95% CIs)**	**OR H1 vs. H2**	**(95% CIs)**	**χ2**	**p-value**	**w**
Full Sample	1519	Obs	30.9%	26.6%	23.3%	19.2%	1.61	1.45-1.79	1.38	1.25-1.54	1.35	1.23-1.49	59.96	<.001	0.20
		Expt	23.8%	24.9%	26.3%	25.1%	0.95		0.99		0.95				
Boys	1259	Obs	30.3%	27.6%	23.0%	19.1%	1.59	1.43-1.76	1.44	1.30-1.61	1.38	1.25-1.51	45.31	<.001	0.19
		Expt	24.0%	25.3%	26.1%	24.7%	0.97		1.02		0.97				
Girls	260	Obs	33.5%	21.9%	25.0%	19.6%	1.71	1.54-1.90	1.12	1.01-1.24	1.24	1.13-1.37	15.31	=.002	0.26
		Expt	23.5%	25.0%	26.5%	25.0%	0.94		1.00		0.94				
Soccer	435	Obs	31.0%	29.9%	19.3%	19.8%	1.57	1.41-1.74	1.51	1.36-1.68	1.56	1.41-1.72	26.74	<.001	0.25
		Expt	23.7%	25.1%	26.2%	25.1%	0.94		1.00		0.95				
Gaelic Football	1084	Obs	30.8%	25.3%	24.9%	19.0%	1.62	1.46-1.90	1.33	1.20-1.48	1.28	1.16-1.41	37.61	<.001	0.19
		Expt	23.9%	24.9%	26.2%	24.9%	0.96		1.00		0.96				
Boys Soccer	373	Obs	30.3%	32.2%	17.7%	19.8%	1.53	1.38-1.70	1.62	1.47-1.80	1.66	1.51-1.84	28.64	<.001	0.28
		Expt	23.9%	24.9%	26.3%	24.9%	0.96		1.00		0.95				
Boys Gaelic Football	886	Obs	30.4%	25.6%	25.2%	18.8%	1.61	1.46-1.80	1.36	1.23-1.51	1.27	1.49-1.82	28.49	<.001	0.18
		Expt	24.0%	24.9%	26.1%	25.0%	0.96		1.00		0.96				
Girls Soccer	62	Obs	35.5%	16.1%	29.0%	19.4%	1.83	1.65-2.03	0.83	0.74-0.93	1.07	0.97-1.17	8.07	=.045	0.36
		Expt	22.6%	25.8%	25.8%	25.8%	0.88		1.00		0.94				
Girls Gaelic Football	198	Obs	32.9%	23.7%	23.7%	19.7%	1.67	1.51-1.85	1.21	1.08-1.34	1.30	1.18-1.44	9.60	=.022	0.22
		Expt	23.7%	25.3%	26.3%	24.7%	0.96		1.02		0.96				

Note. Obs = Observed findings within the sample sport and cohort, Expt = Expected findings based on CSO population birth-rate distribution.

Table 2. Quasi-longitudinal analysis of Inishowen Youth Soccer League representative soccer squads to determine RAEs using comparisons against CSO population birth-rate distribution data.

Squad	**Birth Years**	**N**	**Obs/ Expt**	**Q1 %**	**Q2 %**	**Q3 %**	**Q4 %**	**OR Q1 vs. Q4**	**(95% CIs)**	**OR Q2 vs. Q4**	**(95% CIs)**	**OR H1 vs. H2**	**(95% CIs)**	**χ2**	***p*-value**	***w***
Boys Soccer																
U11	2004-2007	59	Obs	25.4%	33.9%	20.3%	20.4%	1.25	1.13-1.39	1.67	1.51-1.85	1.46	1.32-1.60	4.24	=.236	0.27
			Expt	23.7%	23.7%	27.1%	25.4%	0.93		0.93		0.90				
U12	2003-2006	73	Obs	27.4%	31.5%	23.3%	17.8%	1.54	1.39-1.71	1.77	1.59-1.97	1.43	1.30-1.58	2.97	=.396	0.20
			Expt	23.3%	26.0%	26.0%	24.7%	0.94		1.06		0.97				
U13	2002-2005	73	Obs	21.9%	38.4%	23.3%	16.4%	1.33	1.20-1.49	2.33	2.11-2.60	1.52	1.38-1.67	7.99	=.046	0.33
			Expt	24.7%	24.7%	26.0%	24.7%	1.00		1.00		0.97				
U14	2001-2004	71	Obs	36.6%	31.0%	12.7%	19.7%	1.86	1.68-2.06	1.57	1.42-1.75	2.09	1.89-2.30	11.04	=.011	0.39
			Expt	23.9%	25.4%	25.4%	25.4%	0.94		1.00		0.97				
U15	2000-2002	50	Obs	40.0%	26.0%	8.0%	26.0%	1.54	2.34-2.89	1.00	1.52-1.88	1.94	1.76-2.14	11.65	=.009	0.48
			Expt	24.0%	24.0%	26.0%	26.0%	0.92		0.92		0.92				
U16	1999-2003	47	Obs	34.0%	29.8%	14.9%	21.3%	1.60	1.44-1.77	1.40	1.26-1.55	1.76	1.60-1.94	5.02	=.170	0.33
			Expt	23.4%	25.5%	25.5%	25.5%	0.92		1.00		0.96				
Sub-total		**373**		**30.3%**	**32.2%**	**17.7%**	**19.8%**	**1.53**	**1.38-1.70**	**1.62**	**1.47-1.80**	**1.67**	**1.51-1.84**	**28.64**	**<.001**	**0.28**

Girls Soccer																
U13	2005-2007	25	Obs	52.0%	12.0%	12.0%	24.0%	2.17	1.96-2.40	0.50	0.45-0.56	1.78	1.61-1.96	11.95	=.008	0.69
			Expt	24.0%	24.0%	28.0%	24.0%	1.00		1.00		0.92				
U14	2002-2003	20	Obs	25.0%	20.0%	40.0%	15.0%	1.67	1.50-1.86	1.33	1.19-1.49	0.82	0.82-0.90	2.80	=.423	0.37
			Expt	25.0%	25.0%	25.0%	25.0%	1.00		1.00		1.00				
U16	2002-2003	17	Obs	23.6%	17.6%	41.2%	17.6%	1.33	1.21-1.49	1.00	0.90-1.12	0.70	0.64-0.77	1.30	=.729	0.28
			Expt	23.5%	23.5%	29.4%	23.5%	1.00		1.00		0.89				
Sub-total		**62**		**35.5%**	**16.1%**	**29.0%**	**19.4%**	**1.83**	**1.65-2.03**	**0.83**	**0.74-0.93**	**1.07**	**0.97-1.17**	**8.07**	**=.045**	**0.36**

Note. Obs = Observed findings within the sample sport and cohort, Expt = Expected findings based on CSO population birth-rate distribution.

Table 3. Quasi-longitudinal analysis of Donegal GAA youth development Gaelic football squads to determine RAEs using comparisons against CSO population birth-rate distribution data.

Sport/ Squad	Birth Years	N	Obs/ Expt	Q1 %	Q2 %	Q3 %	Q4 %	OR Q1 vs.Q4	(95% CIs)	OR Q2 vs. Q4	(95% CIs)	OR Q1&2 vs. Q3&4	(95% CIs)	χ2	p-value	w
Boys Gaelic Football																
U14	2003-2005	422	Obs	28.2%	25.1%	27.5%	19.2%	1.47	1.32-1.63	1.31	1.18-1.45	1.14	1.04-1.26	8.52	=.036	0.14
			Expt	23.9%	25.1%	26.3%	24.6%	0.97		1.02		0.96				
U15	2002-2004	234	Obs	31.2%	26.1%	23.5%	19.2%	1.62	1.46-1.80	1.36	1.22-1.51	1.34	1.22-1.48	9.23	=.026	0.20
			Expt	23.9%	24.8%	26.1%	25.2%	0.95		0.98		0.95				
U16	2001-2003	98	Obs	31.6%	23.5%	26.5%	18.4%	1.72	1.55-1.91	1.28	1.15-1.42	1.23	1.12-1.35	4.78	=.188	0.22
			Expt	23.5%	24.5%	26.5%	25.5%	0.92		0.96		0.92				
U17	2000-2003	132	Obs	34.8%	28.0%	19.0%	18.2%	1.92	1.72-2.12	1.54	1.38-1.71	1.69	1.53-1.86	11.45	=.015	0.29
			Expt	24.0%	24.9%	26.0%	25.0%	0.96		1.00		0.96				
Sub-total		**886**		**30.4%**	**25.6%**	**25.2%**	**18.8%**	**1.61**	**1.46-1.80**	**1.36**	**1.23-1.51**	**1.27**	**1.49-1.82**	**28.49**	**=.010**	**0.18**
Girls Gaelic Football																
U14	2003-2006	161	Obs	35.4%	22.4%	22.4%	19.8%	1.78	1.61-1.98	1.13	1.02-1.26	1.37	1.24-1.51	12.57	=.006	0.28
			Expt	23.6%	25.5%	26.1%	24.8%	0.95		1.03		0.96				
U16	2001	37	Obs	21.6%	29.7%	29.7%	19.0%	1.14	1.02-1.27	1.57	1.41-1.74	1.06	0.96-1.16	1.10	.777	0.17
			Expt	24.3%	24.3%	27.0%	24.3%	1.00		1.00		0.95				
Sub-total		**198**		**32.9%**	**23.7%**	**23.7%**	**19.7%**	**1.67**	**1.51-1.85**	**1.21**	**1.08-1.34**	**1.30**	**1.18-1.44**	**9.60**	**.022**	**0.22**

Note. Obs = Observed findings within the sample sport and cohort, Expt = Expected findings based on CSO population birth-rate distribution.

Table 4a. Longitudinal analysis of Inishowen Youth League boys soccer squads birth date quartile distributions including selections and deselections year-on-year.

Birth Year	Squad/ Year	N	Changes (N)	Q1	%	Q2	%	Q3	%	Q4	%	OR Q1 vs. Q4	95 % CIs	OR Q2 vs. Q4	95 % CIs	OR Q1 & 2 vs. Q3 & 4	95 % CIs
2001	U14 - 2015	18		11	61.1	5	27.7	1	5.6	1	5.6	11.0	9.65-12.34	5.0	4.36-5.61	8.0	7.12-8.83
			2	1	50.0	1	50.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
			-3	-3	100.0	0	0.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
	U15 - 2016	17		9	52.9	6	35.3	1	5.9	1	5.9	9.0	7.93-10.13	6.0	5.29-6.78	7.5	6.72-8.32
			2	1	50.0	1	50.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
			-4	-3	75.0	-1	25.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
	U16 - 2017	15		7	46.7	6	39.9	1	6.7	1	6.7	7.0	6.19-7.85	6.0	5.28-6.71	6.5	5.82-7.18

2002	U13 - 2015	18		3	16.7	6	33.3	4	22.2	5	27.8	0.6	0.54-0.67	1.2	1.08-1.33	1.0	0.91-1.10
			5	1	20.0	3	60.0	0	0.0	1	20.0	1.0	0.90-1.11	3	2.71-3.32	4.0	3.62-4.42
			-5	0	0.0	-2	40.0	-3	60.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
	U14 - 2016	18		4	22.2	7	38.9	1	5.6	6	33.3	0.7	0.60-0.74	1.2	1.06-1.29	1.6	1.43-1.73
			3	1	33.3	0	0.0	1	33.3	1	33.4	1.0	0.90-1.10	n/a	n/a	0.5	0.45-0.55
			-5	-1	20.0	-3	60.0	0	0.0	-1	20.0	1.0	0.90-1.11	3.0	2.71-3.32	4.0	3.62-4.42
	U15 - 2017	16		4	25.0	4	25.0	2	12.5	6	37.5	0.7	0.60-0.74	0.7	0.60-0.74	1.0	0.91-1.10
2003	U12 - 2015	18		8	44.4	5	27.8	3	16.7	2	11.1	4.0	3.55-4.42	2.5	2.24-2.80	2.6	2.35-2.86
			4	1	25.0	1	25.0	1	25.0	1	25.0	1.0	0.90-1.11	1.0	0.90-1.11	1.0	0.90-1.11
			-4	-2	50.0	-1	25.0	-1	25.0	0	0.0	n/a	n/a	n/a	n/a	3.0	2.72-3.31
	U13 - 2016	18		7	38.9	5	27.8	3	16.6	3	16.7	2.3	2.1	1.7	1.50-1.85	2.0	1.82-2.21
			2	0	0.0	1	50.0	0	0.0	1	50.0	0.0	n/a	1.0	0.91-1.10	1.0	0.91-1.10
			-2	0	0.0	-1	50.0	0	0.0	-1	50.0	0.0	n/a	1.0	0.91-1.10	1.0	0.91-1.10
	U14 - 2017	18		7	38.9	5	27.7	3	16.7	3	16.7	2.3	2.10-2.59	1.7	1.49-1.85	2.0	1.81-2.20

Note. Changes = the number of players added to the category or join ins (positive) and the number of deselected players or dropouts (negative) from one year to the next.

Table 4b. Longitudinal analysis of Inishowen Youth League boys soccer squads birth date quartile distributions including selections and deselections year-on-year (cont.)

Birth Year	Squad/ Year	N	Changes (N)	Q1	%	Q2	%	Q3	%	Q4	%	OR Q1 vs. Q4	95 % CIs	OR Q2 vs. Q4	95 % CIs	OR Q1 & 2 vs. Q3 & 4	95 % CIs
2004	U11- 2015	15		3	20.0	5	33.3	4	26.7	3	20.0	1.0	0.90-1.11	1.7	1.50-1.85	1.1	1.037-1.26
			3	0	0.0	2	66.7	0	0.0	1	33.3	0.0	n/a	2.0	1.82-2.21	2.0	1.82-2.21
			0	0	0.0	0	0.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
	U12 - 2016	18		3	16.7	6	33.3	5	27.8	4	22.2	0.8	0.68-0.84	1.5	1.35-1.66	1.0	0.91-1.11
			3	2	66.7	0	0.0	1	33.3	0	0.0	n/a	n/a	n/a	n/a	2.0	1.82-2.21
			-2	0	0.0	0	0.0	-2	100.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
	U13 - 2017	19		5	26.3	6	31.5	4	21.1	4	21.1	1.3	1.12-1.38	1.5	1.35-1.66	1.4	1.24-1.51
			1	0	0.0	0	0.0	0	0.0	1	100.0	n/a	n/a	n/a	n/a	n/a	n/a
			-3	-1	33.3	-1	33.3	-1	33.4	0	0.0	n/a	n/a	n/a	n/a	2.0	1.81-2.20
	U14 - 2018	17		4	23.5	5	29.5	4	23.5	4	23.5	1.0	0.90-1.11	1.3	1.13-1.39	1.1	1.02-1.24
2005	U11 - 2016	15		2	13.3	6	40.0	6	40.0	1	6.7	2.0	1.75-2.26	6.0	5.30-6.73	1.1	1.04-1.26
			4	0	0.0	4	100.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
			-1	-1	100.0	0	0.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
	U12 - 2017	18		1	5.6	10	55.6	6	33.2	1	5.6	1.0	0.86-1.16	10.0	8.78-11.23	1.6	1.43-1.74
			1	0	0.0	1	100.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
			-1	0	0.0	0	0.0	0	0.0	-1	100.0	n/a	n/a	n/a	n/a	n/a	n/a
	U13 - 2018	18		1	5.6	11	61.1	6	33.3	0	0.0	n/a	n/a	n/a	n/a	2.0	1.82-2.21

2006	U11 - 2017	14		5	35.7	2	14.3	2	14.3	5	35.7	1.0	0.91-1.10	0.4	0.36-0.45	1.0	0.91-1.10
			5	3	60.0	0	0.0	1	20.0	1	20.0	3.0	2.71-3.32	n/a	n/a	1.5	1.36-1.65
			0	0	0.0	0	0.0	0	0.0	0	0.0	n/a	n/a	n/a	n/a	n/a	n/a
	U12 - 2018	19		8	42.1	2	10.5	3	15.8	6	31.6	1.3	1.21-1.47	0.3	0.30-0.37	1.1	1.01-1.22

Note. Changes = the number of players added to the category or join ins (positive) and the number of deselected players or dropouts (negative) from one year to the next.

Table 5. Longitudinal analysis of Donegal GAA boys Gaelic football youth development squad's birthdate quartile distributions including selections and deselections year-on-year.

Birth Year	**Squad/ Year**	**N**	**Changes (N)**	**Q1**	**%**	**Q2**	**%**	**Q3**	**%**	**Q4**	**%**	**OR Q1 vs. Q4**	**CIs**	**OR Q2 vs. Q4**	**CIs**	**OR Q1 & 2 vs. Q3 & 4**	**CIs**
2001	U16 - 2017	31		11	35.5	6	19.4	5	16.1	9	29.0	1.2	1.11-1.35	0.7	0.60-0.74	1.2	1.11-1.34
			11	4	36.4	4	36.4	3	27.2	0	0.0	n/a	n/a	n/a	n/a	2.7	n/a
			-10	-4	40.0	-3	30.0	0	0.0	-3	30.0	1.3	1.21-1.47	1.0	0.90-1.11	2.3	2.12-2.57
	U17 - 2018	32		11	34.4	7	21.9	8	25.0	6	18.7	1.8	1.66-2.04	1.2	1.05-1.30	1.3	1.17-1.42
2002	U15 -2017	78		19	24.4	26	33.3	18	23.1	15	19.2	1.3	1.14-1.41	1.7	1.56-1.92	1.4	1.24-1.50
			5	2	40.0	0	0.0	1	20.0	2	40.0	1.0	0.91-1.10	0.0	n/a	0.7	0.61-0.73
			-48	-11	22.9	-20	41.7	-5	10.4	-12	25.0	0.9	0.83-1.02	1.7	1.51-1.85	1.8	1.66-2.01
	U16 - 2018	35		10	28.6	6	17.1	14	40.0	5	14.3	2.0	1.79-2.23	1.2	1.07-1.34	0.8	0.76-0.93
			10	4	40.0	3	30.0	1	10.0	2	20.0	2.0	1.80-2.22	1.5	1.35-1.67	2.3	2.12-2.57
			-15	-2	13.3	-1	6.7	-9	60.0	-3	20.0	0.7	0.59-0.74	0.3	0.30-0.38	0.3	0.23-0.28
	U17 - 2019	30		12	40.0	8	26.7	6	20.0	4	13.3	3.0	2.70-3.35	2.0	1.80-2.24	2.0	1.82-2.21
2003	U14 - 2017	173		43	24.9	49	28.3	43	24.9	38	22.0	1.1	1.02-1.26	1.3	1.16-1.43	1.1	1.03-1.25
			10	5	50.0	2	20.0	0	0.0	3	30.0	1.7	1.51-1.84	0.7	0.60-.74	2.3	2.12-2.57
			-107	-22	20.6	-29	27.0	-28	26.2	-28	26.2	0.8	0.71-0.87	1.0	0.93-1.14	0.9	0.83-1.00
	U15 - 2018	76		26	34.2	22	28.9	15	19.7	13	17.2	2.0	1.79-2.21	1.7	1.51-1.87	1.7	1.55-1.88
			6	0	0.0	3	50.0	2	33.3	1	16.7	0.0	n/a	3.0	2.70-3.32	1.0	0.91-1.10
			-50	-16	32.0	-13	26.0	-11	22.0	-10	20.0	1.6	1.11-1.36	1.3	1.17-1.44	1.4	1.25-1.52
	U16 - 2019	32		10	31.3	11	34.4	7	21.8	4	12.5	2.5	2.24-2.79	2.8	2.47-3.07	1.9	1.74-2.11
			12	3	25.0	3	25.0	4	33.3	2	16.7	1.5	1.35-1.67	1.5	1.35-1.67	1.0	0.91-1.10
			-10	-4	40.0	-1	10.0	-3	30.0	-2	20.0	2.0	1.80-2.22	0.5	0.45-0.56	1.0	0.91-1.10
	U17 - 2020	34		9	26.5	13	38.2	8	23.5	4	11.8	2.3	2.01-2.51	3.3	2.90-3.61	1.8	1.66-2.02
2004	U14 - 2018	137		43	31.7	29	21.3	39	28.7	25	18.3	1.7	1.56-1.92	1.2	1.05-1.30	1.1	1.02-1.24
			11	2	18.2	2	18.2	2	18.2	5	45.4	0.4	0.36-0.44	0.4	0.36-0.44	0.6	0.52-0.63
			-68	-18	26.5	-18	26.5	-19	27.9	-13	19.1	1.4	1.25-1.54	1.4	1.25-1.54	1.1	1.02-1.24
	U15 - 2019	80		28	35.0	13	16.3	22	27.4	17	21.3	1.6	1.48-1.82	0.8	0.69-0.85	1.1	0.96-1.16

Note: Changes = the number of players added to the category or join ins (positive) and the number of deselected players or dropouts (negative) from one year to the next.

RESULTS

Cross-sectional analysis

Full sample statistics are reported in Table 1, with highlighted results noted herein. Analysis of the entire sample revealed significant RAEs were present throughout the sample ($X^2_{[3, 1518]}$ = 59.96, p < .001, w = .20, Q1:Q4 = 1.61, H1:H2 = 1.35). When examining sex, both girls ($X^2_{[3, 259]}$ = 15.31, p = .002, w = .26, Q1:Q4 = 1.71, H1:H2 = 1.24) and boys ($X^2_{[3, 1258]}$ = 45.31 p < .001, w = .19, Q1:Q4 = 1.59, H1:H2 = 1.38) had similar results, with RAEs favouring relatively older athletes. When considering sport type, soccer players displayed significant RAEs with advantages for relatively older players ($X^2_{[3, 435]}$ = 26.74, p < .001, w = .25, Q1:Q4 = 1.51, H1:H2 = 1.56), as did Gaelic football players ($X^2_{[3, 1083]}$ = 37.61, p < .001, w = .19, Q1:Q4 = 1.62, H1:H2 = 1.28).

Moving into each sport by sex, relatively older athletes were more likely to be selected to boys soccer squads ($X^2_{[3, 372]}$ = 28.64, p < .001, w = .28, Q1:Q4 = 1.53, H1:H2 = 1.66) and boys Gaelic football squads ($X^2_{[3, 885]}$ = 28.49, p < .001, w = .18, Q1:Q4 = 1.61, H1:H2 = 1.27). Though the same pattern held for girls Gaelic football ($X^2_{[3, 197]}$ = 9.60, p = .022, w = .22, Q1:Q4 = 1.67, H1:H2 = 1.30), a slight deviation existed for girls soccer ($X^2_{[3, 61]}$ = 8.07, p = .045, w = .36). Q1 athletes were more likely to be selected than Q4 athletes (Q1:Q4 = 1.83), but due to a spike in Q3 births, the differences comparing the first half to the second half of the year were not significant.

Quasi-longitudinal analysis

For the quasi-longitudinal analysis, we explored RAEs by sex and sport type within each age division, combining registration data from 2015, 2016, and 2017. Full results are shown in Tables 2 and 3, with highlights included herein. In boys soccer, there was a notable trend of athletes born early in the year, though results were only significant for the U13 ($X^2_{[3, 72]}$ = 7.99, p = .046, w = .33, Q1:Q4 = 1.33, H1:H2 = 1.52), U14 ($X^2_{[3, 70]}$ = 11.04, p = .011, w = .39, Q1:Q4 = 1.86, H1:H2 = 2.09), and U15 ($X^2_{[3, 49]}$ = 11.65, p = .009, w = .48, Q1:Q4 = 1.54, H1:H2 = 1.76) categories. Despite the U11, U12, and U16 having non-significant results (due to low test power), the trend at those ages was that relatively older athletes were still more likely to be selected, which was demonstrated by the Q1:Q4 OR. For girls soccer, only the initial age group of U13 ($X^2_{[3, 25]}$ = 11.95, p = .008, w = .69, Q1:Q4 = 2.17, H1:H2 = 1.78) displayed RAEs towards relatively older athletes. Again, results here were limited by low test power, but nevertheless, showed the propensity for selection of relatively older girls.

Analysis of boys Gaelic football confirmed RAEs at U14 ($X^2_{[3, 421]}$ = 8.52, p = .036, w = .14, Q1:Q4 = 1.47, H1:H2 = 1.14), U15 ($X^2_{[3, 233]}$ = 9.23, p = .026, w = .20, Q1:Q4 = 1.62, H1:H2 = 1.34), and U18 ($X^2_{[3, 131]}$ = 11.45, p = .015, w = .29, Q1:Q4 = 1.92, H1:H2 = 1.69). Test power was too low at the U16 level to detect significant differences. The OR displayed a pattern of bias towards relatively older athletes being selected corresponding with increases in age groups and reduction in squad numbers. At the U14 level in girls Gaelic football, a significant RAE was observed ($X^2_{[3, 160]}$ = 12.57, p = .006, w = .28, Q1:Q4 = 1.78, H1:H2 = 1.37). Again, test power was too low to detect significant differences at the U16 level.

Longitudinal analysis

Available data permitted the tracking of individual birth years within boys soccer and boys Gaelic football (see Tables 4 and 5) which facilitated examination of athletes selected and deselected in each year. Across the sampled years for boys soccer, the analysis revealed that 35 players were added to teams, while 30 players dropped out of these teams. Of the players added, 68.6% were born in the first half of the year and were 2.06

times more likely to get selected (H1:H2 = 2.06). With those deselected, 66.6% were also born in the first half of the year and 2.40 times more likely to be so (H1:H2 = 2.40).

For boys Gaelic football, there was a trend toward greater prevalence of RAEs as the depth of competition increased annually. For example, at U14, 173 boys were selected to Gaelic football development squads and whilst there was a RAE trend, it proved statistically non-significant and had a small effect size ($X^2{}_{[3,\,172]}$ = 1.12, *p* = .771, *w* = .08). One year later, the squad was reduced to 76 athletes and the odds of making the squad had reduced significantly for those born in the second half of the year (H1:H2 = 1.70). This trend continued in 2019 at U16 level where the squad was reduced to 32 athletes. Those athletes born in Q1 of 2003 were 2.5 times more likely to be selected than their peers born in Q4—in fact, just four selected athletes (12.5%) were born in Q4 of that year. In their final year of youth selection (U17), the position had not changed significantly despite 12 join-ins and 10 drop-outs from the previous year, with 64.7% of the athletes selected born in the first half of the year (H1:H2 = 1.80).

DISCUSSION

The purpose of the present study was to examine the presence and longitudinal trends of RAEs in prominent Irish youth sports (soccer and Gaelic football) through a combination of cross-sectional, quasi-longitudinal, and longitudinal analyses. The overall results establish that RAEs are prevalent in youth soccer and Gaelic football in Ireland. Longitudinal results also indicated that younger selection (soccer) onto talent development pathways exacerbated RAEs over time, compared to where the talent development pathway selection was delayed (Gaelic football) to an older age. Findings were consistent with the original hypothesis and squads—across sport type and sexes—displayed a propensity to include athletes born closer to the cut-off date (January 01) than their relatively younger peers. The OR supported that RAEs were stronger in boys than girls, though low test power did not reveal significant chi-square tests in all cohorts, Regardless, the results appear to lend support to existing literature where the prevalence of RAEs is greater in boys' youth sports (Smith et al., 2018).

Sex and sport type

The process and timing by which athletes are selected to teams could be one factor contributing to the presence of RAEs. Specifically, selection to boys soccer begins at U11 and the squad numbers selected are comparatively small, whereas girls' selection begins at U13. In Gaelic football, the selection to development squads for boys and girls commences at U14. An original hypothesis, which was supported, was that RAEs would be more prevalent in sports where talent identification programmes commenced at a younger age compared to others starting at older ages. The smallest effect size was found in the boys Gaelic football (oldest age of talent selection at U14) when compared with the other cohorts who start talent selection at younger ages. It also recorded the narrowest range of OR (0.73-1.70), compared to U11 boys soccer (OR range = 1.00-4.00). It could be argued that the RAE in boys U14 Gaelic football is not as prominent due to the larger pool of athletes retained in the squads compared to the others within the sample or the depth of competition effect. However, based on the sample, RAEs are more pronounced in the sports that commence talent identification practices at earlier ages compared to others. These findings support the calls for less emphasis in competitive sport environments for younger children with a delay of competitive team selection and enhancement of a holistic approach incorporating inclusion, enjoyment, and personal development for longer (Côté et al., 2009; Vaeyens et al., 2008; Wylleman et al., 2004). Overall, initial selections to these representative or talent identification pathways displayed RAEs towards relatively older athletes, which may lend support to the social agents model (Hancock et al., 2013). Specifically, it is possible that the parental influence of early enrolment is an initial driver of RAEs in sport, which then leads coaches to select athletes from a skewed talent pool favouring relatively older athletes. This could be further compounded by coaches making selection decisions based on athletes' size rather than skill. Certainly, this line of investigation warrants further inquiry.

Since girls athletes are largely underrepresented in RAE literature, it is important to highlight their data herein. Mainly, as a collective group, girls in this sample demonstrated RAEs favouring relatively older athletes. While some of the analyses on age divisions within each sport did not yield sufficient test power, other analyses indicated notable RAEs. For instance, the analysis found a strong incidence of RAEs in girls U14 Gaelic football squads (OR range = 1.15-2.00) with a moderate effect size. This is the first study of this cohort and provides valuable information for the governing body to review their coaching and talent identification platforms for boys and girls. This element of the study provides a foundation for replication, extension, and advancement towards future longitudinal studies (Schorer et al., 2020). Thus, the evidence suggests a propensity to select relatively older athletes supporting the findings of previous cross-sectional studies (Campbell et al., 2012). Future studies might aim to examine more girls athletes in Gaelic football to understand if RAEs dissipate post-puberty when test power is sufficient.

Longitudinal analyses

Additional analysis of the longitudinal effect of RAEs within birth years examined the behaviour across individual age groups. The findings illustrate that there is a greater prevalence of RAEs as the age profile increases, coinciding with a reduction in squad numbers. This supports the selection hypothesis (Helsen et al., 2000), which suggests that greater the depth of competition yields stronger and/or more prevalent RAEs. This pattern of relatively older athletes being selected to elite teams could reflect choices made by coaches to select athletes based on their physical attributes, rather than emphasizing sport-specific technical skills. This aligns with tenets of the social agents model (Hancock et al., 2013), however, it merits further investigation. The fact that there is no evidence of reversal of the effect throughout the boys' sports or age groups might also support the Pygmalion effect (Rosenthal & Jacobson, 1968) and the Galatea effect (Merton, 1957) as outlined in the social agents model (Hancock et al., 2013). Plausibly, relatively older athletes initially selected will change their perceptions, self-expectations, and thus behaviours in a form of self-fulfilling prophecy. In essence, they were selected and must change behaviours to align with new expectations placed on themselves and those placed on them by parents (summer camps, gym memberships) and coaches (additional instructions, support, and playing time).

With growth in RAEs prevalence in line with age and depth of competition, it is reasonable to suggest that coaches expectations and selection philosophies are grounded in their individual perceptions of age, size, and maturity levels as opposed to skills, character, or talent. These findings may be of great interest to the governing bodies particularly the GAA, as despite intentions to cast a wider net for talent identification initially, the RAEs impact increases with age which questions the efficacy of their developmental practices (Johnston et al., 2017; Vaeyens, 2008). Future longitudinal analyses could assist in gaining a better understanding of variables influencing RAEs and athlete development (Schorer et al., 2020).

Limitations

A limitation of the present study was the lack of available data, especially so with girls athletes. Overall, the girls samples analysed contained a narrow range of birth rates and age profiles. In addition, Gaelic football squads were a county-wide selection whereas the soccer cohorts were based on a single regional league. Widening of the sample to include boys and girls from the other leagues in the country would permit a more balanced representation. A further limitation is in line with a widely held view that quartile-based RAE typically underestimates the effect size and that using monthly birth rate information would reflect a more accurate position (Finnegan et al., 2017). The authors' initial intention was to analyse based on birth dates, however, Government Data Protection Regulations (GDPR) limited the available data to a quartile basis only. Evaluation of the impact of RAEs on selection for adult representative squads would assist assessment of the impact of RAEs.

CONCLUSION

In summary, RAEs are evidenced and persist within prominent Irish youth sports of soccer and Gaelic football and across the sexes with prevalence greater in the boys' population relative to the girls' population. Sport governing bodies and policymakers must advocate to ensure that relatively younger athletes are still given an equal opportunity to develop and advance through provision of opportunities for peak athletic performance, promote lifelong participation, and influence personal development (Bergeron et al., 2015). To achieve this, the focus must shift towards a holistic approach of talent development underpinned by evidence-based research (Hancock et al., 2013). Together with requisite policies and frameworks, coach education is also a critical component of delivery of athlete pathways that ensure awareness and opportunity for all to fulfil their potential regardless of their quartile or month of birth. Indeed, RAEs in sport are not caused by a child's birth date. Rather, they are the product of societal structures, through parents' and coaches' decision making and influences, together with selection policies including talent identification and athlete development. Future longitudinal studies on RAEs should triangulate the quantitative data with qualitative information provided by athletes, parents, and coaches, which would provide greater conceptual understanding and support for the models that attempt to explain RAEs in sport.

AUTHOR CONTRIBUTIONS

Paul McGonigle contributed to data collection, data analysis, and writing. Kyle Paradis contributed to data analysis and writing. David Hancock contributed to data analysis and writing.

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