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Gender differences in the relative age effect among US Olympic Development Program youth soccer players

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Abstract

A large body of research has shown that a disproportionate number of elite youth male soccer players competing in age-segmented competition are born early in the selection year. The advantage of being born early in a cohort has been termed the "relative age effect". Although there has been an exponential growth in women's soccer, few studies have examined the relative age effect in female youth soccer. This study compared the relative age effect of 1344 female and male youth soccer players considered by the US Olympic Development Program (ODP), in 2001, to be the most talented soccer players born in 1984. The birth dates were taken from the women's state and regional ODP, and national team rosters, and were analysed using basic descriptive statistics and chi-square tests. Results revealed only a marginal relative age effect for female ODP regional and national team players and no relative age effect for female ODP state team players. In comparison, a strong relative age effect was found in male state, regional and national team players. The results suggest that there are gender differences in the relative age effect of 17-year-old elite female and male soccer players. The gender differences may be explained by a complex interaction of biological and maturational differences with socialization influences.

Keywords: *Relative age effect, association football, soccer, talent identification and development*

Introduction

Children are frequently grouped by age for school or sport activities to improve the control of the effects of developmental differences. However, even when groupings are limited to one-year categories, intellectual, physiological and psychological differences can be great (DeMeis & Stearns, 1992). The oldest children can be almost a year older than the youngest children and the advantage of being born early within a cohort has been termed the "relative age effect" or the "birth date effect".

Educational research has shown that relative age is an important factor in academic performance (Bigelow, 1934; Uphoff & Gilmore, 1986). Students who enter school at age 6 score better on achievement tests in that grade and in the fourth grade compared with students who began school at age 5 (Davis, Trimble, & Vincent, 1980). Children in gifted programmes often entered school when they were relatively old (Maddux, Stacy, & Scott, 1981). At the other end of the performance spectrum, children with learning disabilities are over-represented among children born later in the academic year (Diamond, 1983). There is ample evidence that being a few months older than one's peers is advantageous in the acquisition of academic skills (Bisanz, Morrison, & Dunn, 1995). Having a birthday soon after the selection date for entry into school is thus an advantage, while a birthday just before the selection date is a disadvantage.

The relative age effect has also been found in physical education performance. A study of British 16-year-olds taking the General Certificate of Secondary Education (GCSE) tests in physical education performance revealed strong relative age effects both for female and male pupils (Bell, Massey, & Dexter, 1997). The impact of birth date was greater than the effect of sex. In other words, the oldest girls performed better than the youngest boys. Also, the effect of age was greater among boys than among girls. The authors suggested that although the differences observed by month of birth could simply be the effect of developmental advantages, they could also reflect training advantages gained from selection for various teams and competition at an earlier age, which was related to their relative maturity at that time.

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English high school sports teams' birth dates were analysed to determine if the members of school teams differed in season of birth from those not selected. At a large comprehensive school, boys born in the first third of the school year were approximately twice as likely as those born in the final third to be on the rugby or soccer teams (Wilson, 1999). Girls born in the first third of the school year were three times more likely to be on the field hockey or netball teams than the youngest girls (Wilson, 1999). Wilson noted that while the benefits of physical maturation are clear, one must also consider psychological factors. Initial successes could increase confidence and motivation, which in turn could lead to additional successes. Once a person has been selected for a team, he or she becomes known to selectors, and thus is likely to be considered in the future. Correspondingly, younger players who are not initially selected for competitive teams might become discouraged enough to drop out of sport altogether.

Youth sport programmes use selection dates to ensure that children will receive age-appropriate instruction and to allow for fair competition. However, a large body of research has made it clear that the age differences within a year can have large effects on sports success, especially at elite levels. The discovery of the relative age effect in youth sport came as the result of an analysis of the birthdays of professional hockey players in Canada. Barnsley, Thompson and Barnsley (1985) found that these players were much more likely to have been born early in the calendar year than in later months. First quarter birthdays were twice as common as last quarter birthdays.

In a follow-up study, it was found that the relative age effect was even greater among elite youth teams (Barnsley & Thompson, 1988). In the case of 9- and 10-year-olds, almost 70% of the top players were born in the first half of the year and only 10% had birthdays in the last quarter of the year. In contrast, the relative age effect was not evident in professional hockey in the 1960s (Daniel & Janssen, 1987). This suggests that the regimentation and sophistication of youth hockey in recent decades is a factor in producing the relative age effect.

Once the relative age effect in sports was discovered, researchers began investigating the effect in various sports around the world. An excellent review of that body of research was conducted by Musch and Grondin (2001). Their review presented evidence of a strong relative age effect in soccer, ice hockey, swimming and tennis. The evidence for a strong relative age effect in men's professional soccer was overwhelming. Male professional players in the UK, Belgium, Australia, Brazil, France, Netherlands, Germany and Japan were more likely to have a birthday in the first half of the soccer year than in the second half. The percentage of players with birthdays in the first half of the soccer year was near 60% in most studies (Musch & Grondin, 2001).

The data for elite male youth soccer players in Europe reveal an even stronger relative age effect (Musch & Grondin, 2001; Simmons & Paull, 2001). Studies of elite male youth soccer players in the UK, Sweden and Belgium found approximately 70% had birthdays in the first half of the soccer year. A literature review of the various factors relevant to the early identification of soccer talent by Williams and Reilly (2000) makes it clear that advanced physical maturation and stature are important in the selection of elite male youth soccer players. Children born early in the selection year are greatly advantaged. Williams and Reilly also note a "residual bias" that accrues from being selected very early in this process.

The overwhelming majority of research on the relative age effect has focused on elite male athletes. However, as part of the Training of Young Athletes (TOYA) longitudinal study, Baxter-Jones and Helms (1994) carried out one of the few studies examining the relative age effect in elite female athletes. Their investigation of the distribution of the birth dates of elite British female gymnasts, swimmers and tennis players aged 8–16 years found that almost 50% of the female swimmers and tennis players were born in the first 3 months of the selection year. However, the female gymnasts' birth dates were evenly distributed throughout the year. The rationale given for this result was that late physical development and maturation are advantageous for elite female gymnasts. The authors suggested that the relative age effect might be stronger in male youth sports than female youth sports because competition in male youth sports was more intense, girls mature earlier and there is greater variability in the maturity of boys.

Theoretical framework

The theoretical underpinnings of the relative age effect are in the concepts of developmental advantage, socialization and the Pygmalion effect or self-fulfilling prophecy. In the initial stages of the selection of young athletes, a 6- to 12-month developmental advantage can be decisive. Slightly older participants tend to possess physical and psychological advantages that make their selection more likely. Once young players are selected for elite sport participation, they are socialized into the appropriate skills, techniques and attitudes for later success by capable coaches. This specialized socialization process is not experienced by players not selected for elite teams. The absence of this early experience puts younger players who were not initially selected at risk of non-selection at subsequent player evaluations. Over time, that disadvantage builds.

Harter's (1978) competence motivation theory suggests that athletes who perceive that they are able to perform at a high level and think that they are talented are more likely to continue perfecting their abilities and invest more time and effort into their sport with predictable results. Thus, early selection for elite sport participation can become a self-fulfilling prophecy for athletes and coaches. As the identity of previously selected players becomes known to coaches and administrators, they watch those players more closely so that they do not miss an elite performer. Thus, players with talent will not be overlooked in subsequent selection processes.

The reason that the discovery of the relative age effect in organized sport, which is a recent phenomenon, is important is that it implies that talented but physiologically and psychologically immature individuals could have developed given an opportunity, but are overlooked because they are born late in the selection year, especially in sports where height, body mass, strength and power are an advantage. The long-term result of the relative age effect could be a lowering in the overall quality of the highest competitive teams. This problem was recognized by the English Football Association, which, as a result, in the mid-1990s, implemented a body mass matching programme at their national male youth team trials, to try to ensure that players were selected predominantly on their technical ability and tactical application (Simmons & Paull, 2001).

Significance

The significance of this study is underscored by the growth of women's soccer that has benefited considerably from gender equity legislation in the United States. Title IX of the Education Amendments Act (1972) outlawed sex discrimination in publicly funded educational institutions. This has fuelled an exponential increase in female youth, high school and college soccer teams throughout the United States in the last 30 years. The growing international popularity of women's soccer was acknowledged by Sepp Blatter, who, in 1999, was elected President of FIFA, soccer's worldwide governing body. He predicted that the future of soccer, the world's most popular spectator sport, would be feminine and that by 2010 the women's World Cup would be as important as the men's competition.

Although the last two decades have produced a plethora of research examining the relative age effect in male youth soccer players, especially in Europe, there has been a relative dearth of studies examining the same effect in female youth soccer players and few comparisons between the sexes. Both Williams and Reilly (2000) and Simmons and Paull (2001) emphasized the importance of extending the body of knowledge related to talent identification and development in youth sport to address issues related to female youth soccer players. Musch and Grondin (2001) suggested that future research should focus on the relative age effect in female youth sport to compare the influence of gender on the relative age effect.

Olympic Development Program

The Olympic Development Program (ODP) is organized by the US Youth Soccer Association (USYSA) to identify and train the most talented female and male youth soccer players in the country. The ultimate goal of the ODP is to provide the respective age-segmented and senior national teams with quality players to represent the United States in FIFA competitions and the Olympic Games. The ODP is recognized as the premier soccer talent identification and development system in the United States. Many of the US women's senior national players are products of this system, and they have dominated women's international soccer competitions in the last decade.

Organizationally, the ODP operates at three hierarchical levels: state, regional and national. Across the United States, each state association holds regular ODP training sessions and try-outs both for female and male soccer players in five segmented age-groups, (under-13 through under-17). At these training sessions and try-outs, the players are evaluated on their technique, tactical application, attitude, fitness and athletic ability by nationally licensed coaches. The most able are then selected for the state team. At the regional level, the ODP is divided into four regions: East, Midwest/North, South and West. Each region holds an annual regional camp that state association ODP teams, in each eligible age group, attend. The regional camps are designed to provide quality training, coaching and competition for the participants. They also allow regional and national staff coaches to identify the most able players for possible future inclusion in National camp, pool or team participation. The most able players are selected for four regional team pools. These players are considered to be the most talented players available in an entire region, and are invited to inter-regional events, where the national team coaching staff members observe, train and identify players for inclusion in the age-segmented and full national teams. ODP soccer uses 1 January to 31 December for its selection year to comply with recent practice used in international FIFA youth competitions.

Aims of the study

This study, which is the the second in a series, investigated the relative age of female ODP state, regional and national pool team players, born in 1984, to determine if the birth date distribution pattern found in elite male youth soccer players also extended to elite female players. Based on the results of previous research on the relative age effect on elite male youth athletes, two research questions were developed:

1. Is the birth date distribution of female ODP state, regional and national team pool soccer players, born in 1984, skewed towards the first part of the selection year?
2. How do the birth date distributions for female ODP state, regional and national team pool players, born in 1984, compare with those of their male peers?

Methods

Data collection

Birth dates were acquired from the rosters of female and male ODP state and regional player pools for the four US Youth Soccer Federation regions: East, Midwest/North, South and West. In addition, birth dates were acquired from the rosters of the US women's under-19 and men's under-17 national team pools. The US women's under-19 national team roster was examined because, in 2001, a separate under-17 women's national team pool did not exist. However, the best female under-17 players (born in 1984) were members of the under-19 women's national team pool and their birth dates were acquired from the roster of the under-19 women's national team pool. By including all the players on all the state, regional and national team pools, we have the national population of elite female and male soccer players born in 1984.

Rationale

The rationale for analysing the birth date distribution of elite female and male youth soccer players born in 1984 was that, in 2001, at the age of 17 nearly all the young women and men were entering their senior year of high school. This is the time when interest is greatest in college scholarships on the players' part and in player evaluation by college coaches. This ensures maximum participation by all parties. After this year, most of the players will be playing college soccer and will have less incentive to participate in a summer programme. In younger groups, players might be willing to miss a summer programme for various reasons in the knowledge that the critical year is the senior year in high school.

Procedure and data analyses

The birth dates of female and male ODP state and regional players, the women's under-19 national pool team players and the men's under-17 national pool team players, born in 1984, were tabulated by month. These categories were compiled into quarters reflecting the ODP soccer year, which starts on 1 January and ends on 31 December. Thus, the first quarter comprised January, February and March, and the fourth quarter comprised October, November and December. Regional birth date distributions (East, Midwest/North, South and West) are indicated for the female state and regional ODP players for information purposes only (see Tables I and II). The results are presented with basic descriptive statistics such as frequency counts and percentages. Additionally, chi-square tests were performed to compare differences between the observed and expected birth date distributions across the four quarters of the ODP soccer year. Statistical significance was set at $P \leqslant 0.05$.

Before undertaking an analysis of the birth month of elite youth soccer players, it is necessary to examine the distribution of all female and male births throughout the year in 1984. Although births

Table I. Quarterly birth rate distribution of female ODP state team players born in 1984, by region.

Region	Quarter				Total
	First	Second	Third	Fourth	
East	68	72	65	64	269
Midwest	40	57	53	42	192
South	33	41	39	38	151
West	65	41	46	40	192
Total	206	211	203	184	804
	(25.6%)	(26.2%)	(25.2%)	(23%)	(100%)

$\chi^2 = 2.080$, d.f. $= 3$, $P = 0.556$.

Table II. Quarterly birth rate distribution of female ODP regional team players born in 1984, by region.

Region	Quarter				Total
	First	Second	Third	Fourth	
East	8	5	2	3	18
Midwest	6	7	2	2	17
South	0	5	5	8	18
West	6	6	4	2	18
Total	20	23	13	15	71
	(28.2%)	(32.4%)	(18.3%)	(21.1%)	(100%)

$\chi^2 = 3.535$, d.f. $= 3$, $P = 0.316$.

are evenly distributed across the year, there are seasonal patterns in the United States. In order, the three months with the most births are August, September and July. The three months with the fewest births from least to most are February, April and January. In 1984, 48% of births occurred in the first 6 months of the year, and the first quarter had the fewest total births (US Department of Health and Human Services, 1988). Thus, any relative age effect favouring early months in the year occurs in spite of fewer births. Additionally, a comparison of the national distribution of births for females and males born in 1984 revealed a consistent pattern of 105 males born for every 100 females throughout the year.

Results

This study examined the distribution of 1344 birth dates of female and male under-17 state and regional ODP as well as national team players.

The first research question guiding this study asked whether the birth date distribution of female ODP state, regional and national team players, born in 1984, was skewed towards the first part of the selection year, indicating the presence of a relative age effect. Analysis of the female ODP state team players' birth dates revealed an equitable distribution, with 206 (25.6%) birthdays in the first quarter, 211 (26.2%) birthdays in the second quarter, 203 (25.2%) birthdays in the third quarter, and 184 (23%) birthdays in the fourth quarter (see Table I). The chi-square test revealed no differences in the quarterly birth date distribution of the 804 female ODP state team players ($\chi^2 = 2.080$, d.f. $= 3$, $P = 0.556$).

Analysis of the quarterly birth date distribution of the 71 female ODP regional team players, born in 1984, revealed no differences ($\chi^2 = 3.535$, d.f. $= 3$, $P = 0.316$), with 20 (28.2%) birthdays in the first quarter, 23 (32.4%) birthdays in the second quarter, 13 (18.3%) birthdays in the third quarter, and 15 (21.1%) birthdays in the fourth quarter (see Table II). However, half-yearly comparisons revealed that 43 (60.6%) of the players were born between January and June and the remaining 28 (39.4%) players were born between July and December. Although the chi-square test revealed no difference in the quarter birth date distribution, a one-tailed chi-square test comparing the first two quarters and the last two quarters found that more birth dates occurred in the first two quarters ($\chi^2 = 3.169$, d.f. $= 1$, $P = 0.038$).

Several researchers have reported that that the relative age effect intensifies with competition for male athletes (Grondin, Deshaires, & Nault, 1984; Musch & Grondin, 2001). This finding suggests that competition for places is an important factor in the relative age effect phenomenon for elite female youth ODP players. Additionally, the finding that the 71 birth dates of the female ODP regional team players were skewed towards the first two quarters of the selection year occurred even though many of the players competing for selection to ODP state and regional teams were products of select clubs teams that use 1 August to 31 July as their selection year. This means that the oldest players in the club system are the youngest in the ODP; thus when selections are made for the state and regional ODP teams, there should be plenty of players with late birthdays available for selection. This underscores the strength of the relative age effect.

Although there was no under-17 women's national team in 2001, the best female players born in 1984 were members of the under-19 women's national team pool in 2001. Tracey Leone, the under-19 women's national team coach, used a pool of 39 players, born in 1985, 1984 and 1983, to prepare for the inaugural FIFA Women's Youth World Championship, which the United States won in 2002. The chi-square test revealed no differences in the quarterly birth date distribution of the 39 players in the under-19 women's national team pool ($\chi^2 = 6.436$, d.f. $= 3$, $P = 0.092$). The birth date distribution of the 18 players in the under-19 women's national team pool, born in 1984, also revealed no relative age effect, with 8 (44%) players born in the first two quarters of the selection year and 10 (56%) players born in the last two quarters of the selection year. However, the birth date distribution of the eldest 17 players, born in 1983, indicated the presence of a relative age effect, with 12 (71%) players born in the first two quarters and 5 (29%) players born in the last two quarters of the selection year. A one-tailed chi-square test comparing the 12 birth dates occurring in the first two quarters with the 5 birth dates occurring in the last two quarters of the players born in 1983 revealed a difference ($\chi^2 = 2.882$, d.f. $= 1$, $P = 0.045$). It is also noteworthy that a comparison of the quarterly birth date distribution of all the members of the under-19 women's national team pool revealed that the fourth quarter contained the fewest birth dates (see Table III).

The second research question guiding this study asked how the birth date distribution of female ODP state, regional and national pool players, born in 1984, compared with that of their male peers. For comparison purposes, this study analysed the birth month of the 259 male ODP region II (Midwest) state team players born in 1984 and found that the quarterly birth date distribution was skewed. This indicated the presence of a relative age effect, with 101 (39%) of the players born in the first quarter,

Table III. Quarterly birth rate distribution of the women's under-19 national team pool, by year of birth.

Year	Quarter: First	Second	Third	Fourth	Total
1983	8	4	4	1	17
1984	5	3	7	3	18
1985	2	0	1	1	4
Total	15	7	12	5	39
	(38.5%)	(17.9%)	(30.8%)	(12.8%)	(100%)

$\chi^2 = 6.436$, d.f. = 3, $P = 0.092$.

Table IV. Quarterly birth rate distribution of the men's under-17 national team pool, born in 1984.

	Quarter: First	Second	Third	Fourth	Total
1984	13	2	5	4	24
	(54.2%)	(8.3%)	(20.8%)	(16.7%)	(100%)

$\chi^2 = 11.667$, d.f. = 3, $P = 0.009$.

58 (22%) born in the second quarter, 43 (17%) born in the third quarter and 57 (22%) born in the fourth quarter of the selection year ($\chi^2 = 29.232$, d.f. = 3, $P < 0.001$).

A previous study by Glamser and Vincent (2004) that investigated the birth date distribution of male soccer players selected for the four under-17 regional ODP pool teams revealed that their birthdays were heavily skewed towards the first half of the year, indicating the presence of a relative age effect. The first quarter contained 54 (37%) birth dates and the second quarter contained 48 (33%) birth dates, thus 102 (69%) of 147 male players were born in the first two quarters of the selection year. The third quarter contained 27 (18%) birth dates and the fourth quarter contained 18 (12%) birth dates ($\chi^2 = 23.694$, d.f. = 3, $P < 0.001$). Male ODP regional team soccer players born in January were over five times more likely to be selected for the national player pool than their cohort peers born in December. The pattern of birth months did not follow the linear decline seen in many studies of male athletes. Although January was the highest, all the months up to and including July were high. All the months from August to December were low and less than half the mean of the first 7 months (16.29). Thus, being born in the first 7 months of the year appears to be the critical advantage in this male population.

An analysis of the birthdays of the 24 members of the US men's under-17 national pool, born in 1984, revealed the presence of a relative age effect, with 13 (54%) of the 24 players being born in the first quarter ($\chi^2 = 11.667$, d.f. = 3, $P = 0.009$). Although the pattern of birth months did not follow the linear decline seen in many studies of male athletes, only four (16.6%) national team players were born in the last quarter, with none having birthdays in November or December (see Table IV).

The results of this study provide empirical evidence of the relative age effect for under-17 ODP male soccer players, born in 1984, at state and regional levels as well as those elite players in the US men's national under-17 team, in 2001. In comparison, analysis of the birth date distribution of state and regional under-17 ODP female soccer players, born in 1984, revealed no relative age effect in the state ODP players and only the marginal presence of a relative age effect for the female regional ODP players. Analysis of the birth dates of the 18 members of the under-19 women's national team, in 2001, who were born in 1984, revealed no relative age effect. However, the relative age effect was found in the birth date distribution of their 17 peers who were born in 1983. Comparisons of the relative age effect of female and male, state and regional ODP and national pool team players, expressed as percentages, are shown in Figures 1, 2 and 3.

Discussion

Although there might be many reasons for the gender differences found in the relative age effect of ODP youth soccer players, some researchers have explained the relative age effect for male athletes simply in terms of the physical maturation advantage that those athletes who are born early in the selection year have over their younger cohorts. As this study provides empirical evidence that in comparison to their male peers the relative age effect is weaker for 16- and 17-year-old elite female youth soccer players, it is suggested that this could be the result of the interaction of biological and maturational differences, with socialization influences.

Before puberty, differences in gross motor skill performance between girls and boys are minimal. Generally, gross motor skill performance for girls and boys improves linearly across childhood until puberty when females' gross motor skill performance plateaus, while that of males improves (Gabbard, 2000).

The onset of puberty for males signals a host of biological factors, including neurological maturity, body size, anatomical structure and physiological functioning, that are positively correlated with athletic performance. During puberty, increased production of testosterone tends to provide the males with greater lean body mass, less adipose tissue and improved cardiopulmonary capacity, which assists them in performing gross motor skills

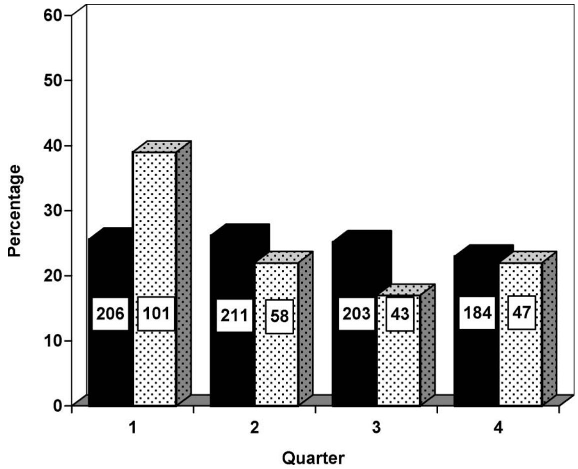

Figure 1. Comparison of female (solid bars) and male (stippled bars) state ODP players' percentage quarterly birth rate distribution.

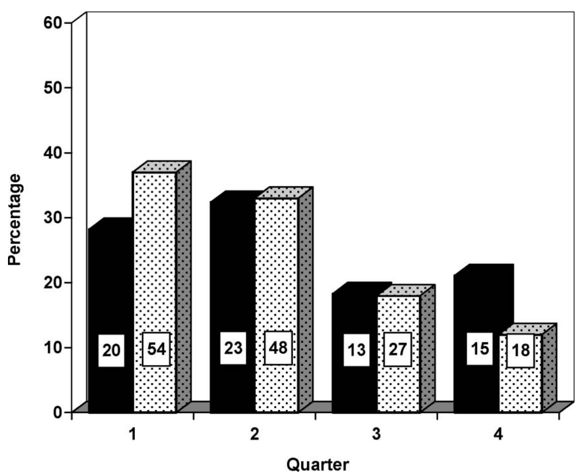

Figure 2. Comparison of female (solid bars) and male (stippled bars) regional ODP players' percentage quarterly birth rate distribution.

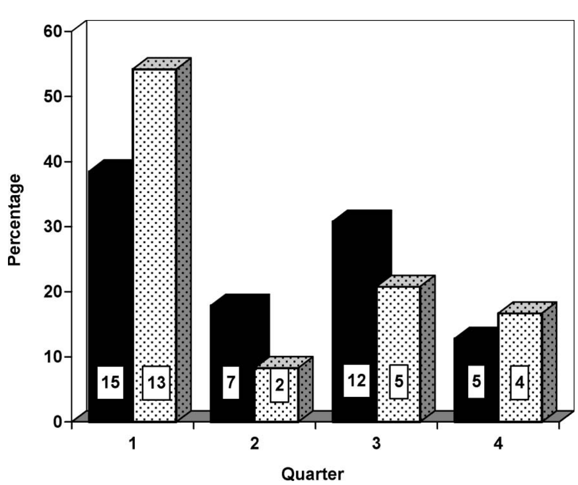

Figure 3. Comparison of female (solid bars) and male (stippled bars) national team players' percentage quarterly birth rate distribution.

that require strength, power, speed and endurance (Malina, Bouchard, & Bar-Or, 2004).

Males who are born earlier in the selection year could benefit from a physical maturation advantage, which means that they might be taller and heavier and generally demonstrate superior performance in motor tasks requiring speed and power compared with males who are born later in the selection year. Advanced physical maturation could provide males who are born early in the selection year with a critical advantage during the pivotal years of youth sport development, which is typically considered to be 11 – 14 years of age (Malina, 1996). Brustad (1992) theorized that advanced physiological maturity is probably crucial in facilitating superior athletic performance. Success in early sporting endeavours could interact with encouragement from socializing agents such as parents and enable young males to be identified by, and gain access to, quality coaching, which would facilitate further athletic accomplishment and produce the heightened motivation and persistence required to excel in elite youth sport. In comparison, it is theorized that males who are born later in the selection year could find it more difficult to excel in athletic endeavours because of disadvantages relating to physical size and development, which also manifests itself in a correspondingly lower level of social support.

Anecdotally, one southern state director of coaching reported in the summer of 2001 that, for evaluation and talent identification purposes, the male state ODP players born in 1998 were divided into two teams. Those players born in the first half of the year formed one team, and those players born in the second half of the year formed another, because many of the players born in the last 6 months of the selection year were "too small and or too slight in physique" to compete successfully against their older cohorts (Boulton, 2001). The later physical maturation of males results in greater height and body mass variability compared with females (Bouchard, Hollman, & Herkenrath, 1968). These biological and maturational differences suggest that there is more variability in the physical development of young men, leading up to and including their 17th year, compared with their female counterparts. This would accentuate any advantages resulting from being born early in the selection year.

In contrast, the onset of puberty for females heralds a host of physiological factors that constrain their athletic performance compared with their male peers. Post-pubescent females generally have shorter legs and develop wider hips, which are disadvantageous in performing motor skills such as jumping and running. Additionally, female anaerobic and aerobic characteristics, running speed and physical fitness performance plateau at about the age of 12 or

13, which is much earlier than for their male peers (Haywood & Getchell, 2001; Thomas, Nelson, & Church, 1991). Similar patterns in gross motor skill performance for females have been found in agility, jumping and kicking tests (Gabbard, 2000, Thomas & French, 1985). These maturational factors suggest that the athletic performance of females plateaus shortly after menarche, negating some of the physiological benefits of being born early in the selection year.

Females who mature early are generally taller and heavier, with more body mass for stature than late maturing females. As with their male counterparts, females who mature early have athletic performance advantages early in puberty. However, because females generally mature earlier than their male peers, by 13 or 14 years of age performance differences are reduced or disappear. Thus the athletic performance of adolescent females is poorly related to maturity status and late maturing females frequently produce superior athletic performances compared with their peers who matured early (Malina, 1996).

The interaction of biological maturation and sport socialization could be different for females who mature early compared with their female peers who mature late. Malina (1996) suggested that females who mature late have physiological characteristics that benefit athletic performance. Late maturing females generally have a more ectomorphic, linear physique, with longer legs and relatively narrow hips, less body mass for their stature and less adipose tissue. In contrast, the physical characteristics of females who mature early, such as a lateral physique, endomorphic body shape, greater body mass for stature, shorter legs, wider hips and greater body fat, are generally associated with inferior athletic performance (Malina *et al.*, 2004). Traditionally, a contact sport such as soccer has been considered "gender-inappropriate" for females and early maturing females' social identity may be heavily linked to a socially constructed, narrow, stereotyped definition of femininity. The social pressures to conform to such a socially constructed gender role could make early maturing females less motivated to achieve excellence in competitive sports because of a perception that society does not value female athletic accomplishments in the same way it does those of males. Thus, early maturing females may be socialized away from participation in youth sport and develop other interests (Wells & Ransdell, 1996). In comparison, females who mature late might not be so easily socialized away from sport. A late maturing female might not attain menarche until after her 14th birthday. This could provide her with more time to learn and develop athletic skills, which in turn would enable her to experience greater athletic achievement, and so provide her with the motivation to resist socialization away from sport. All of this suggests that being born early in the selection year and thereby being advanced in terms of physiological maturation does not provide elite female youth soccer players with as much advantage as it does elite male youth soccer players.

An additional explanation for the athletic success of females who are born later in the selection year, and thus may be less physically mature, is that their developmental phase is more in synchrony with early and average maturing males of the same chronological age. This would provide them with greater social status with their male peers. A female who matures late could attain menarche at 14 years of age and is biologically closer to early and average maturing males, who are often successful athletically. In contrast, females who mature early are out of synchrony in a developmental sense with male chronological age peers. An early maturing female attaining menarche at 12 years of age puts her out of synchrony biologically with her male chronological peers by as much as 3–4 years. Thus early maturing females typically associate with older age groups, something which socializes them away from athletic endeavours. The US Women's under-19 national team pool, which in 2001 was preparing for the inaugural FIFA Women's Youth World Championship, contained players born in 1985, 1984 and 1983 (see Table III). It is difficult to imagine male players who are potentially 3 years younger than their oldest peers training with and competing effectively at the national level. This also suggests that the relative age effect is not as influential for elite female youth soccer players.

The gender differences in the relative age effect of 17-year-old elite female and male soccer players could be explained by a complex and dynamic interaction of biological, maturational and socialization issues. The results of this study and the theories that are offered as explanations of the gender differences in the relative age effect have important implications for the coaching and scouting staffs of sporting national governing bodies and the increasing number of soccer academies whose mission it is to identify, train and develop talented female and male youth athletes. Selection criteria for elite female and male youth soccer programmes should take into consideration gender differences in the interaction of biological maturation and sport socialization when deciding which athletes to discard and which athletes to retain.

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