The Journal of Sports Medicine and Physical Fitness
EDIZIONI MINERVA MEDICA

Relative Age Effect in Italian Soccer. A cultural issue in talent management?

Bruno RUSCELLO, Gabriele MORGANTI, Gennaro APOLLARO, Antonio SAPONARA, Mario ESPOSITO, Lorenzo MARCELLI, Cristoforo FILETTI, Marco PORTA, Alberto GROSSI, Laura PANTANELLA

The Journal of Sports Medicine and Physical Fitness 2022 Apr 19
DOI: 10.23736/S0022-4707.22.13663-7

Article type: Original Article

Article first published online: April 19, 2022
Manuscript accepted: April 12, 2022
Manuscript revised: March 30, 2022
Manuscript received: December 8, 2021

Relative Age Effect in Italian Soccer. A cultural issue in talent management?

Bruno RUSCELLO,[1,2,3,4*] Gabriele MORGANTI,[1] Gennaro APOLLARO,[1] Antonio SAPONARA,[1] Mario ESPOSITO,[1] Lorenzo MARCELLI,[1,3] Cristoforo FILETTI,[5] Marco PORTA[2], Alberto GROSSI,[1] and Laura PANTANELLA[1]

[1] School of Sports and Exercise Sciences – Faculty of Medicine and Surgery – National Talent Observatory – "Tor Vergata" University – Rome, Italy

[2] School of Sports and Exercise Sciences, "San Raffaele" University – Rome, Italy

[3] Department of Industrial Engineering, Faculty of Engineering, "Tor Vergata" University – Rome, Italy

[4] LUISS SportLab – LUISS University, Rome, Italy

[5] Paris Saint Germain Football Club – Paris – France

*** Corresponding Author**: Bruno Ruscello. School of Sport Sciences and Exercise, Faculty of Medicine and Surgery, University "Tor Vergata", Rome, Italy. Via Montpellier 1, 00133 Rome – Italy.
E-mail: bruno.ruscello@uniroma2.it – ORCID: https://orcid.org/0000-0002-5381-9146

ABSTRACT

BACKGROUND: Relative Age Effect (RAE) is a well-known phenomenon among those involved in youth sports, especially when the sport being investigated is widespread and involves early selection for participation in national and international competitions. **METHODS**: The purpose of this study was to verify whether the Italian youth soccer ecosystem has adapted to this issue over the years, comparing players born in 1995 and in 2005 and been playing in Under 16 teams in the appropriate years. The sample included 13 professional Italian soccer teams. The number of players analysed was 260 (1995) and 344 boys (2005), respectively, making a total of 604 players enrolled in this study. **RESULTS**: Relative age effects were detected by chi-square (χ^2) goodness of fit tests both in players born in 1995 (p<0.000;V=0.40) and in 2005 (p<0.0001;V=0.39). χ^2 test of independence showed no significant difference between the two groups of players (p=0.986;V=0.02), confirming a substantial parity of the phenomenon over the two investigated birth years. **CONCLUSIONS**: Ten years of research and dissemination of RAE did not change the selection policies adopted by coaches and/or scouts, who favor relatively older players during the selection processes. Therefore, RAE appears as the result of the Talent Identification and Development Structures, characterized by early selection and early specialization, and which consider performance as the pre-requisite for gaining access to the next developmental stages. Sport organizations should be aware of this issue and counteract accordingly, since it is important to mitigate the presence of RAE, as it causes inequality of opportunity.

KEY WORDS: Youth Sport; Competition Structure; Talent Pathway; Long-Term Development; Performance Potential.

INTRODUCTION

Modern sport exhibits a high quest for elite performance, as a result of the increased competitiveness, between athletes, nations and professional clubs, caused by the high financial and commercial rewards of winning sporting competitions or avoid relegations (1, 2, 3). Most sport organizations opt to identify early talented athletes and develop them in an optimal environment (e.g., 1; 3; 4), following what has been called by Bailey and Collins (5) the Standard Model of Talent Development (SMTD), which is indeed based on early identification from current level of performance or psychological and/or anthropometrical measures, and on the removing of the not eligible athletes in the progression to the next developmental stages. Therefore, the idea behind talent identification (TID) is to select the most "promising" young players from the general population to give them the chance to raise as elite players in a Talent Development Program (TDP), in which selected players are supported throughout a system of practice and competitions (1). Soccer is by far the most popular sport globally and continue to flourish in terms of participation rates and commercial growth (6). This means that in soccer the competitive (7) and financial gains (8), associated to the early recruitment of talented youngsters, are even higher. Therefore, the identification and development of young soccer players have become increasingly professionalized, involving now significant amounts of resources (e.g., personnel, financial and time; 6). Youth soccer is certainly the largest youth sporting movement in Italy, with over one million members [9] in various age groups, who compete in several provincial, regional, and national competitions, organized based on the year of birth (under 15, under 16, etc.).

In Italy, to be able to coach at any level, including children, one must attend training courses, organized by the Italian Football Federation (FIGC) (10) which entitles a coaching license.

The main types of coaching licenses are:

- UEFA PRO
- UEFA A
- UEFA B
- UEFA "GRASSROOTS" LICENSE C
- LICENSE D (Amateur Football Coaching License)

The Amateur Football Coaching License (License D) is needed to coach in the Amateur leagues (i.e., from the "*Eccellenza*", the 5th level of football in Italy, to the "*Terza Categoria*", the 9th and lowest level of football in Italy); and is also required for children's football not involved in professional soccer clubs. The UEFA Grassroots Young Player Course (License C) is the level of qualification needed to coach in youth soccer, in professional level clubs. While UEFA B, UEFA A, and UEFA PRO licenses represent the level of qualification needed to coach at the higher professional level ("Serie C", "Serie B", "Serie A").

The Italian Football Federation, as most other sports organizations, guarantees athlete participation and development during the youth years, providing talent development pathway, based on the SMTD (see, 5), having an organizational strategy which follows a cutoff criterion, thus grouping players based on their birthdate (from January 1st to December 31st), in trying to provide every child an equal chance to succeed (11). However, in this grouping approach, players born at the begin of the cut-off date are 12 months older than players born at the end of the cut-off year, thus based on the timing of one's birth within a given cohort, an individual can be relatively older or younger in comparison to their peers [11].

In youth sport, relatively older athletes are favored in terms of talent identification, selection and development opportunities, compared to the relatively younger ones [12]; indeed when observing the birth dates of young athletes selected for an elite youth team (i.e., professional club, national selections) one notices a highly skewed distribution of birth periods with relatively older players being overrepresented [1], almost as if to signify that talent - in our case soccer talent - is born in a precise period of the year. This selection bias is labelled as Relative Age Effect (RAE) and it is a well-known phenomenon among those involved in youth sports, especially when the sport being investigated is widespread and involves early selection for participation in national and international competitions [2-6].

From a theoretical point of view RAEs are the results of multiple interactions involving individual (i.e., individual's birth date, sex, physical maturation and size), task (i.e., sport type and level of competitive play), and environmental constraints (i.e., cultural popularity of a sport in a particular country or region, different policies and developmental systems of sport, a sport's maturity level and family influences) [20]. Relatively older athletes are generally assumed to be more biologically mature compared to their younger counterparts [21], but the presence of RAE also before puberty signifies that this is not a solely maturity-associated selection bias, and therefore is connected also to longer developmental advantages, greater time for practice and advanced psychosocial skills [19, 22].

In both youth and professional soccer, RAE has been a research topic since the early nineties (23-24). Indeed, soccer is probably the most researched sport throughout the RAEs literature, as research has been done across a broad range of countries and level of competition (e.g., 14; 25-28). It has been showed that higher levels of popularity, competition and selection processes focused on the short-term success are all features which can exacerbate the presence of RAE (Jackson & Comber, 2020). Indeed, RAEs are more prevalent in youth academies and clubs classified with a higher level of certification (e.g., 14; 27). Moreover, RAEs are present even at a senior level (e.g., 16; 26; 29), and recent RAEs literature highlighted how relative age influences future career outcome (30), whereby in professional soccer relatively older players earn more money, compared to the relatively younger

ones (31), and have the greatest market values (32). ~~However,~~ Furthermore, it has been hypothesized that RAE can very likely decrease the pool of available talents that nations can select from [15], as it can lead to an increase in drop-out rate from sports [33-34], and thus it is considered as an unintended form of age discrimination and talent wastage (35-36), which can clearly indicates how the "talent identification is not done on a level playing field" [37].

Italian soccer seems to be prone to RAE [26, 30]. Brustio et al., (26) found a skewed birthdate distribution in all Italian elite playing categories (both youth and senior), but no studies are still available, investigating this phenomenon over time. Therefore, our main aim was to examine the birth composition of elite Italian youth soccer teams over two seasons of a decade apart (i.e., 2010-11 and 2020-21), to investigate whether the magnitude or the presence of this bias has changed over time. We hypothesize two kind of results: (a) the decreasing of RAE in the last decade, due the increased practitioners' awareness of this bias, as RAE is a major topic in formal training courses held by the Italian Universities – Sport Sciences degrees – and the Italian Football Federation; and (b) no decreasing in RAE trends in the last decade, as a recent study have highlighted how the most important youth soccer competitions around the world are characterized by the presence of RAE, leading the authors to state that: "The new generation of professional soccer talent is born under the bias of RAE" (38).

METHODS

Participants and data collection

The study included 260 players for the 1995 class and 344 boys for the 2005 class, respectively, making a total of 604 players, representing a sample of about 18% of the entire considered population of young players engaged at this level of qualification, over the two investigated classes. This sample was recruited from 13 Italian professional soccer teams: A.C. Milan, A.C.F. Fiorentina, A.S. Roma, Benevento Calcio, F.C. Empoli, F.C. Internazionale, F.C. Juventus, Parma Calcio, Pordenone Calcio, S.S. Lazio, U.C. Sampdoria, Udinese Calcio, Vicenza Calcio. Birth dates were collected from publicly available online sources (https://www.transfermarkt.it/ and https://www.figc.it/it/home/). The use of data from open access sites has been previously described in other studies [16, 26] and there are no ethical issues involved in the analysis and interpretation of the data used as these were obtained in a secondary form and not from direct experimentation.

Procedures

After collecting the dates of birth of the players involved in this study, these were allocated to the four quarters considered – birth quarter (BQ) – for each year of birth analysed in this study (1995, 2005). This collection is representing the variable of interest of our study.

Birth Quarters considered in this study

- First quarter (BQ1) from January 1st to March 31st.
- Second quarter (BQ2) running from April 1st to June 30th.
- Third quarter (BQ3) running from July 1st to September 30th.
- Fourth quarter (BQ4) running from October 1st to December 31st.

Statistical analysis

Data were tabulated and organized in a Microsoft Excel worksheet and then reported and analysed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). For the first part of the study, chi-square (χ^2) goodness of fit tests were used to compare the observed U16 players BQ distributions (for each year of birth considered) against the expected BQ distributions. Similar to other studies [18, 26], the sample consisted of multinational players (i.e., coming from different world countries) so the expected BQ distributions were calculated on the basis of the assumption of an even distribution of births throughout each quarter of the year, because it has been showed that the births are not evenly distributed in the year and they are affected by environmental zones and cultural factors [39]. Effect sizes (ES) (Cramer's *V*), odds ratios (ORs), and 95% confidence intervals (CIs) were calculated. The Cramer's V was interpreted as follows: a value of 0.06 or more indicated a small effect size, 0.17 or more indicated a medium effect size, and 0.29 or more indicated a large effect size [40]. The ORs and 95% CIs were calculated for the quartiles (BQ1, BQ2, and BQ3) with the youngest group used as reference (BQ4), as previously conducted in other relative age studies [16, 41]. For the second part of the study, χ^2 test of independence was used to compare the BQs distributions of the selected years. For this analysis, ES was reported using Cramer's *V*. The value of statistical significance was accepted with $p < 0.05$.

A flow-chart diagram summarizing the study protocol is provided in Figure I.

PLEASE INSERT FIGURE 1 ABOUT HERE *************************

Figure I. – Flow-diagram describing enrollment, methodological investigation and analysis of the young soccer players undergone this research project.

RESULTS

Results for the first part of this study (i.e., verifying RAEs in the investigated years of the study) are shown in Table I and in Figure II. Relative age effects were detected by χ^2 goodness of fit tests, confirming significant differences in BQ distributions of the players born in 1995 (considered U16 in 2010-11 season) and in 2005 (considered U16 in 2020-21 season). In both cohorts, the ORs showed an increased likelihood of relatively older footballers of playing with the U16 elite talent clubs (U16 – 1995: BQ2 vs BQ4: OR = 3.63, 95% CI = 1.97–6.71; BQ3 vs BQ4: OR = 1.84, 95% CI = 0.96–3.55; U16 – 2005: BQ2 vs BQ4: OR = 3.21, 95% CI = 1.91–5.40; BQ3 vs BQ4: OR = 1.64, 95% CI = 0.94–2.87).

Table I. – Birthdate distribution of the U16 players (born in 1995 and in 2005) compared to the uniform distribution.

	BQ1 (expected)	BQ2 (expected)	BQ3 (expected)	BQ4 (expected)	χ^2 (df)	*p*	*V* (effect)	BQ1 vs. BQ4 OR (95% CI)
U16 – 1995	137	69	35	19	126.40	[a]0.0001	0.40	7.21
	(65)	(65)	(65)	(65)	(3)		(large)	(4.00 – 13.01)
%	52.7	26.5	13.5	7.3				
U16 – 2015	180	90	46	28	160.65	[b]0.0001	0.39	6.43
	(86)	(86)	(86)	(86)	(3)		(large)	(3.91 – 10.58)
%	52.3	26.2	13.4	8.1				

Notes: [a, b] Significantly skewed when compared to the expected distribution. (n)

PLEASE INSERT FIGURE 2 ABOUT HERE *************************

Figure II. – Observed and expected relative (%) BQs distributions of U16 players (born in 1995 and in 2005).

Regarding the results for the second part of the study (i.e., comparing the BQ distributions between players born in different years: 1995 vs. 2005), performing a χ^2 test of independence we found no significant differences between the distributions of the two groups of players ($\chi^2_{(3)} = 0.14$; $p = 0.986$; $V = 0.02$, small).

DISCUSSION

Prior works have already documented the presence of RAE in Italian soccer [26, 30], but no studies are available investigating this phenomenon over time, to explore RAEs trends. Therefore, to the best of our knowledge this was the first study, which investigated RAEs' trends over a decade, considering

the BQ distributions of two different cohorts of soccer players (born in 1995 and in 2005) and then acting as Under 16 players in the seasons 2010-11 and 2020-21, respectively.

Results showed that the BQ distributions of both cohorts are characterized by the presence of RAE, indicating how selection into elite Italian youth soccer club are influenced by players' relative ages. This study highlighted how ten years of research and dissemination of RAE, in both the academic and Italian Football Federation environments, did not change the selection mechanisms, whereby RAE was present ten years ago, and it is still present nowadays, with the same magnitude of a decade ago, indicating how youth Italian elite clubs are still favoring relatively older players. These findings are in line with other studies which tried to depict RAEs trends over time in soccer (e.g., 42-44), and ice-hockey (45), and which showed a historical no decrease of this issue. In one of the most relevant studies of RAE in soccer, Helsen and colleagues in 1998 (46) found a skewed birthdate distribution in Belgian youth players selected by first division teams, but not in players who played in regular youth leagues. More recently, in England Jackson & Comber (47) found a more pronounced RAE at academy level, compared to the grassroots level. Similar results were found in Portuguese and Scottish soccer (14, 41). Perez-Gonzalez and colleagues (38) found RAEs in four major male junior championships (i.e., FIFA U20 World Cup, UEFA U19-U21 European Championship and Conmebol U20) and concluded affirming that the new generation of soccer talent is born under the bias of RAE. Therefore, these findings taken together suggest how RAE is a global phenomenon, resulting from the strict selection-based policy, associated with competitive pressures, which characterizes most sport organizations' talent identification and development programs across the world, which striving with the limited availability of positions inform their decision-making analyzing players' current level of performance (48). When selecting players based on their current performance level, relatively older players have the greatest likelihood of being selected, as they are usually taller, heavier and able to perform best at physical fitness test compared to their younger peers (49), which is the possible cause of birthdate asymmetry found in both our cohorts.

The Italian Football Federation, in an attempt to mitigate the presence of RAE, decided to follow the recommendations delineated by Grossman and Lames (50), and opted to include the relative age phenomena into coach and practitioner education, with the aim of enhancing knowledge and understanding of RAEs. Despite this, talent detection and selection decision-making showed no changes, as results from this study clearly highlighted how selection procedures done by Italian coaches and/or scouts, are still influenced by players' relative age. Indeed, past research has already shown that coaches' knowledge of RAE and awareness of its impacts, do not eliminate or reduce the presence of this bias (51-52). Therefore coaches, yet knowing full well the RAE-related issue, decide to ignore it, by simply respond adequately and practically to the functionally perspective of the

society, whereby every aspect of society (i.e., people, social institutions, social systems) is evaluated based on its ability to meet its goal (i.e., *"is it functional?"*), meaning that in a sport context any sport performance that yields a victory is functional and preferred over a defeat [53]: as coaches' perceptions and evaluations are defined by their ability to satisfy the "need" of producing "winning" age group [54], their main focus will be that of achieving short-term success, because only by achieving it they will be able to retain their employment [37], and bring some reputational capital [55]. For this reason, rather than providing players good long term developmental experiences [54], they will tend to select the actual most proficient players (i.e., the most functional player which can best help the team winning games), in terms of maturity and fitness performances (i.e., the relatively older athletes, who are physically and functionally superior compared to their younger peers; 49), in order to win matches and leagues – right here, right now. Indeed, it has been showed by Augste & Lames (25) that selecting early born athletes is an important aspect for succeeding in youth soccer.

This is a big issue in every talent development pathway, which often are assessed by their ability to produce the few who eventually "make it", rather than against the impact they have on the many (i.e., the many who don't "make it") [56]. Whereby coaches have a strong influence on athletes but are not the one who directly influence the settings in which coaching happens, other actors and stakeholders are responsible for it, as coaches are often required to balance contradictory concerns, such as the one of fulfilling short-term success and long-term development (57). Coaching therefore can be understood as the results of intertwined goals, interests and relationships which happens in this context (58). Coaches may thus fall into the trap of sport systems which see victory, "right here, right now" as the pre-requisite for future sport success, and which value age-group coaches by their "win or loss records" [37], whose consequently start to be concerned in trying to find the best current player, rather than finding the best player for the future [59].

Concluding thoughts, in trying to answer the question we posed on the title: "Is RAE a cultural issue in talent management?", the findings from our study suggest that RAE is the resultant of the Talent Identification and Development Systems' structures, which facing with selective and competitive pressures, are mostly focused on early identification (based on current level of performance/early ability or psychological and/or anthropometrical measures) and early specialization, practices both based on the concept of deliberate practice (e.g., 5, 37, 60-63). Therefore, RAE derives from a structural issue, but that is influenced and dependent on a specific cultural approach to youth sport, whereby STDM are rooted in the 10.000 hours theory (64); it is centered on the quest of youth performance, as players in order to advance to the next developmental stage are required to attain certain performance level; and often see players as a form of capital (65), which should benefit the clubs' both financial resources and field results. Thereby, sports organizations should start trying to

ask themselves: (a) "what is youth sport for?"; and (b) "what achievement are they working for?" (i.e., performance, participation or personal development).

PRACTICAL APPLICATIONS

To move the RAE debate forward in this last section of the paper we will try to delineate some of the best practices utilized by some country to effectively counteract this issue. Lidor et al. [66], described the "open door" policy which characterizes sports in Israel, whereby children who are selected by a talent development program are encouraged to continue their sporting experience, even though they do not demonstrate the physical attributes required to achieve elite performances, so that even the late bloomers have the opportunity to train in high quality sporting environment, thus continuing to participate in sport.

Mann & Van Ginneken [67] proposed an age-ordered shirt numbering, whereby the numbers on player's shirts corresponded to their relative age. The Belgium Soccer Federation provides a system based on semester of birth rather than considering the year of birth, so limiting the effects of maturation status on the selection processes [68]. To remove particular selection times and fixed chronological age groups, Kelly et al. [69] introduced the birthday-banding whereby young athletes move up to their next birthdate group on their birthday. Lawrence et al. [70], proposed the Average Team Age (ATA) method and found that youth teams with an average age closer to the beginning of the cut-off date experienced competitive advantages. Based on this mathematical model, it has been recently proposed to set the average age of a team to a predetermined maximum [71]. Furthermore, using repeated procedures of selection and deselection through childhood and youth, to avoid early deselection and long-term continuous nurture [72] is a possible and viable solution with the aim of reducing the loss of talent.

CONCLUSIONS

This survey allows us to confirm that RAE is still a problem that characterizes the management of soccer talent in Italy, whereby ten years of research and dissemination of RAE, in both the academic and Italian Football Federation environments, did not change the selection policy associated with elite youth Italian football teams. The detrimental effects of this phenomenon are clearly evident: relatively younger players are less likely to develop in high quality training environment, compared to their relatively older peers, and this is cause of inequality. Based on the results from our study, to respond adequately to the expectations posed on them of building successful age-group teams, coaches follow the functionalist perspective of the society, and inform their decision-making searching for the best possible player, which can best help the team winning games, independently of his birthdate.

Therefore, RAE appears as the result of the standard model of talent development's structure, characterized by early identification and early specialization, influenced culturally by the concept of deliberate practice and which puts an over-emphasis on the quest of youth performance, as it is the pre-requisite for gaining access to the next developmental stages. We thereby suggest that sport organization should ask themselves what their main aim is (i.e., performance, participation and/or personal development). In the last section of the paper, we tried to suggest some practical applications, taken from previous research done on this field, which could help sport organizations and practitioners in trying to mitigate RAE presence in youth sport, and as a consequence in senior sport too.

Author contributions. B.R., A.S., G.A., G.M and L.P. have given substantial contributions to the conception or the design of the manuscript to acquisition, analysis and interpretation of the data. All authors have participated to drafting the manuscript revised it critically. All authors read and approved the final version of the manuscript.

AKNOWLEDGEMENTS

The authors wish to thank for their precious help all the players participating to the study.

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

The authors certify that there are no professional relationships with companies or manufacturers who would benefit from the results of the present study and that the results of the present study do not constitute endorsement of the product by the authors.

REFERENCES

1. Güllich A, Cobley S. On the efficacy of Talent Identification and Development Programmes. In: Baker J, Cobley S, Schörer J, and Wattie J. (editors). Routledge Handbook of Talent Identification and Development in Sport. London: Routledge: 2017.
2. Till K, Emmonds S, and Jones B. Talent identification. In: Lloyd R. and Oliver J. (editors). Strength & Conditioning for Youth Athletes. Science and Practical Aplications, 2nd Edn. London: Routledge: 2019.
3. Till K, Baker J. Challenges and [Possible] Solutions to Optimizing Talent Identification and Development in Sport. Front. Psychol. 2020;11:664.
4. Baker J, Schorer J, Wattie N. Compromising Talent: Issues in Identifying and Selecting Talent in Sport. Quest. 2018;70:1:48-63.
5. Bailey R, Collins D. The standard model of talent development and its discontents. Kinesiology Review. 2013;2(4);248–259.
6. Williams AM, Ford PR, Drust, B. Talent identification and development in soccer since the millennium. Journal of sports sciences. 2020;38(11-12);1199–1210.
7. Vaeyens R, Lenoir M, Williams AM, Philippaerts RM. (2008). Talent identification and development programmes in sport: Current models and future directions. Sports Medicine. 2008;38(9);703–714.
8. Reilly T, Bangsbo J, Franks A. Anthropometric andphysiological predispositions for elite soccer. Journal of Sports Sciences. 2000;18;669–683.
9. Federazione Italiana Giuoco Calcio [Internet]. I numeri del calcio italiano; 2021 [cited 2021 Oct 1]. Available from: https://www.figc.it/it/federazione/mission-e-governance/i-numeri-del-calcio-italiano/.
10. Federazione Italiana Giuoco Calcio [Internet]. Regolamento del Settore Tecnico; 2018. Available from: https://www.figc.it/media/105223/regolamento-st_parte-2.pdf.
11. Musch J, Grondin S. Unequal competition as an impediment to personal development: A review of the relative age effect in sport. Dev Rev. 2001;21:147–167.
12. Till K, Cobley S, Wattie N, O'Hara J, Cooke C, Chapman C. The prevalence, influential factors and mechanisms of relative age effects in UK Rugby League. Scand J Med Sci Sports. 2010;20:320-329.
13. Mujika I, Vaeyens R, Matthys SP, Santisteban J, Goiriena J, Philippaerts R. The relative age effect in a professional football club setting. J Sports Sci. 2009;27:1153-1158.
14. Figueiredo P, Seabra A, Brito M, Galvão M, Brito J. Are Soccer and Futsal Affected by the Relative Age Effect? The Portuguese Football Association Case. Front Psychol. 2021;12:679476. Published 2021 May 28.
15. Helsen WF, Thomis M, Starkes JL, et al. Leveling the Playing Field: A New Proposed Method to Address Relative Age- and Maturity-Related Bias in Soccer. Front Sports Act Living. 2021;3:635379. Published 2021 Mar 4.
16. Götze M, Hoppe MW. Relative Age Effect in Elite German Soccer: Influence of Gender and Competition Level. Front Psychol. 2021;11:587023. Published 2021 Jan 7.
17. Gutierrez Diaz Del Campo D, Pastor Vicedo JC, Gonzalez Villora S, Contreras Jordan OR. The relative age effect in youth soccer players from Spain. J Sports Sci Med. 2010;9:190-198. Published 2010 Jun 1.
18. Williams JH. Relative age effect in youth soccer: analysis of the FIFA U17 World Cup competition. Scand J Med Sci Sports. 2010;20:502-508.
19. Doncaster G, Medina D, Drobnic F, Gómez-Díaz AJ, Unnithan V. Appreciating Factors Beyond the Physical in Talent Identification and Development: Insights From the FC Barcelona Sporting Model. Front Sports Act Living. 2020;2:91. Published 2020 Jul 31.

20. Wattie N, Schorer J, Baker J. The relative age effect in sport: a developmental systems model. Sports Med. 2015;45:83-94.
21. Cobley S, Baker J, Wattie N, McKenna J. Annual age-grouping and athlete development: a meta-analytical review of relative age effects in sport. Sports Med. 2009;39:235-256.
22. Harter S. Effectance motivation reconsidered: toward a developmental model. Hum Dev. 1978;21:34–64.
23. Verhulst J. Seasonal birth distribution of West European soccer players: A possible explanation. Medical Hypotheses. 1992;38;346–348.
24. Dudink A. (1994). Birth date and sporting success. Nature. 1994;368;592.
25. Augste C, Lames M. (2011). The relative age effect and success in German elite U-17 soccer teams. Journal of sports sciences. 2011;29(9);983–987.
26. Brustio PR, Lupo C, Ungureanu AN, Frati R, Rainoldi A, Boccia G. The relative age effect is larger in Italian soccer top-level youth categories and smaller in Serie A. PLoS One. 2018;13:e0196253. Published 2018 Apr 19.
27. Bezuglov EN, Nikolaidis PT, Khaitin V, Usmanova E, Luibushkina A, Repetiuk A, Waśkiewicz Z, Gerasimuk D, Rosemann T, Knechtle B. Prevalence of Relative Age Effect in Russian Soccer: The Role of Chronological Age and Performance. International Journal of Environmental Research and Public Health. 2019; 16(21):4055.
28. Söderström T, Brusvik P, Lund S. Factors underlying competitive success in youth football. A study of the Swedish national U15 football talent system. Scandinavian Sport Studies Forum. 2019; 10;139–162.
29. Yagüe JM, de la Rubia A, Sánchez-Molina J, Maroto-Izquierdo S, Molinero O. The Relative Age Effect in the 10 Best Leagues of Male Professional Football of the Union of European Football Associations (UEFA). Journal of sports science & medicine. 2018;17(3); 409–416.
30. Lupo C, Boccia G, Ungureanu AN, Frati R, Marocco R, Brustio PR. The beginning of senior career in team sport is affected by relative age effect. Frontiers in Psychology. 2019;10, 1465.
31. Fumarco L, Rossi G. The relative age effect on labour market outcomes – evidence from Italian football, European Sport Management Quarterly. 2018;18:4;501-516.
32. Gyimesi A, Kehl D. Relative age effect on the market value of elite European football players: a balanced sample approach. European Sport Management Quarterly. DOI: 10.1080/16184742.2021.1894206. 2021.
33. Jiménez IP, Pain MT. Relative age effect in Spanish association football: its extent and implications for wasted potential. J Sports Sci. 2008;26:995-1003.
34. Vaeyens R, Philippaerts RM, Malina RM. The relative age effect in soccer: a match-related perspective. J Sports Sci. 2005;23:747-756.
35. Doyle JR, Bottomley PA, Angell R. Tails of the Travelling Gaussian model and the relative age effect: Tales of age discrimination and wasted talent. PLOS ONE. 2017;12(4): e0176206, 2017.
36. Romann M, Javet M, Cobley S, Born DP. How Relative Age Effects Associate with Football Players' Market Values: Indicators of Losing Talent and Wasting Money. Sports. 2021;9(7);99.
37. Baker J, Schorer J, Wattie N. Compromising Talent: Issues in Identifying and Selecting Talent in Sport. Quest 2018;70:48-63.
38. Pérez-González B, León-Quismondo J, Bonal J, Burillo P, Fernández-Luna Á. The New Generation of Professional Soccer Talent Is Born under the Bias of the RAE: Relative Age Effect in International Male Youth Soccer Championships. Children (Basel). 2021;8(12):1117.

39. Condon RG, Scaglion R. The ecology of human birth seasonality. Hum Ecol. 1982;10:495-511.
40. Cohen J. Statistical Power Anaylsis for the Behavioural Science, 2nd Edition. L. Erlbaum Associates; 1988.
41. Dugdale JH, McRobert AP, Unnithan VB. "He's Just a Wee Laddie": The Relative Age Effect in Male Scottish Soccer. Front Psychol. 2021;12:633469. Published 2021 Jan 28.
42. Helsen WF, Baker J, Michiels S, Schorer J, Van Winckel J, Williams AM. The relative age effect in European professional soccer: did ten years of research make any difference?. J Sports Sci. 2012;30:1665-1671.
43. Cobley SP, Schorer J, Baker J. Relative age effects in professional German soccer: A historical analysis. Journal of Sports Sciences. 2008;26;1531–1538.
44. Da Costa IT, Albuquerque RM, Garganta J. Relative age effect in Brazilian soccer players: a historical analysis. International Journal of Performance Analysis in Sport. 2012;12:3, 563-570.
45. Wattie N, Cobley S, Macpherson A, Howard A, Montelpare WJ, Baker J. Relative age and injuries in youth ice-hockey. Pediatrics. 2007;120;140–148.
46. Helsen WF, Starkes JL, Van Winckel J. The influence of relative age on success and dropout in male soccer players. American Journal of Human Biology. 1998;10;791–798.
47. Jackson RC, Comber G. Hill on a mountaintop: A longitudinal and cross-sectional analysis of the relative age effect in competitive youth football, Journal of Sports Sciences. 2020;38:11-12;1352-1358.
48. Bjørndal CT, Luteberget LS, Till K, Holm S. The relative age effect in selection to international team matches in Norwegian handball. PLoS ONE. 2018;13(12): e0209288.
49. Figueiredo AJ, Gonçalves CE, Coelho-e-Silva MJ, Malina RM. Characteristics of youth soccer players who drop out, persist or move up. J. Sports Sci. 2009;27;883–891.
50. Grossmann B, Lames M. Relative age effect (RAE) in football talents—The role of youth academies in transition to professional status in Germany. Int. J. Perform. Anal. Sport. 2013;13;120–134.
51. Hill B, Sotiriadou P. Coach decision-making and the relative age effect on talent selection in football. European Sport Management Quarterly. 2016;16:3;292-315.
52. Lund S, Söderström T. (2017). To See or Not to See: Talent Identification in the Swedish Football Association. Sociology of Sport Journal. 2017;34;1-27.
53. Delaney T. The Functionalist Perspective on Sport. In: Giulianotti R. (editor). Routledge Handbook of the Sociology of Sport. London: Routledge; 2015.
54. Martindale RJ, Collins C, Daubney J. Talent Development: A Guide for Practice and Research Within Sport. Quest. 2005;57:353-375.
55. Collins D, MacNamara A, Cruickshank A. Research and Practice in Talent Identification and Development—Some Thoughts on the State of Play. J Appl Sport Psychol. 2019;31:340-351.
56. Rongen F, McKenna J, Cobley S, Till K. Are youth sport talent identification and development systems necessary and healthy? Sports Med Open. 2018;4:18. Published 2018 May 22.
57. Bjørndal CT, Ronglan LT. Engaging with uncertainty in athlete development – orchestrating talent development through incremental leadership. Sport, Education and Society. 2021;26:1;104-116.
58. Jones RL, Wallace M. Another bad day at the training ground: Coping with ambiguity in the coaching context. Sport, Education and Society. 2005;10(1);119–134.
59. Ford PR, Bordonau JLD, Bonanno D, et al. A survey of talent identification and development processes in the youth academies of professional soccer clubs from around the world. J Sports Sci. 2020;38:1269-1278.

60. Côté J, Hancock DJ. Evidence-based policies for youth sport programmes. International Journal of Sport Policy and Politics. 2016;8:1;51-65.
61. Bjørndal CT, Ronglan LT, Andersen SS. Talent development as an ecology of games: a case study of Norwegian handball. Sport, Education and Society. 2017;22:7, 864-877.
62. Till K, Baker J. Challenges and [Possible] Solutions to Optimizing Talent Identification and Development in Sport. Front. Psychol. 2020;11:664.
63. Lascu A, Spratford W, Pyne D, Etxebarria N. Practical application of ecological dynamics for talent development in cricket. International Journal of Sports Science & Coaching. 2020;15(2):227-238.
64. Ericsson KA, Krampe RT, Tesch-Roemer C. The role of deliberate practice in the acquisition of expert performance. Psychological Review. 1993;100(3);363–406.
65. Ojala AL. Nurturing and sidelining capitalism in discourses of player potentiality in Finnish ice hockey. Sport in Society. 2021;24:9;1574-1589.
66. Lidor R, Côté J, Arnon M, Zeev A, Cohen-Maoz S. Relative age and birthplace effects in Division 1 players—do they exist in a small country? Talent Dev Excell. 2010;2:181–192.
67. Mann DL, van Ginneken PJ. Age-ordered shirt numbering reduces the selection bias associated with the relative age effect. J Sports Sci. 2017;35:784-790.
68. Royal Belgian Football Association [Internet]. 2021 [cited 2021 Oct 1]. Available from: https://www.rbfa.be/en.
69. Kelly AL, Jackson DT, Taylor JJ, Jeffreys MA, Turnnidge J. "Birthday-Banding" as a Strategy to Moderate the Relative Age Effect: A Case Study Into the England Squash Talent Pathway. Front Sports Act Living. 2020;2:573890. Published 2020 Nov 17.
70. Lawrence S, Jonker L, Verbeek J. The age advantage in youth football. In D. Karlis, I. Ntzoufras, & S. Drikos (Eds.), Proceedings of the MathSport International Congress. Athens: Propobos Publications. 2019.
71. Verbeek J, Lawrence S, van der Breggen J, Kelly AL, Jonker L. The average team age method and its potential to reduce relative age effects. In: A.L. Kelly, J. Coté, M. Jeffreys & J. Turnnidge (editors). Birth Advantages and Relative Age Effects in Sport. New York: Routledge. 2021.
72. Güllich A. Selection, de-selection and progression in German football talent promotion. Eur J Sport Sci. 2014;14:530-537.