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ORIGINAL ARTICLE

Relative age effects in Swiss junior soccer and their relationship with playing position

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Abstract
Relative age effects (RAEs) refer to age differences between children in the same selection year. The present study investigated the prevalence of RAEs and their link to playing positions in Swiss junior soccer. Swiss male junior soccer players ($n = 50{,}581$) representing 11% of the age-matched population – members of extra-curricular soccer teams – were evaluated to determine the influence of RAEs on Swiss junior soccer. Subgroups were the national talent development programme ($n = 2880$), and U-15 to U-21 national teams ($n = 630$). While no RAEs were found for the self-selected extra-curricular soccer teams or for the U-20 teams ($P > 0.05$), significant RAEs were found for talent development and the national U-15 to U-19 and U-21 teams ($P < 0.01$). Additionally, defenders born early in the year were significantly overrepresented compared with goalkeepers, midfielders and strikers ($P < 0.05$). In Switzerland, RAEs apparently have substantial influence on the talent identification process for U-15 to U-18 teams, significantly influencing the selection of players in talent development teams already at an early age, but do not influence self-selected participation in extra-curricular soccer. Additionally, the RAE bias may be a predictor of playing positions in national teams. To minimise RAEs in Swiss soccer, systematic education for all coaches regarding RAEs should be established, in addition to a slotting system with rotating calendar cut-off dates.

Keywords: *Junior soccer, birth date, player selection, playing position*

Introduction

For school or sport activities, children are grouped by age to reduce the effects of developmental differences. However, this procedure leads to age differences between individuals in the same annual cohort. This can lead to an age difference of almost 12 months between the youngest and the oldest participants in the same annual age category. The advantage of being born early within a cohort has been termed relative age effects (RAEs). Early research from 1984 until today has identified RAEs in a variety of sports, such as volleyball (Grondin, Deschaies, & Nault, 1984), baseball (Thompson, Barnsley, & Stebelsky, 1991), tennis (Edgar & O'Donoghue, 2005), ice hockey (Barnsley & Thompson, 1988) and soccer (Helsen, van Winckel, & Williams, 2005). In certain activities where physical attributes are less important, such as golf (Côté, Macdonald, Baker, & Abernethy, 2006), RAEs have not been identified. In dance, gymnastics and shooting, inverse RAEs have even been described (Baxter-Jones & Helms, 1996; Delorme & Raspaud, 2009; Malina, Bouchard, & Bar-Or, 2004). Soccer, however, is among a group of highly popular sports, such as ice hockey, with the highest prevalence of RAEs (Cobley, Baker, Wattie, & McKenna, 2009).

Different mechanisms have been proposed for explaining the causes of RAEs. Maturational differences and physical attributes (e.g. greater aerobic power, muscular strength and height) appear to be mainly responsible (Carling, le Gall, Reilly, & Williams, 2009). As RAEs are based on chronological age, relatively older children consistently have an advantage due to their extended age, favouring an advanced maturation (Schorer, Cobley, Busch, Brautigam, & Baker, 2009). It is also important to note that an even higher impact results from biological age differences, which refers to psycho-physical maturity and can lead to variations of more than 2 years

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(Malina & Bielicki, 1992). Additional explanations for relatively older children's superior performance involve psychological development, practice experience and mechanisms related to the selection processes (Musch & Grondin, 2001). Once selected, the relatively older children also experience better coaching, more positive feedback, deeper involvement and more intense competition, all of which enhance performance (Sherar, Baxter-Jones, Faulkner, & Russell, 2007). On the other hand, children with a relative age disadvantage play at a competitively lower level with less support and less training. As a consequence, those children are less likely to reach the highest levels in elite sports (Helsen, Starkes, & Van Winckel, 2000) and are more likely to drop out of a particular sport (Delorme, Boiché, & Raspaud, 2010a). In line with this assumption, Delorme et al. (2010a) observed an overrepresentation of male soccer player dropouts from the U-9 to U-18 age categories, who were born late in the selection year. Musch and Grondin (2001) described factors related to the sport setting which may increase RAEs in male sports, such as the sport's popularity, the level of competition, early specialisation, and the expectations of the coaches who are involved in the selection process. Generally, soccer's importance and popularity has increased during the last decade, resulting in a higher number of players who wish to play soccer (Cobley, Schorer, & Baker, 2008; Wattie, Baker, Cobley, & Montelpare, 2007). The increasing participation and infrastructure intensifies the competition to be selected for elite teams. Additionally, there has been an increasing emphasis on clubs to detect young players who are likely to become world-class performers (Wattie, Cobley, & Baker, 2008). Finally, in international junior soccer, there may be a focus on winning instead of developing talent for the elite stage (Helsen, Hodges, Van Winckel, & Starkes, 2000). RAEs in male soccer have been analysed in several countries, such as Belgium (Helsen et al., 1998), England (Helsen et al., 2005), Germany (Augste & Lames, 2011), France (Delorme, Boiché, & Raspaud, 2009), Spain (Jimenez & Pain, 2008). All of these studies have revealed significant RAEs in favour of players born in the first quarter of the selection year. Hence, RAEs in male soccer seem evident; therefore, young players with potential may be overlooked (Vaeyens, Philippaerts, & Malina, 2005). In previous literature, links between RAEs, maturation and playing positions have been identified, which could have biased the talent identification process. More mature players with more experience in soccer perform better in ball control by using their body size. In addition, a player's level of maturity significantly contributes to variations in shooting accuracy (Malina et al., 2005). In youth soccer, forwards were found to be significantly leaner than midfielders, defenders and goalkeepers. A discriminating variable of defenders compared to midfielders and strikers is their lower leg power (Gil, Gil, Ruiz, Irazusta, & Irazusta, 2007). Interestingly, players born late after the cut-off date have been shown to earn systematically higher wages (Ashworth & Heyndels, 2007). This effect was reported as being strongest for goalkeepers and defenders, but not evident for forwards. It was speculated that this pattern could reflect a bias in talent scouts' selection of teams and playing positions. This finding is consistent with Grondin and Trudeau (1991), who demonstrated a link between ice hockey players' RAEs and playing positions. In their analysis, the RAEs were strongest among defenders and goalkeepers. Moreover, physical attributes and playing positions have been found to be related to the magnitude of RAEs in both handball (Schorer et al., 2009) and rugby (Till et al., 2009). However, whether there is a link between RAEs and playing positions in male soccer has not been analysed to date.

In Switzerland, soccer is the largest sport federation with 50,581 registered male soccer players ranging from 10 to 20 years of age, representing 11% of the age-matched Swiss population. Despite the country's small population (7.7 million), the Swiss senior team was listed 13 January 2010 in the FIFA world ranking, and the Swiss U-17 team won the European Cup in 2002 and the World Cup in 2009. Due to this achievement, Tschopp, Biedert, Seiler, Hasler, and Marti (2003) assumed that the Swiss soccer federation may have a relatively efficient and successful talent development system. However, to our knowledge, RAEs in Swiss soccer have not been analysed to date.

Given the relevance of RAEs and their potential for introducing a bias to the talent identification process, an examination of RAEs in the entire setting of Swiss male junior soccer seems warranted. Therefore, the aim of this study was to examine the prevalence and size of RAEs at the different performance levels of Swiss junior soccer and their relationship with playing positions.

Methods

Participants

The Swiss system of talent identification, selection and development is based on three levels of performance (Figure 1). The first level is a nationwide extra-curricular programme (level 1) called 'Jugend und Sport' ('J + S'), which is for all children who are interested in a specific sport. Soccer is one of 77 disciplines available. The minimum duration for a 'J + S' course is at least 30 weeks per year with one

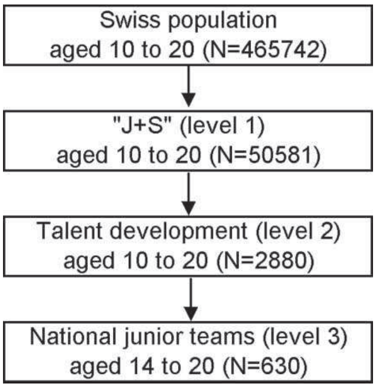

Figure 1. Overview of the different levels of selection in Swiss junior soccer.

training session per week. Every soccer training session has to last at least 60 minutes.

'J + S' contains $n = 50{,}581$ registered male soccer players ranging from 10 to 20 years of age, which is 10.8% of the male Swiss population ($n = 465{,}742$). Data for 'J + S' were obtained from the Swiss Federal Office of Sport. The Swiss population was defined as the number of live male births in Switzerland. All data for the corresponding Swiss population (10–20 years old) were obtained from the Swiss Federal Statistical Office.

The second level of performance is the national talent detection and development programme (level 2) of 'J + S'. These players ($n = 2880$), ranging from 11 to 20 years of age (U-12 to U-21), are assisted by licensed soccer trainers and are expected to train more than 400 hours per year (Swiss Federal Office of Sport, 2010). The cut-off criterion of 400 hours and the age range of 11–20 years for adoption into the programme were jointly established by the Swiss Soccer Association and the Swiss Olympic Association. The junior national teams ($n = 630$) represent the third level (level 3) of performance. The inclusion criterion for a national team player was being selected as a Swiss national under-15 (U-15), under-16 (U16), under-17 (U17), under-18 (U18), under-19 (U19), under-20 (U20) and under-21 (U-21) team member in the 2007–2008, 2008–2009 and 2009–2010 seasons. All data for the Swiss population, 'J + S' and the talent development programme of 'J + S' involve the 2009–2010 season. Each player was presented only once in the analysis.

In total, we examined seven Swiss national U-teams' birth date distributions for each of three seasons (21 in total) to calculate the relationship between RAEs and playing positions. Comparisons were carried out between the datasets of the junior national teams, players in the talent development programme, all registered players of 'J + S' and the entire male Swiss population.

Procedure

The 50,581 soccer players registered in the Swiss Youth Sport database were grouped according to the selection period's month. The birth month of each player was recorded to define the birth quarter (Q). The cut-off date for all soccer leagues in Switzerland is 1 January. Thus, the first selection year month was 'month 1' (January), while 'month 12' (December) represented the last month. The year was divided into four quarters (Q1 represents January, February and March; Q2 represents April, May and June; Q3 represents July, August and September; and Q4 represents October, November and December).

The observed birth date distributions of all players were calculated for each quarter. The expected distributions were recorded from representative birthdates of Swiss children using weighted mean scores (Helsen et al., 1998) and the Swiss Youth Sport database, where all players who participate in organised soccer activities are registered. The Swiss Youth Sport database was analysed to verify equal distribution between all registered 'J + S' players' birthdates (10–20 years of age) and all corresponding birthdates for the Swiss male population (also 10–20 years of age). Consistent with Delorme, Boiché, & Raspaud (2010b), we used the distribution of 'J + S' (all registered players) as a basis (expected distributions) to evaluate RAEs. If a biased distribution already existed among the entire population of registered players ('J + S'; level 1), the same pattern would arise among the elite (level 3) as well, and could bias the conclusions drawn about RAEs among the elite. From these original data, odds ratios (ORs) were calculated for Q1 versus Q4. When comparing quartiles in all OR analyses, 'J + S' were assigned as the referent group.

All statistical analyses were carried out using SPSS 16.0. χ^2 tests were used to assess differences between the observed and expected birth date distributions. When significant, post hoc tests were used to determine the mean differences between quarters. In addition, effect sizes were computed to qualify the χ^2 test results. The appropriate index of effect size is the phi coefficient (f) if there is one degree of freedom (df), and Cramer's V (V) is appropriate if the df > 1 (Aron, Aron, & Coups, 2002).

For the χ^2 analyses, the magnitude of the effect size was measured using f and V. According to Cohen (1977) and Cramer (1999), for df = 3 (which is the case for all comparisons of birth quarters), V = 0.06–0.17 indicated a small effect, V = 0.18–0.29 noted a medium effect, and V $\geq$ 0.30 illustrated a large effect. An alpha level of $P < 0.05$ was applied as the criterion for statistical significance.

Results

Prevalence of RAEs in Swiss junior soccer

As Table I shows, there were neither RAEs nor significant differences between the distribution of the Swiss population and all 'J + S' registered players (selection level 1) ($P > 0.05$). The birth date distributions of the talent development teams and of the national U-15 to U-21 selections are also presented in Table I. In all selected teams examined (except the U-20 team), Q1 elite players were significantly overrepresented and Q4 elite players were significantly underrepresented compared to 'J + S' ($P < 0.01$). The talent development teams showed a distribution of more than 35% in Q1, and less than 15% in Q4, which differs significantly from the 'J + S' distribution ($P < 0.001$). The RAE was large for U-15 to U-18 teams, medium for U-19 and U-21 teams, and small for U-20 teams. Significant RAEs were found for the national junior selections in the U-15, U-16, U-17, U-18 and U-19 groups. The peak of the RAEs was found in the U-18 team, where 76% of the players were born in the first half of the year. No RAEs were found for the teams in the U-20 age group. Apart from the 'J + S' players and the U-20 team, the χ^2 and post hoc tests highlighted an overrepresentation of players born at the beginning of the selection year and a decreasing number of players born in subsequent quarters.

While we found no RAEs in 'J + S' players (selection level 1), RAEs were present in the U-12 talent development team (selection level 2). Specifically, more than 70% of the players were born in the first half of the year, as shown in Figure 2. The RAEs decreased slightly in the U-14 talent development team. Afterwards, the RAEs increased to a peak value in the U-18 talent development team. Specifically, more than 75% of the players were born in the first half of the year. In the U-20 and the U-21 talent development teams, RAEs were no longer statistically significant (Figure 2).

Playing positions

The birth date distributions for playing positions in the elite U-15 to U-21 teams are presented in Figure 3.

Chi-square tests showed significant differences between defenders, goalkeepers, midfielders and strikers compared to the 'J + S' distribution ($P < 0.001$). Defenders, midfielders and strikers were overrepresented at the beginning of the selection year, and in each case, a decreasing number of players were born in the subsequent quarters. Only goalkeepers had a peak in birthdates in Q2. In a second analysis, we calculated the distribution of birth dates between the different playing positions. Defenders were significantly ($P < 0.05$) overrepresented in the first half of the year (79%) compared to strikers (57%). The remaining comparisons were not significant.

Discussion

Prevalence of RAEs in Swiss junior soccer

We found substantial and consistent RAEs as early as the second and third levels of junior soccer selections, that is, in the entire sample of talent development teams, and in all elite Swiss junior soccer teams with the exception of the U-20 teams. In addition, we demonstrated that there is link between RAEs and playing positions in Swiss junior soccer.

Despite a systematic, nationwide and multi-level talent identification and selection system in Switzerland, RAEs are not lower comparison to other nations described in the literature (Cobley et al., 2009). It seems that the national effort in talent development, with its particular focus on technical soccer skills, game intelligence and the weighting of physical attributes (e.g. leg power normalised for body weight), could not reduce the biological advantage of being older.

'J + S' teams, which represent the entire, regularly playing junior soccer population on selection level 1,

Table I. Birth date distributions of Swiss junior soccer teams, expressed as annual quarters (Q)

Team	Q1 (%)	Q2 (%)	Q3 (%)	Q4 (%)	Total	χ^2	P	V	OR
SP(10–20)	115,494 (24.8)	119,738 (25.7)	119,626 (25.7)	110,884 (23.8)	465,742				
J + S(10–20)	12,801 (25.3)	12,980 (25.7)	12,942 (25.6)	11,858 (23.4)	50,581	7.2	>0.05	0.01	
TD(10–20)	1090 (37.8)	802 (27.8)	589 (20.5)	399 (13.9)	2880	366.4	<0.001	0.21	2.53
U-15	59 (52.7)	22 (19.6)	20 (17.6)	11 (9.8)	112	48.2	<0.001	0.38	4.97
U-16	43 (45.7)	26 (27.7)	14 (14.9)	11 (11.7)	94	26.9	<0.001	0.31	3.62
U-17	44 (52.4)	15 (17.9)	14 (16.6)	11 (13.1)	84	34.0	<0.001	0.37	3.71
U-18	43 (42.6)	34 (33.7)	15 (14.9)	9 (8.9)	101	30.1	<0.001	0.32	4.43
U-19	32 (39.5)	25 (30.9)	12 (14.8)	12 (14.8)	81	14.7	<0.01	0.25	2.47
U-20	18 (27.7)	16 (24.6)	18 (27.7)	13 (20)	65	1.0	>0.05	0.07	1.28
U-21	37 (39.8)	11 (11.8)	27 (29.0)	18 (19.4)	93	16.4	<0.001	0.24	1.90

Note: SP = Swiss population; J + S = Players of extra-curricular soccer teams; TD = Players of talent development teams; U-15 to U-21 = Players of national under-15 to under-21 teams; $\chi2$ = Chi-square; P = significance; V = Cramer's V; OR = Odds ratio of Q1 vs. Q4.

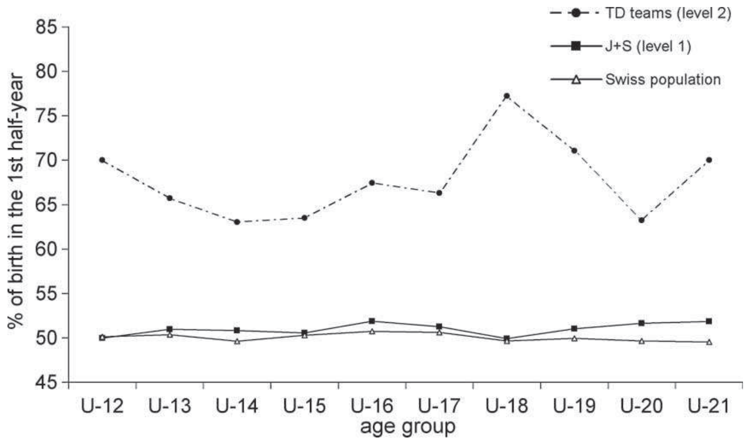

Figure 2. Distribution of births in the first half year of age-specific talent development teams (level 2) compared to the Swiss population and all registered 'J + S' players (level 1).

showed no evidence of RAEs and did not differ significantly from the Swiss population. In contrast to this finding, Delorme et al. (2010b) showed that RAEs exist among the entire population of French licensed players. Given that the Swiss population and all 'J + S' players are equally distributed, it can be assumed that talent is also equally distributed over time (Vaeyens, Lenoir, Williams, & Philippaerts, 2005). Our results support the presence of moderate RAEs in talent development teams, as 70% of these players were born in the first half of the year. Hence, in Switzerland, RAEs appear as soon as the first step of talent selection – out of the self-selected 'J + S' players' pool (level 1) – has been effected by the talent development team coaches (level 2).

At the junior national team level (level 3), Q2, Q3 and Q4 had a shortfall of 1%, 6% and 12% (in total 19%), respectively, compared to the Swiss population. As a consequence, it seems that in Swiss junior soccer, many talented players (19%) are not selected for the junior national team level and, therefore, get less support.

In particular, the RAEs influence the selection process of elite Swiss soccer, and affect the with large consequences for U-15 to U-18 teams. The ratio of being selected to a Swiss national U-15 team is 2.1 for a player born in Q1, and 0.4 for one born in Q4. Accordingly, the OR of being selected for the Swiss U-15 team for a player born in Q1 compared to Q4 is almost fivefold. This ratio is among the highest worldwide (Cobley et al., 2009; Helsen et al., 2005; Jimenez & Pain, 2008). In contrast, for the U-20 team, RAEs were not significant and the effect size was small. This may be due to statistical reasons, that is the small number of evaluated players ($n = 65$). Moreover, in the U-20 and U-21 teams, 98 of the 158 players (62%) were selected for the first time. We suppose that the high dropout rates for U-20 and U-21 players and the large number of new players may be an additional reason for the drop in

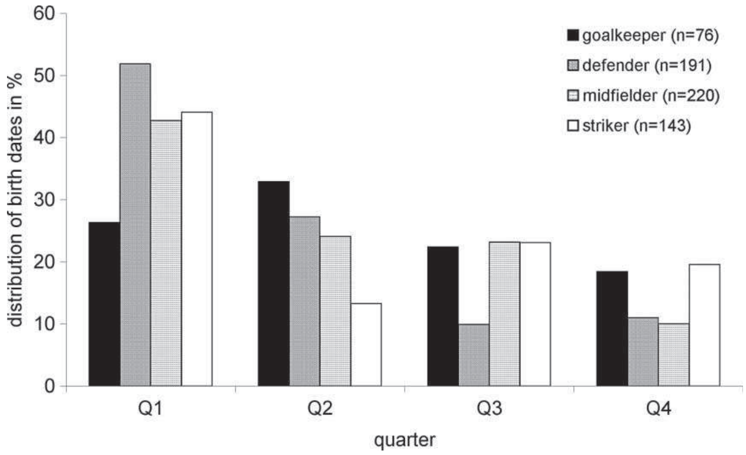

Figure 3. Distribution of playing positions and birth quarters in U-15 to U-21 teams (level 3). Significant overrepresention of early born defenders compared to strikers ($p < 0.05$).

RAEs. In this age group of U-20 teams, the majority of players are fully mature, which reduces RAEs (Cobley et al., 2009).

Our data suggest that playing positions are associated with the prevalence and size of RAEs in soccer. In the present study, we demonstrate that in Swiss junior soccer, defenders show a significantly stronger RAE compared to goalkeepers, midfielders and strikers. Previous research on ice hockey has suggested that the magnitude of RAEs may relate to the context's physical demand and the player's position (Grondin & Trudeau, 1991). Recently, Schorer et al. (2009) showed that the RAEs of handball players playing on the left wing are stronger than that of players on the right wing. These results provided evidence that height, laterality and position affect the magnitude of RAEs in handball. RAEs also appear to be inflated when positions or roles are physically intensive. This is in line with the observation that tall soccer players also tend to have an advantage, especially as goalkeepers and central defenders (Di Salvo et al., 2007). Swiss goalkeepers at the professional senior level are among the smallest in Europe (Besson, Poli, & Ravenel, 2010), which could partially explain why no differences between goalkeepers and other playing positions could be found in the present study. Sherar et al. (2007) suggested that maturational differences lead to an increased likelihood of being identified as talented and selected by coaches for higher tiers of competition. Additionally, Ashworth and Heyndels (2007) assumed that talent scouts looking for young talent are more biased in their evaluation of different playing positions. In line with these findings, Swiss coaches may tend to select relatively older players who are taller and more mature as defenders.

Possible solutions

Several solutions to reduce RAEs have been proposed in the literature. One solution is to establish 'current' and 'potential' teams: the 'current' team contains the best players, both technically and physically, at the selection time, while the 'potential' team contains players who are technically skilled, but who are lacking in terms of their physical development (Brewer, Balsom, & Davis, 1995). Barnsley and Thompson (1988) have suggested creating more age categories with a smaller bandwidth (e.g. half a year rather than one). This change would result in smaller RAEs and fewer physical differences between players within any specific age category. A single change in the selection date would result in an equal shift of RAEs (Helsen et al., 2000). Therefore, (Grondin et al., 1984) described an alteration of the activity year's cut-off dates. A yearly rotation for the cut-off date might work, because all players would then experience the advantage of a higher relative age at some point in their soccer career (Hurley et al., 2001). One potential solution could be to change the mentality of youth team coaches (Helsen et al., 2000). Coaches should pay more attention to technical and tactical skills when selecting players, as opposed to over-relying on physical characteristics such as height and strength. Additionally, they should find a better balance between short-term success and a more process-oriented approach to instruction (Helsen et al., 2005).

The challenge for Switzerland will be to keep players who are physically or psychologically disadvantaged due to RAEs involved in the sport until they have fully matured. In the current Swiss system, players who are accepted on elite teams start benefiting quite early from receiving more support, a higher level of competition, increased training, longer playing times, more positive feedback and improved coaching, as observed previously (Sherar et al., 2007). Further, unselected players may tend to have lower self-esteem and show higher dropout rates (Helsen et al., 1998). Delorme et al. (2010a) illustrated that dropout rates result from two major processes. First, children born late in the selection year may be less likely to join a sport in which weight, height or strength could be seen as relevant for performance. Second, those who are involved in a sport are more likely to drop out and have fewer chances to be selected. It is important to note that the first phenomenon cannot be solved by federations reducing the RAEs (Delorme et al., 2010a).

The decrease in RAEs may substantially enhance performance at the elite senior level in the future, especially for Switzerland, which has a rather shallow talent pool due to the limited number of inhabitants. Interestingly, in the current Swiss coach education programme, only junior national level coaches are confronted with RAEs during their education. According to our data, these coaches on 'level 3' already acquire some junior soccer players from 'level 2', that is, the talent development teams, a level that is clearly influenced by RAEs. Therefore, in our estimation, the consequences of RAEs should be taught at all levels of coach education. From our point of view, implementing rotating calendar cut-off dates and furthering the education of all soccer coaches may counteract future RAEs in Swiss soccer. In Switzerland, the talent identification and player development should be viewed as more long-term processes. In contrast to aspects of performance, skill and potential, assessments should be emphasised (Vaeyens, Lenoir, Williams, & Philippaerts, 2008). In any case, it would be a significant step forward for coaches and federations to attempt to select the teams with the highest potential in future elite soccer instead of the team with the highest chance of winning at present (Helsen et al., 2000).

Limitations

Our study has several limitations. First, this study simply examines RAEs in Swiss soccer during the 2009–2010 season, which is not necessarily a reflection of the general situation over a longer time period. A second limitation is that our data did not include specific match-based values (e.g. the number of matches played). These data may provide a more complete picture of RAEs (Vaeyens et al., 2005).

Main findings and conclusion

Based on the present data, we argue that RAEs significantly bias the selection process of elite junior soccer in Switzerland as early as 10 years of age. Our results indicate that RAEs have a moderate to significant influence on the talent identification process. In addition, we have demonstrated that there is a link between RAEs and playing positions. Significantly higher RAEs were observed for defenders compared to goalkeepers, midfielders and strikers.

In particular, those born early in the calendar year are almost five times more likely to be selected to the Swiss national U-15 soccer team, which is one of the highest values reported in Europe. The RAEs are evident in talent development teams below 12 years of age, and seem to be greatest around 18 years of age (more than three quarters of the selected players were born in the first half of the year). To minimise RAEs in Swiss soccer, systematic training for all coaches regarding RAEs and a more equitable slotting system with rotating calendar cut-off dates should be established. Furthermore, the talent selection process should be optimised and developed into a more long-term and multidisciplinary approach.

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