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Influences of player nationality, playing position, and height on relative age effects at women's under-17 FIFA World Cup

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Abstract

Previous research has shown that young male soccer players who are born early in a cohort are overrepresented on elite soccer teams. Selection advantages such as this have been termed 'relative age effects' (RAEs). Few studies have examined RAEs in elite women's youth soccer. Therefore, the aim of this study is to investigate the occurrence of RAEs in the Fédération Internationale de Football Association (FIFA) U-17 Women's World Cup competition and their link to playing positions. In the entire cohort of 672 players, we found significant RAEs in the geographical zones of Europe and North and Central America, no RAEs in the zones of Asia, Oceania, and South America, and significant inverse RAEs in the zone of Africa. Additionally, significant RAEs were found for goalkeepers and defenders from Europe and North and Central America. Inverse RAEs occurred for African goalkeepers, defenders, and strikers. Goalkeepers of all zones were significantly taller than players of all other playing positions. The results of this study show that remarkable RAEs do exist at elite women's youth soccer. Similar to men's soccer, there is a bias toward the inclusion of relatively older players, and a link between RAEs and playing positions.

Keywords: *talent development, female soccer, birth date, playing position*

Introduction

During the early stages of life, children are grouped into age categories based on specific cut-off dates. In schools and in almost all organised-sports institutions, age groupings are established to ensure that every child has an equal chance of participation and success. For international youth soccer, the Fédération Internationale de Football Association (FIFA) uses a system with January 1 as the cut-off date to establish its age groups. However, such a procedure can result in large age differences of almost 12 months between the youngest and the oldest players in the same annual cohort. The consequences of such age differences are called relative age effects (RAEs).

Different mechanisms have been proposed to specify the causes of RAEs. Maturational differences and physical attributes (e.g., greater aerobic power, muscular strength, and height) appear to be mainly responsible (Cobley, Baker, Wattie, & McKenna, 2009). Since 1984, research has continued to identify the occurrence of RAEs within a variety of sports at the junior level (Cobley et al., 2009). While RAEs have been investigated extensively in male sports, only two per cent of such research has analysed RAEs in women's sports (Cobley et al., 2009). In the existing literature, inconsistent RAEs have been observed in elite women's sports. For example, RAEs have been reported in women's junior tennis (Baxter-Jones & Helms, 1996) and Canadian ice hockey (Weir, Smith, & Paterson, 2010); however, no RAEs were identified in a historical analysis of Canadian female ice hockey players (Wattie, Baker, Cobley, & Montelpare, 2007). Furthermore, it has been shown that no – or possibly inverse – RAEs exist for women participating in dance and gymnastics (Baxter-Jones & Helms, 1996; van Rossum, 2006).

Although there has been exponential growth worldwide in the number of women playing soccer (FIFA, 2008), it has been observed that research regarding the effect of an athlete's gender on RAEs remains neglected (Cobley et al., 2009; Musch & Grondin, 2001). To our knowledge, only four studies to date have investigated RAEs in women's soccer. In one, RAEs were observed among all registered female players ($n = 57{,}892$) in the French Football Federation (Delorme, Boiché, & Raspaud, 2010b). The study revealed significant RAEs in all

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youth categories ranging from under-8 to under-17 years, including all skill levels from amateur to elite players. In a second study, no RAEs were found among adult female soccer players ($n = 242$) playing in the highest league of French female soccer (Delorme, Boiché, & Raspaud, 2009). In another study, Vincent and Glamser (2006) compared RAEs among 1,344 elite male and female soccer players of the U-17 US Olympic Development Program. In their study, marginal RAEs were shown for girls at the national ($n = 39$) and regional ($n = 71$) levels, and no RAEs were shown for those playing at the state level ($n = 804$). Romann and Fuchslocher (2011) detected significant RAEs among all registered female soccer players ($n = 2987$) and a subgroup of players of a talent development program ($n = 450$) in the 10 to 14 years age category. It was speculated that the RAEs emerged by self-selection and the possible higher drop-out rate of players with a 'young' relative age. No significant RAEs were found among all registered female players aged 15 to 20 years ($n = 3242$) and the U-17 and U-19 national teams ($n = 167$).

In previous literature, links between male RAEs, maturation, and playing positions have been identified, which could have biased the talent-identification process. Players who are more mature and who have more experience in soccer demonstrate better ball control, because they are able to use their body size. In addition, a male player's level of maturity significantly contributes to variations in shooting accuracy (Malina et al., 2005). In boys' soccer, forwards have been found to be significantly leaner than midfielders, defenders, and goalkeepers. A discriminating variable of male defenders compared to midfielders and strikers is their lower leg power (Gil, Gil, Ruiz, Irazusta, & Irazusta, 2007). Interestingly, male soccer players with 'old' relative age have been shown to earn systematically higher wages (Ashworth & Heyndels, 2007). This effect was reported as being strongest for goalkeepers and defenders, but was not shown for forwards. It was speculated that this pattern could reflect a bias in talent scouts' selections of teams and playing positions. This finding is consistent with Grondin and Trudeau (1991), who demonstrated a link between male ice hockey players' RAEs and playing positions. In their analysis, the RAEs were strongest among defenders and goalkeepers. Moreover, in both men's handball (Schorer, Cobley, Busch, Brautigam, & Baker, 2009) and men's rugby (Till et al., 2009), physical attributes and playing positions are related to the magnitude of RAEs. To our knowledge, only one study has analysed the link between RAEs and playing positions in women's soccer. For Swiss elite women's soccer players, Romann and Fuchslocher (2011) identified RAEs among all playing positions. Defenders and goalkeepers had significantly higher RAEs compared to midfielders in junior and elite Swiss national teams.

Given the relevance of RAEs and their potential for introducing a bias in talent identification, it is worth examining RAEs within the setting of the FIFA under-17 soccer World Cup. The purposes of this study were twofold: first, to examine the occurrence and size of RAEs in national teams participating in the FIFA Women's World Cup and, second, to identify if playing positions modify the occurrence and size of RAEs.

Method

The past two FIFA U-17 Women's World Cup competitions, which took place in 2008 and 2010, were analysed. Rosters with player birth dates were obtained from the FIFA website (www.fifa.com). All team rosters and all players who were registered for the tournament were included. This comprised a total of 32 teams with 21 players each. Nine countries participated in both tournaments (2008 and 2010), 13 countries participated just once. For the purpose of analysis, the birth month, birth year, height, and playing position of all 672 female soccer players from 22 countries and six FIFA zones were recorded. All federations of each participating country accepted the FIFA regulations and confirmed to provide birth dates of players from official written records (FIFA, 2009).

Chi-square analyses were used to determine if observed distributions were statistically different from the expected distributions. National teams were sub-grouped using the FIFA-designated geographical zone, country, and playing positions. The FIFA zones and countries analysed were Africa (Ghana, Nigeria, and South Africa), Asia (Japan, Korea DVR, and the Korea Republic), Europe (Denmark, England, France, Germany, Ireland, and Spain), North and Central America (Canada, Mexico, Trinidad and Tobago, and the USA), South America (Brazil, Chile, Colombia, Paraguay, and Venezuela), and Oceania (New Zealand). According to Delorme et al. (2010b), generally the distribution of all registered players should be used to calculate the expected distributions for the analysis of RAEs. If a biased distribution already existed among the entire population of registered players, the same pattern would arise among the elite as well, and bias the conclusions drawn about RAEs among the elite. In this study, neither the birth dates of all registered players, nor the distribution of live births in the countries were available. In this case, currently published studies perform all analyses with the theoretical assumption that birth dates are equally distributed across all quarters (25 per cent per quarter) (Cobley et al., 2009; Helsen, van Winckel, & Williams, 2005). This assumption should be valid, because in most countries birth dates for humans are equally distributed over the year and do not have significant seasonal variations (Brewis, Laycock, & Huntsman, 1996; Lam & Miron, 1991; Pascual, 2000; Roenneberg & Aschof, 1990).

Procedure

The birth month of each player was recorded to define their birth quarter (Q). As the cut-off date in all FIFA soccer tournaments is January 1, the first month of the selection year was month one (January), while month twelve (December) represented the last month of the selection period. This procedure was performed for all players of the team rosters, like in the majority of existing RAEs studies (Cobley et al., 2009). In some team rosters, there were players younger than 16 years who were also included in the study. 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.

From these original data, chi-square tests and odds ratios (ORs) were calculated (all statistical analyses were carried out using SPSS 16.0). Chi-square tests were used to assess differences between the observed and expected birth date distributions. Also, differences of body heights across birth quarters were analysed with one-way analysis of variance (ANOVA). If significant, Tukey's post-hoc tests were used to determine the mean differences. In addition, effect sizes were computed in order to qualify the results of the chi-square tests. If the *degree of freedom* is above 1, then the appropriate index of effect size is Cramer's V (V) (Aron, Aron, & Coups, 2002). For the chi-square analyses, the magnitude of the effect size was measured using V. According to Cohen (1977) for $df = 3$ (which is the case for all comparisons of birth quarters), $V = 0.06$ to 0.17 describes a small effect, $V = 0.18$ to 0.29 describes a medium effect, and $V \geq 0.30$ describes a large effect. An alpha level of $P < 0.05$ was applied as the criterion for statistical significance.

Results

As can be seen in Table I, in an analysis of all the national teams participating in the FIFA U-17 Women's World Cup, no significant RAEs occurred except for Ireland, Trinidad and Tobago, Ghana, and Nigeria.

Ireland and Trinidad and Tobago showed large, regular RAEs; players born at the beginning of the year being overrepresented. Ghana and Nigeria showed large, inverse RAEs, having an overrepresentation of players born at the end of the year. The subgroups of the FIFA geographical zones varied – from significant, medium RAEs among players from Europe and small RAEs among players from North and Central America, on the one hand, to a lack of significant RAEs among players in Asia, Oceania and South America (Table II) on the other. In contrast to these findings, the African players showed significant, inverse RAEs.

These inverse RAEs existed in the western African countries of Ghana and Nigeria, but not in South Africa. The birth dates of players from Nigeria were extremely different from the expected distribution, with 55% of the players having been born in Q4, and 43% having been born in the month of December.

Playing positions and RAEs

The analysis of playing positions was performed in three groups. The first group includes Europe and North and Central America, which show significant RAEs. The second group is comprised of Asia, Oceania, and South America, where no RAEs occur. The third group is formed by Africa, where significant inverse RAEs occur. Among European teams and North and Central American teams, we found significant RAEs regarding goalkeepers ($V = 0.38$) and defenders ($V = 0.21$) but no RAEs regarding midfielders and strikers (Table III). Among teams in Asia, Oceania, and South America, no significant RAEs were observed regarding any playing positions (Table IV). Among African teams, large, inverse RAEs occurred regarding goalkeepers ($V = 0.45$), defenders ($V = 0.37$), and strikers ($V = 0.36$), but there were no RAEs regarding midfielders (Table V).

Playing positions and height

Among all FIFA U-17 soccer players who were analysed, goalkeepers were significantly taller than defenders, midfielders, and strikers. Also, defenders were significantly taller than midfielders. Within the subgroups of the FIFA geographical zones, similar results were found. Goalkeepers from Africa, North and Central America, and Oceania were significantly taller than midfielders. Goalkeepers from Asia, Europe, and South America were significantly taller than defenders, midfielders, and strikers. Additionally, defenders from Asia were significantly taller than strikers.

In a second analysis, we compared players' heights among the different FIFA geographical zones

Table I. RAEs of national teams participating at FIFA U-17 World Cup.

Country	Q1	Q2	Q3	Q4	Total	χ^2	OR Q1/Q4	V	Effect
Brazil	15	11	8	8	42	3.1	1.88	0.2	no
(%)	35.7	26.2	19.0	19.0					
Canada	14	15	8	5	42	6.6	2.80	0.2	no
(%)	33.3	35.7	19.0	11.9					
Chile	4	6	8	3	21	2.8	1.33	0.2	no
(%)	19.0	28.6	38.1	14.3					
Colombia	9	5	4	3	21	4	3.00	0.3	no
(%)	42.9	23.8	19.0	14.3					
Costa Rica	7	5	7	2	21	3.2	3.50	0.2	no
(%)	33.3	23.8	33.3	9.5					
Denmark	6	9	4	2	21	5.1	3.00	0.3	no
(%)	28.6	42.9	19.0	9.5					
England	3	3	8	7	21	4	0.43	0.3	no
(%)	14.3	14.3	38.1	33.3					
France	6	9	4	2	21	5.1	3.00	0.3	no
(%)	28.6	42.9	19.0	9.5					
Germany	17	10	10	5	42	7	3.40	0.2	no
(%)	40.5	23.8	23.8	11.9					
Ghana	3	7	14	18	42	13	0.17	0.3	large
(%)	7.1	16.7	33.3	42.9					
Ireland	10	8	2	1	21	11	10.00	0.4	large
(%)	47.6	38.1	9.5	4.8					
Japan	12	12	12	6	42	2.6	2.00	0.1	no
(%)	28.6	28.6	28.6	14.3					
Korea DVR	10	13	10	9	42	0.9	1.11	0.1	no
(%)	23.8	31.0	23.8	21.4					
Korea Rep.	16	10	8	8	42	4.1	2.00	0.2	no
(%)	38.1	23.8	19.0	19.0					
Mexico	6	4	9	2	21	5.1	3.00	0.3	no
(%)	28.6	19.0	42.9	9.5					
New Zealand	8	13	9	12	42	1.6	0.67	0.1	no
(%)	19.0	31.0	21.4	28.6					
Nigeria	5	7	7	23	42	20	0.22	0.4	large
(%)	11.9	16.7	16.7	54.8					
Paraguay	3	6	6	6	21	1.3	0.50	0.1	no
(%)	14.3	28.6	28.6	28.6					
South Africa	7	2	6	6	21	2.8	1.17	0.2	no
(%)	33.3	9.5	28.6	28.6					
Spain	7	6	8	0	21	n.d.	n.d	n.d	no
(%)	33.3	28.6	38.1	0.0					
Trinidad and Tobago	11	2	2	6	21	10	1.83	0.4	large
(%)	52.4	9.5	9.5	28.6					
USA	5	8	5	3	21	0	1.67	0	no
(%)	23.8	38.1	23.8	14.3					
Venezuela	6	6	4	5	21	0.1	1.20	0	no
(%)	28.6	28.6	19.0	23.8					

Note: Q1 to Q4 = birth quarter 1 to 4; χ^2 = Chi^2-value; P = significance; OR = Odds ratio; V = Cramer's V; $^*P < 0.05$; $^{**}P < 0.01$.

grouped by playing position (Table VI). Goalkeepers from Africa were significantly shorter than goalkeepers from Europe, Asia, and South America. Defenders and midfielders from Africa were also shorter than defenders from all other zones.

Discussion

The results of this study show that no RAEs occurred in teams participating in the FIFA U-17 Women's World Cup except in Ireland, Trinidad and Tobago, Ghana, and Nigeria. However, remarkable RAEs existed within the FIFA geographical zones. Players from Europe and North and Central America showed significant RAEs, while no RAEs were found in Asia, Oceania, and South America. Significant inverse RAEs occurred in Africa. Additionally, RAEs and players' heights seem to be linked to playing positions in women's soccer.

As previously shown, no RAEs were observed in most of the elite national teams (Delorme et al., 2010b; Vincent & Glamser, 2006; Romann & Fuchslocher, 2011). One potential reason for the absence of RAEs may be that compared to male

Table II. RAEs of FIFA zones participating at the FIFA U-17 World Cup.

Zone	Q1	Q2	Q3	Q4	Total	χ^2	OR Q1/Q4	V	Effect
All players	190	177	163	142	672	7.5	1.34	0.06	no
(%)	28.3	26.3	24.3	21.1					
All players without Africa	175	161	136	95	567	26.1**	1.84	0.12	small
(%)	30.9	28.4	24.0	16.8					
Africa	15	16	27	47	105	25.2**	0.32	0.28	medium†
(%)	14.3	15.2	25.7	44.8					
Asia	38	35	30	23	126	4.1	1.65	0.10	no
(%)	30.2	27.8	23.8	18.3					
Europe	49	45	36	17	147	16.6**	2.88	0.19	medium
(%)	33.3	30.6	24.5	11.6					
North and Central America	43	34	31	18	126	10.2*	2.39	0.16	small
(%)	34.1	27.0	24.6	14.3					
Oceania	8	13	9	12	42	1.6	0.67	0.11	no
(%)	19.0	31.0	21.4	28.6					
South America	37	34	30	25	126	2.6	1.48	0.08	no
(%)	29.4	27.0	23.8	19.8					

Note: Q1 to Q4 = birth quarter 1 to 4; χ^2 = Chi^2-value; OR = Odds ratio; V = Cramer's V; *$P < 0.05$; **$P < 0.01$. † = inverse relative age effect.

Table III. Distribution of birth-dates subdivided by playing positions in Europe and North and Central America.

Playingposition	Q1	Q2	Q3	Q4	Total	χ^2	P	OR Q1/Q4	V	Effect
Goalkeepers	9	20	8	2	39	17.3**	<0.01	4.50	0.38	large
(%)	23.1	51.3	20.5	5.1						
Defenders	33	21	22	11	87	11.2**	<0.01	3.00	0.21	medium
(%)	37.9	24.1	25.3	12.6						
Midfielders	27	19	21	12	79	5.8	>0.05	2.25	0.16	no
(%)	34.2	24.1	26.6	15.2						
Strikers	22	19	16	10	67	4.7	>0.05	2.20	0.15	no
(%)	32.8	28.4	23.9	14.9						

Note: Q1 to Q4 = birth quarter 1 to 4; χ^2 = Chi^2-value; OR = Odds ratio; V = Cramer's V; *$P < 0.05$; **$P < 0.01$.

Table IV. Distribution of birth-dates subdivided by playing positions in Asia, South America and Oceania.

Zone	Q1	Q2	Q3	Q4	Total	χ^2	OR Q1/Q4	V	Effect
Goalkeepers	16	9	12	5	42	6.2	3.20	0.22	no
(%)	38.1	21.4	28.6	11.9					
Defenders	24	27	18	20	89	2.2	1.20	0.09	no
(%)	27.0	30.3	20.2	22.5					
Midfielders	30	27	26	25	108	0.5	1.20	0.04	no
(%)	27.8	25.0	24.1	23.1					
Strikers	14	19	13	10	56	3.0	1.40	0.13	no
(%)	25.0	33.9	23.2	17.9					

Note: Q1 to Q4 = birth quarter 1 to 4; χ^2 = Chi^2-value; OR = Odds ratio; V = Cramer's V; *$P < 0.05$; **$P < 0.01$.

soccer, there is less competition and less selection among girls to gain a position on an elite women's soccer team (Delorme et al., 2009). This is in line with Musch and Grondin (2001), who proposed that the high popularity of a sport and a high participation in that sport increase RAEs. It is important to note that the number of players in individual team rosters are very small, which may additionally explain why no significant RAEs occurred in most counties.

Nevertheless, four out of the 22 teams showed significant RAEs. Therefore, the analysis of the FIFA geographical zones with higher numbers of players may lead to a complementary interpretation of the data.

Table V. Distribution of birth-dates subdivided by playing positions in Africa.

Playing position	Q1	Q2	Q3	Q4	Total	χ^2	OR Q1/Q4	V	Effect
Goalkeepers	1	1	5	8	15	9.3*	0.13	0.45	large
(%)	6.7	6.7	33.3	53.3					
Defenders	8	4	5	18	35	14.0**	0.44	0.37	large
(%)	22.9	11.4	14.3	51.4					
Midfielders	4	7	9	8	28	2.0	0.50	0.15	no
(%)	14.3	25.0	32.1	28.6					
Strikers	2	4	8	13	27	10.5*	0.15	0.36	large
(%)	7.4	14.8	29.6	48.1					

Note: Q1 to Q4 = quarter 1 to 4; χ^2 = Chi^2-value; OR = Odds ratio; V = Cramer's V; *$P < 0.05$; **$P < 0.01$.

Table VI. Height of players classified by FIFA zones and playing positions.

Playing position	**G**	**D**	**M**	**S**	**Total**	**Anova**	**Post-hoc**
	height mean $\pm s$						
All players	170 ± 5	165 ± 7	163 ± 5	164 ± 7	165 ± 6	**	G>D,M,S; D>M
Africa	165 ± 4	161 ± 6	159 ± 4	162 ± 6	161 ± 6	**	G>M
Asia	170 ± 4	165 ± 4	162 ± 5	161 ± 6	164 ± 6	**	G>D,M,S; D>S
Europe	172 ± 6	168 ± 7	166 ± 5	164 ± 7	167 ± 7	**	G>D,M,S
North and Central America	169 ± 4	166 ± 7	164 ± 5	166 ± 7	166 ± 6	*	G>M
Oceania	171 ± 2	168 ± 6	164 ± 4	166 ± 6	166 ± 5	*	G>M
South America	172 ± 6	165 ± 5	163 ± 5	163 ± 7	165 ± 6	**	G>D,M,S

Note: G = Goalkeeper; D = Defender; M = Midfielder; S = Striker; s = Standard deviation; *$P < 0.05$; **$P < 0.01$.

RAEs in European and North and Central American players

The analysis of the geographical FIFA zones revealed significant RAEs for Europe and North and Central America. One explanation could be that relatively older players are more likely to be identified by coaches as 'talented' and to be selected for all-star or representative teams (Helsen, Starkes, & Van Winckel, 1998). Selection for an elite team is often linked to more positive effects, including more opportunities to play and practise, better coaching, higher competition, and a greater amount of positive feedback (Cobley et al., 2009). These positive effects are increasingly advantageous for the relatively older players: early success often promotes the athlete's further physical and psychological investment in the sport, resulting in a greater likelihood of continuing to play. Other psychological effects, such as increased perceptions of competence (Vincent & Glamser, 2006), higher involvement, and increased self-esteem (Thompson, Barnsley, & Battle, 2004) are positively related to an 'old' relative age.

It is important to note that due to possible self-selection, coaches of talent-development programmes may need to carry out their selections using a pool of players whose birth dates are already unequally distributed, which could increase RAEs at elite levels. This phenomenon has been shown in French women's soccer for all youth age categories and in Swiss women's soccer in the 10 to 14 years age category (Delorme et al., 2010a; Romann & Fuchslocher, 2011). In other words, female players born in the first half of the selection year may be more likely to begin playing soccer compared to their younger counterparts. Those born in Q3 and Q4 show a kind of self-deselection process before even trying to play soccer. Additionally, they are more likely to drop out and become unavailable for selection (Delorme et al., 2010a). Given that France is just one out of 22 participating countries from which the data of all registered players in the federation is published, no conclusions can be drawn to the whole sample of all participating countries. Therefore, more research is needed to investigate the impact of RAEs among all registered players on the respective elite teams.

A possible explanation for the absence of RAEs in the zones of Asia and Oceania might be that soccer is less popular and there is a lack of opportunity to play at a professional level and in professional leagues compared to in Europe and North and Central America. In Asia and Oceania just 2.2% and 4.7% respectively of the total population are registered soccer players, while in Europe and in both North and Central America and South America 7.3% and 7.4% respectively are registered (FIFA, 2008). Additionally, it can be speculated that early talent detection and early streaming into talent-development programmes is carried out more often in Europe and North and Central America compared to the other FIFA zones, which could cause an increase in RAEs (Vaeyens, Lenoir, Williams, & Philippaerts, 2008).

Inverse RAEs in western Africa

An essential finding of the present study is the inverse RAEs within the western African zone. This phenomenon is recognised as existing in men's soccer, but it has never been shown in women's soccer (Williams, 2009). Studies of vital registration in African countries indicate that only 19 to 57% of people have official birth certificates (Akande & Sekoni, 2005; Dow, 1998; Morris, Black, & Tomaskovic, 2003; Ndong, Gloyd, & Gale, 1994). Therefore, the speculation by Williams (2009) that there may be errors in the reporting of valid birth dates seems reasonable. Interestingly, the birth date distribution in Nigeria, with 43% of all players being born in the month of December, is remarkable and extremely different from the expected distribution. In addition, the analysis of all players shows no RAEs, but when calculated without African players small RAEs exists (Table II). According to Onis et al. (2007), it can be expected that 16-year-old players born at the beginning of the selection year (Q1) are approximately two centimetres taller than those born at the end of the selection year (Q4). This assumption is true for the mean height of players from non-African countries, who are 166 $\pm$ 7 cm if born in Q1 and 164 $\pm$ 6 cm if born in Q4. Contrary to this, African players born in Q1 are 162 $\pm$ 5 cm and have the same height as those players born in Q4 (162 $\pm$ 5 cm). Thus, the potential for error in the reported birth dates of African players may be large. However, it has to be mentioned that height is just an approximation of age and maturation. As suggested by Williams (2009), more work is needed in order to understand the atypical distribution of birth dates in African countries.

Waste of potential talent

To optimise talent-development systems in women's soccer, the challenge is twofold. On one hand, it seems important to include players in soccer activities at an early age if they have a 'young' relative age. On the other hand, it is crucial to keep players involved in soccer after puberty ends. Regarding senior elite women's youth soccer, there are a number of negative consequences of RAEs. Many relatively younger players, who have the potential to be elite adult players, may drop out before their full potential is realised. This seems to be the case in women's youth soccer (Delorme et al., 2010b; Romann & Fuchslocher, 2011) as well as in women's youth ice hockey (Weir et al., 2010). Jimenez and Pain (2008) argued that the current identification and development process, which allows age bias, results in 'wasted potential'. It could be assumed that if women's soccer grows in popularity and if talent-development programmes become increasingly structured, RAEs will increase too. In any case, it would be a significant step forward to select players who will have the greatest potential in elite soccer in the future, instead of selecting players with the highest chance of winning in the present (Helsen et al., 1998).

RAEs and playing positions

In the present study, playing positions were interrelated with the occurrence and size of RAEs in women's soccer. Goalkeepers and defenders in the European and North and Central American zone showed large RAEs. Recently, Romann and Fuchslocher (2011) observed significant RAEs among Swiss female soccer players in all playing positions – RAEs of defenders and goalkeepers were significantly higher than those of midfielders in junior and elite national teams. It was speculated that the coaches of Swiss women's soccer teams may tend to select relatively older goalkeepers and defenders, who are taller and more mature. In the present study, goalkeepers from all zones were significantly taller than players of all other playing positions. Additionally, defenders were taller than midfielders. This is in line with an observation by Di Salvo et al. (2007), who demonstrated that tall male soccer players tend to have an advantage, especially if they are goalkeepers or central defenders. Similarly, Baker, Schorer, Cobley, Brautigam, and Busch (2012) examined US national-level female youth and adult soccer players. For the youth athletes, RAEs were found for all player positions (goaltending, midfield, forward, and defence), but for the adults, RAEs emerged only for the goalkeepers and defenders. Interestingly in the present study, it was most common for goalkeepers to be born in Q2. This confirms the findings by Baker et al. (2012) and those by Weir et al. (2010), who described an overrepresentation of elite female goalkeepers in Q2. This phenomenon may result from a skewed basic population of female soccer players like in France and Switzerland, where the basic population of registered female soccer players shows an overrepresentation of players born in Q2 (Delorme et al., 2010a; Romann & Fuchslocher, 2011). In these studies, it is speculated that soccer as a contact sport may be considered gender-inappropriate for women and that social pressures may prevent females from achieving excellence in competitive sport. In addition, the physical characteristics needed for athletic performance are sometimes inconsistent with the stereotyped idea of an ideal female body which is expected to be thin and tiny in western countries (Choi, 2000). This conflict could lead elite female players to drop out from soccer. Vincent and Glamser (2006) suggested that especially early maturing and relatively 'older' (Q1) females trying to conform to gender-based stereotypes could drop out from elite sports.

In brief, early physical development may act as a socially constructed disadvantage for young women during puberty and may result in a higher dropout rate of Q1 players. Nevertheless, this interpretation remains speculative, and more research is needed to examine the 'ifs' and 'why' Q1 female players are underrepresented in basic populations of soccer players.

Our study has several limitations. First, this study simply examines RAEs in the national teams during the 2008 and 2010 World Cup, which is not necessarily a reflection of the general situation over a longer time period. A second limitation is that the sample size in several teams is low; therefore we included all players in the analysis and combined the teams into the geographical FIFA zones. FIFA uses January 1 already in younger age categories in all the FIFA zones, but especially in the African zone only a small proportion of the players are registered, therefore the cut-off dates for talent development remain uncertain (FIFA, 2004). A final limitation is the assumption that birth dates in the basic population are equally distributed, but this procedure is generally used in RAEs studies when data of the distribution of all licensed players and the population data are not available (Cobley et al., 2009).

Main findings and conclusion

Overall, the current results demonstrate that RAEs do exist in elite women's youth soccer in Europe, in North and Central America and (inversely) in Africa, but do not occur in Asia, Oceania and South America. Based on the present data, we argue that RAEs bias the selection process of elite under-17 women's soccer players in Europe, North and Central America, and (inversely) Africa. It could be assumed that if female soccer grows in popularity and if talent-development programmes become increasingly structured, RAEs will also increase. RAEs may bias the talent selection of women's soccer, and it seems evident that in Europe and North and Central America Q1 and Q2 players are overrepresented, whereas Q4 players are underrepresented. This may lead to a loss of potential players in the elite stage. Additionally, significant RAEs were observed in goalkeepers and defenders from Europe and North and Central America. Moreover, goalkeepers of all zones were significantly taller than players of all other playing positions. These data suggest that, similar to men's soccer, there is a bias toward the inclusion of relatively older players and there is a link between RAEs and playing positions in elite women's soccer.

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