The relative age effect in young French basketball players: a study on the whole population.

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Abstract

The aim of this study is to test the presence of the Relative Age Effect (RAE) on overall population of the young French basketball players, male (*n* = 151 259) and female (*n* = 107 101). For the boys as for the girls, the results show a statistically significant RAE in all age categories. These results require a new look at the methodology in the statistical calculation and the interpretation of RAE. A study wanting to give a precise measurement of this effect will have to take as expected theoretical distribution the whole population of licensed players in the corresponding years, rather than one on the global population of the country. This will avoid the hasty conclusion that an asymmetric distribution of dates of birth of professional players would be due to RAE, whereas in reality it would be representative of one existing in the population of licensed players.

Keywords: Birth date, gender, discrimination, adolescence, seasonal variation, height.

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Introduction

Initially used in studies on the determinants of scholastic success (Dickinson & Larsen, 1963; Gilly, 1965), the concept of 'relative age' highlights the strong link between the month of birth and academic success. The 'relative age' means the age difference existing between two children, a difference which is due to the cut-off dates chosen to define the school year.

Thus, taking as an example a system based on the 1st January, a child born in January will have an advantage in physical and cognitive maturity of eleven months compared to a child born in December of the same year, though both find themselves in the same age group. The consequences of 'relative age' are called Relative Age Effect (RAE). The studies centred on scholastic success have shown that the youngest children in relative age (i.e., born late in relation to the cut-off date) are more often considered as academic failures (Maddux, 1980; Diamond, 1983) and are significantly less successful than pupils born just after the cut-off date (Davis et al., 1980; Di Pasquale et al., 1980; Uphoff & Gilmore, 1986; Sweetland & De Simone, 1987).

In sport as in school, the cut-off dates are used in order to put in place different categories of practice according to the age of the young sports persons. The aim of these age categories is to allow a more balanced competition between the participants. Inspired by studies carried out in schools, Grondin et al. (1984) are the first to discuss the possible relationship between the term of the birth and reaching the highest level in the chosen sport.

Using data from the National Hockey League (NHL), they found a strong over-representation of hockey players born at the beginning of the year and an under-representation of those born at the end of the year. They suggest that this biased distribution is a consequence of the cut-off date of the 1st January which is used to determine the age categories in minor hockey. The results of Barnsley et al. (1985) and

Barnsley and Thompson (1988) reinforce these conclusions and confirm the existence of RAE in the NHL.

Since those first results, an increasing number of studies concerning RAE in the sporting world have been published. At professional sport level, most of the studies relate to football and ice-hockey (Musch & Grondin, 2001) but studies have also been carried out on baseball (Thompson et al., 1991; Stanaway & Hines, 1995; Grondin & Koren, 2000), basketball (Daniel & Janssen, 1987; Côté et al., 2006), American football (Daniel & Janssen, 1987; Stanaway & Hines, 1995) and tennis (Edgar & O'Donoghue, 2005). Research has also been undertaken at the youth and elite levels. Here too, football and ice-hockey are the most studied sports (Musch & Grondin, 2001). Equally of note is research on baseball (Thompson et al., 1992), gymnastics (Baxter-Jones, 1995), swimming (Baxter-Jones, 1995), tennis (Dudink, 1994; Baxter-Jones, 1995; Edgar & O'Donoghue, 2005) and volleyball (Grondin et al., 1984).

With a few rare exceptions (Daniel & Janssen, 1987; Baxter-Jones, 1995; Stanaway & Hines, 1995) most of the studies report a significant RAE. This latter is seen as a discriminatory effect in the youth categories because it disadvantages players born late after the cut-off date by greatly reducing their chances of reaching the elite level (Hurley et al., 2001; Simmons & Paull, 2001; Edgar & O'Donoghue, 2005).

All the studies agree that the cut-off dates used to determine the different categories among young people are the only or principal factor explaining the RAE (Musch & Grondin, 2001). Musch and Hay (1999), in an intercultural study, show that socio-cultural and climatic factors do not influence the RAE. Moreover in showing that the change of cut-off date in youth categories of Australian soccer (i.e., 1st January replaced by 1st August) leads ten years later to a shift in the over representation of the months of January, February and March to those of August, September and October, provides solid proof in favour of the cut-off date as the principal causal factor of RAE. Recently Edgar and O'Donoghue (2005) arrive at similar conclusions in their study on tennis in showing that the cut-off date for the junior competition year is responsible for the biased distribution of dates of birth, more than of regional or climatic factors.

As Musch and Grondin (2001) highlight, we know very little about the role of gender in the RAE. Few studies have examined this aspect (Baxter-Jones, 1995; Vincent & Glamser, 2006). Vincent and Glamser's study (2006) compare the RAE of 1344 young soccer players, male and female, looked at by the US Olympic Development Program in 2001. Those players are the most talented players among children born in 1984. The results show a marginal RAE for female players of regional and national level and no effect at all for those of state level. On the contrary, a strong RAE was noticed among male players of regional, state, and national level. The authors conclude that the differences of gender in the RAE among the seventeen year old male and female players can be the result of a complex interaction between the biological differences and those due to puberty associated with sociological factors. Baxter-Jones's (1995) suggestion that the RAE is much stronger among boys comes from two distinctive phenomena working simultaneously: a more precocious puberty in girls, and the bigger variance in the development of puberty in boys.

In literature, the presence of RAE is determined in testing if there is a difference between the expected theoretical number of players born by month or by quarter (i.e., period of three consecutive months) and the number observed. The theoretical number being calculated from the national population from which the sample of players is taken. This implies therefore that, *a priori*, we postulate that the distribution of licensed of a particular sport's dates of birth is the same as the one of the national population. Indeed, apart from some very rare exceptions, the future high level class players come from the population of young licensed. Yet, we know that in terms of relative age, an important gap among young players of the same age category exists. This gap will be equally strongly felt in terms of physical development (Tanner & Whitehouse, 1976) and cognitive development (Bisanz et al., 1995; Morrisson et al., 1995). One can reasonably assume that sports enhancing physical attributes will be more easily abandoned by players born at the end of the year and therefore less mature physically. Height being, for example, a physical attribute valued in basketball, one can imagine that tall young players will be more easily attracted by this sport. Up to now, in literature, the over-representation at a professional level of players born just after the age limit could be explained by the fact that, because of their advantage of relative age, the latter had significant assets in their development (i.e., height, weight, strength) which were influencing their perceived potential (e.g., Helsen et al., 2005). These young players being more easily identified as talented or promising, they were therefore more easily recruited to go to high level team's training centres and national youth team, having thus the possibility to hope for a high level career. The uneven distribution of player observed at a professional level and in national youth teams can be explained therefore by this way of selecting, preferring an early physical development discriminating against players born late in the competitive year (Hurley et al., 2001; Simmons & Paull, 2001; Edgar & O'Donoghue, 2005).

In order to have a true discrimination, the distribution of the licensed player's population must be identical with the distribution of birth among the global population of the country. For, if it turns out that an unequal distribution among the whole population of licensed players existed, it will mean that it is not the way of recruiting for professional careers which generates the unequal distribution of high level players but a 'self-elimination' before – or a quick abandonment – from the youngest players in relative age, and therefore less gifted in the physical attributes.

So that we can test this hypothesis, we are going to look at the distribution of dates of birth for the overall licensed of the youth categories in the French Basketball Federation (FFBB), during the 2005-06 season. It is the first time that a study on the RAE includes all the young licensed participants in a given sport. Moreover, apart from the recent study of Vincent and Glamser (2006), the majority of researches on the RAE are directed at male athletes (Musch & Grondin, 2001). We are therefore going to separate the boys from the girls in order to see if the gender has an impact on the RAE. Up to now, only two studies concerning the RAE in basketball have been published (Daniel & Janssen, 1987; Côté et al., 2006). Looking at the American male professional championship, these researchers did not find any significant RAE.

In basket-ball, at youth level, height is the most valued attribute (it is the only anthropometric particular asked by the FFBB for giving or renewing licence). One can reasonably imagine that players young in relative age will tend to be less attracted to this sport and/or abandon it more easily given that they will be less developed physically. Thus, there would be a 'self-elimination' at the start for those players. From then on, one expects to find an unequal distribution of players with an over-representation of those born just after the cut-off date and an under-representation of those born a long time after. Moreover, we can expect significant height differences between players of different quarters. Players born just after the cut-off date must be taller than those born a long time after. Finally, given the results of previous studies, one can expect a strong RAE among boys whereas one should not (or only marginally) observe this effect among girls.

Materials and methods

Data collection

For the present study's purpose, birth dates and height on all female players (n = 107 101) and male players (n = 151 259) of French nationality having licensed in the youth categories during 2005-06 season were gathered from FFBB database.

This federation includes seven different age categories: 'baby-basket' (less than 7 years old), 'mini-poussins' (7 and 8 years old), 'poussins' (9 and 10 years old), 'benjamins' (11 and 12 years old), 'minimes' (13 and 14 years old), 'cadets' (15, 16 and 17 years old) and 'seniors' (over 18 years old).

For 'baby-basket' players (under 7 years old) a federal licence is not required. A cheaper 'basket card', allows the youngest to practise in clubs insured in case of accidents. The majority of players in this age group prefer the 'basket card' to the traditional licence. The player's height is not required to obtain a card. Therefore we removed the 'baby-basket' category from the present study.

Data analysis

In previous studies, the presence of RAE was determined by testing if a statistically significant difference between the expected theoretical number of players born per month or per quarter, and the number observed, existed. As far as French basketball is concerned, the limit date is the 1st January. So, players months of birth are classified in four quarters, starting with the period January- March (Q1) ending with the period October-December (Q4). Thus, a chi-square goodness of fit test is done in order to determine if the distribution observed by quarter differs significantly from the theoretical distribution expected. Following the example of the majority of previous studies, the theoretical expected distribution is calculated from birth statistics by months for the French male and female corresponding population (1988-1998) obtained through the National Institute of Statistics and Economics Studies (INSEE).

As for the height, one-way analysis of variance (ANOVA) and a Tuckey's *post-hoc* test have been used to investigate mean differences between the quarters.

The calculations were done with the software Statistica version 6.1 (StatSoft Inc.) and statistical significance was set at $P < 0.05$.

Results

Tables 1 and 2 show respectively the distribution per quarter and the associated average heights of female licensed players in the youth categories during the 2005-06 season. Tables 3 and 4 show results for boys.

****Table 1 near here****

****Table 2 near here****

As far as girls were concerned, one notices that for all the categories and for all the dates of birth, the distribution observed differs significantly from the theoretical distribution expected. Each time, one notices an over-representation of female players born in the quarters 1 and 2 and an under-representation of those born in the quarter 4. It is in the 'minimes' that one finds the biggest gaps between the observed distribution and the theoretical distribution ($\chi^2 = 216.816$, d.f. = 3, $P < 0.0001$), notably for young girls born in 1992 ($\chi^2 = 115.101$, d.f. = 3, $P < 0.0001$).

As for the height, for the categories 'mini-poussins' to the 'minimes', one notices that the height averages of each quarter are statistically different and decrease gradually from Q1 to Q4 ($P < 0.05$). For the 'cadets', the female players of the first and second quarters are taller than those in the fourth quarter ($P < 0.01$). It is in the category 'benjamins' that one sees the biggest differences between players of different quarters. Nevertheless, if one looks at the years, the biggest difference between Q1 and Q2 exists among girls born in 1995. The smallest gaps were observed among the 'cadets', notably for those born in 1988, when we can find no statistically significant difference between the height averages of the different quarters.

****Table 3 near here****

****Table 4 near here****

As far as the boys are concerned, one notices also that for all the categories and dates of birth, the observed distribution differs significantly from the theoretical distribution expected. Here again, players born in Q1 and Q2 are over-represented whereas those born in Q4 are under-represented. The same as for the female players, it is in the category 'minimes' ($\chi^2 = 141.832$, d.f. = 3, $P < 0.0001$) and during the year 1992 ($\chi^2 = 78.862$, d.f. = 3, $P < 0.0001$) that one finds the biggest asymmetry.

As far as the height is concerned, among the categories 'mini-poussins' to 'minimes', one notes that the height averages of each quarter are statistically different and decrease progressively from Q1 to Q4 ($P < 0.0001$). For the 'cadets', the players born in the quarters 1 and 2 are significantly taller than those born in the quarter 3, who are themselves significantly taller than those born in the quarter 4 ($P < 0.001$). It is in the 'minimes' that one finds the biggest differences in height between players of different quarters, especially for those born in 1992. The smallest differences are observed among the 'cadets'.

To sum up, we found a statistically significant RAE in all youth categories of the FFBB ($P < 0.0001$). We notice also that this effect is more pronounced among the female categories. As far as the height is concerned, players born in the quarters 1 and 2 are always significantly taller than those born in the quarter 4, apart from the female players born in 1988. The differences in averaged heights in the quarters 1 and 4 are more pronounced among girls in the 'mini-poussins' to the 'benjamins' categories. In the 'minimes' and 'cadets' categories, it is among the boys that we note the biggest differences.

Discussion

The recurrent asymmetry observed in the distribution of birth dates of senior professional players and of the elite young players led us to see if such asymmetries emerged for all licensed in the youth categories of the FFBB and, if so, from what age.

In their study concentrating mostly on 493 average youth male soccer players, Helsen et al. (1998) found an uniform distribution of dates of birth for the 6-10 years old and a biased distribution for the 12-16 age group. In the present study, right from the 7-8 group, and up to the 15-17, the results show clearly that players born in the two first quarters are over-represented whereas those born in the last are under-represented. Musch and Grondin (2001) postulate that it is the fact of competing for a place in the team that favours the appearance of RAE. Yet, in the present case, an unequal significant distribution in the 7-8 and the 9-10 years old (notably among the girls) even though there are no official competitions (i.e., no games) for these age categories in the FFBB and therefore no internal competition to gain a place in the team.

Recently, Vincent and Glamser (2006) found an influence of gender in the RAE. They found a strong RAE among boys, whereas they could not find any among the girls. With those results, they confirm Musch and Grondin's (2001) prediction that a strong RAE must be found among young boys. The present study's results contradict those of Vincent and Glamser (2006) and go against the prediction of Musch and Grondin (2001). Indeed, in the case of young French basket ball players, one notices that the RAE is systematic and more pronounced among girls than among boys.

Fenzel (1992) showed that, as far as girls are concerned, the RAE is positively correlated with self-esteem and negatively with stress, particularly during adolescence. So, girls born in Q1 will have a better self esteem and will be less stressed than their counterparts born in Q4. Adler and Adler (quoted by Shakib, 2003) postulated that during adolescence, girls win popularity thanks to their material possessions and physical appearance. Girls born in Q4 are less developed physically, have a lower self-esteem and are more stressed. All these factors explain that they are under-represented because of unfavourable comparisons with their more physically developed (and consequently more popular) peers. Moreover, Shakib (2003) showed that the primacy of physical appearance in the peer context during adolescence was a factor for giving up basketball among girls.

The previous investigations in schools (Donofrio, 1977; Di Pasquale et al., 1980; Uphoff & Gilmore, 1986) showed that the RAE could be more pronounced for boys in primary school but tends to shift to girls in adolescence. One supposes that in the domain of sports, the same mechanism occurs, thus explaining why our results show that the RAE is more pronounced in female basketball players than in the male.

The principal objective of this investigation was to verify that the distribution of dates of birth on all young players of the FFBB was representative of the global population in France for the corresponding years. In the majority of cases, the future players of high level emerge from the population of young players.

Yet, in studies, the presence of RAE is tested by checking the existence of a statistically significant difference between the distribution observed of players dates of birth and the theoretical distribution expected, taken from the global population of the country concerned. One postulates therefore *a priori* an homology between the licensed population and the global population of the country. The results of this study show that a statistically significant difference exists between the distribution of dates of birth on the whole of young players and that of the global corresponding French population. This implies an important and necessary methodological modification in the statistics and interpretation of RAE. A study wanting to take a precise measure of the effect will necessarily have to choose as theoretical expected distribution the one of the whole of practicing licensed for the corresponding years rather than the one of the global population of the country. Thus we could hastily conclude that an asymmetric distribution of dates of birth of high level players would be due to the RAE whereas in reality it would be representative of the one existing in the population of licensed. The over-representation of elite players born in Q1 and Q2 and the under-representation of those born in Q4 would not therefore be anymore systematically the consequences of a mode of selection valuing a precocious physical development but could be the mimetic expression of the representativeness of all players. From this perspective, it would be wrong to conclude to a discrimination against players born in Q4. Besides, Vaeyens et al. (2005) have showed already the existence of a significant RAE in the sample of 2757 senior semi-professional and amateur soccer players in Belgium.

A second hypothesis has been formulated that the height was one of the determining factors in the choice to practise basketball and could even explain partly the biased distribution observed in the whole of youth categories. In order to verify this hypothesis, the height averages of the whole young players of the FFBB have been calculated according to the quarters of birth. For the girls as for the boys, players born in Q4 are significantly smaller than those born in Q1 and Q2. More important discrepancies are observed in the 11-12 years old for the girls and in the category 'minimes' (13-14 years old) for the boys, which correspond to the puberty period. This category time-lag is explained by puberty happening sooner in girls (e.g., La Rochebrochard, 2000). In the present study, we notice, in girls as in boys, it is during puberty that the RAE is more pronounced. Players born in Q4 are therefore at the same time under-represented and significantly smaller than those born in Q1 and Q2. Pineau (1987) shows the importance of puberty in the performances of young sportsmen and Tanner and Whitehouse (1976) underline the striking discrepancies, due to relative age existing in the physical attributes during this period. Thus, players born in Q1 and Q2 start, *ceteris paribus*, their puberty before those born in Q4. The latter, suffering from a significant disadvantage in height and body mass, culminating at puberty, have therefore less tendency to go for this sport and are self-eliminating systematically, which explain their systematic under-representation in all age categories. After puberty, this advantage in height decreases gradually, and in the case of the 17 years old females disappears. These results are in accordance with those of Bäulmer (quoted by Musch & Grondin, 2001) who suggests that the physical advantage of players born in the first half in the sports year decreases gradually and corresponds to a shift towards players with better technical attributes, even though they may have suffered a disadvantage in terms of relative age when they started.

Thus, height seems to really play a preponderant part in the presence of RAE observed among the whole youth categories of the FFBB. However, as Musch and Grondin (2001) highlight, it is not the only factor contributing to RAE. For them, "a mixture of physical, cognitive, emotional and motivational causes work together to produce the effect." (p. 159).

To sum up, the data of this study reveal the presence of a significant RAE in the whole of youth categories of the FFBB, both among boys and girls. It is the first time that a study on the RAE was looking at two complete practising cohorts. One will notice as well that few studies have analysed the impact of gender on this phenomenon.

The results indicate that the RAE appears as soon as the age of 7, among girls and boys. In a study on young amateur soccer players, Helsen et al. (1998) only show the presence of RAE from the age of 12. This phenomenon appears therefore earlier in basketball.

Concerning gender, the present results are in contradiction with those found previously: RAE exists among boys and girls, though more pronounced among the latter. As Musch and Grondin (2001) highlight, too few studies have been carried out on young sportswomen. Other research must be done in order to clarify the influences of gender on the RAE and notably to see if differences existed according to the practised sports. One can reasonably imagine that certain sports are better grounds for the presence of RAE among girls.

Perspectives

Our results indicate that the traditional method to evaluate and interpret the RAE cannot always be effective and introduces bias in the conclusions on the phenomenon. Indeed, the presence of RAE is tested by verifying the existence of a significant difference between the observed distribution of players birth dates and the theoretical distribution expected taken from the global population of the country concerned on the basis that the latter must be representative of the one for all young players, for it is from it that future high-level players will emerge. Yet, our results indicate that in the case of French basketball, an unequal distribution of players already exists among the whole of young licensed. In order not to introduce bias into the analysis of RAE, it is proper to take as the expected theoretical distribution, all licensed rather than the global population of the country studied.

If an unequal distribution already exists among the whole population of players, it is normal by mimicry that one finds it again among elite players. Taking into account the global population of the country, one could be led to hastily conclude that there was discrimination due to the system of recruiting to professional pathways.

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Table 1. Season of birth of young female players compared against the French female corresponding population.

	Q1 (%) (expected)	Q2 (%) (expected)	Q3 (%) (expected)	Q4 (%) (expected)	Total	χ^2	*P*
Cadets							
17 years old	1619 (26,45) (1491)	1763 (28,79) (1561)	1490 (24,33) (1566)	1251 (20,43) (1505)	6123	83.643	< 0.0001
16 years old	1978 (26,30) (1800)	2115 (28,12) (1952)	1824 (24,25) (1894)	1605 (21,33) (1876)	7522	72.990	< 0.0001
15 years old	2255 (25,68) (2106)	2437 (27,76) (2239)	2240 (25,51) (2253)	1848 (21,05) (2182)	8780	79.169	< 0.0001
Total	**5852 (26,10)**	**6315 (28,16)**	**5554 (24,77)**	**4704 (20,97)**	**22425**	**228.462**	**< 0.0001**
Minimes							
14 years old	2876 (26,88) (2573)	2919 (27,28) (2713)	2618 (24,47) (2777)	2288 (21,37) (2637)	10701	106.725	< 0.0001
13 years old	3025 (27,93) (2669)	2846 (26,27) (2747)	2732 (25,22) (2778)	2229 (20,58) (2638)	10832	115.101	< 0.0001
Total	**5901 (27,40)**	**5765 (26,77)**	**5350 (24,85)**	**4517 (20,98)**	**21533**	**216.816**	**< 0.0001**
Benjamins							
12 years old	2859 (26,94) (2549)	2922 (27,53) (2695)	2611 (24,60) (2763)	2221 (20,93) (2606)	10613	122.308	< 0.0001
11 years old	2919 (26,35) (2612)	3037 (27,42) (2839)	2742 (24,75) (2825)	2380 (21,48) (2802)	11078	115.932	< 0.0001
Total	**5778 (26,64)**	**5959 (27,47)**	**5353 (24,68)**	**4601 (21,21)**	**21691**	**236.432**	**< 0.0001**
Poussins							
10 years old	3293 (25,86) (3003)	3418 (26,84) (3190)	3173 (24,92) (3313)	2850 (22,38) (3228)	12734	94.213	< 0.0001
9 years old	3058 (26,33) (2793)	3160 (27,22) (2934)	2863 (24,65) (2973)	2532 (21,80) (2913)	11613	96.085	< 0.0001
Total	**6351 (26,09)**	**6578 (27,02)**	**6036 (24,79)**	**5382 (22,10)**	**24347**	**188.588**	**< 0.0001**
Mini-poussins							
8 years old	2491 (26,17) (2283)	2612 (27,44) (2440)	2308 (24,25) (2421)	2107 (22,14) (2374)	9518	66.008	< 0.0001
7 years old	1978 (26,07) (1822)	2076 (27,37) (1898)	1897 (25,00) (1981)	1639 (21,56) (1886)	7587	66.615	< 0.0001
Total	**4469 (26,13)**	**4688 (27,41)**	**4205 (24,58)**	**3743 (21,88)**	**17105**	**133.041**	**< 0.0001**
TOTAL	**28351 (26,47)**	**29305 (27,36)**	**26498 (24,74)**	**22947 (21,43)**	**107101**	**970.462**	**< 0.0001**

Table 2. Average heights of young female players.

	Q1 (s.d.)	Q2 (s.d.)	Q3 (s.d.)	Q4 (s.d.)	Q1 - Q4	*Post Hoc*
Cadets						
17 years old	166.77 (7.11)	166.46 (7.42)	166.47 (7.42)	166.27 (7.48)	0.50	Q1=Q2=Q3=Q4
16 years old	166.12 (7.55)	166.17 (7.38)	165.88 (7.04)	165.40 (7.38)	0.72	Q1,Q2>Q4 (p < 0.05)
15 years old	165.07 (7.74)	164.89 (7.66)	164.60 (7.22)	164.13 (7.81)	0.94	Q1,Q2>Q4 (p < 0.05)
Total	**165.91 (7.53)**	**165.76 (7.45)**	**165.53 (7.26)**	**165.14 (7.63)**	**0.77**	**Q1,Q2>Q4 (p < 0.01)**
Minimes						
14 years old	163.44 (7.57)	163.02 (7.69)	162.15 (7.83)	161.69 (7.97)	1.75	Q1,Q2>Q3,Q4 (p < 0.001)
13 years old	160.71 (7.96)	159.81 (8.11)	159.06 (8.44)	158.37 (8.11)	2.34	Q1>Q2>Q3>Q4 (p < 0.05)
Total	**162.04 (7.89)**	**161.44 (8.06)**	**160.59 (8.28)**	**160.05 (8.21)**	**1.99**	**Q1>Q2>Q3>Q4 (p < 0.05)**
Benjamins						
12 years old	156.31 (8.60)	155.13 (8.33)	153.79 (8.53)	152.29 (8.73)	4.02	Q1>Q2>Q3>Q4 (p < 0.0001)
11 years old	150.61 (9.01)	149.04 (8.42)	147.95 (8.57)	146.30 (8.76)	4.31	Q1>Q2>Q3>Q4 (p < 0.0001)
Total	**153.43 (9.26)**	**152.04 (8.91)**	**150.79 (9.04)**	**149.17 (9.24)**	**4.26**	**Q1>Q2>Q3>Q4 (p < 0.0001)**
Poussins						
10 years old	143.94 (8.63)	142.37 (8.30)	141.11 (7.77)	139.41 (7.89)	4.53	Q1>Q2>Q3>Q4 (p < 0.0001)
9 years old	138.18 (7.85)	137.08 (7.61)	135.97 (7.66)	134.60 (7.39)	3.78	Q1>Q2>Q3>Q4 (p < 0.0001)
Total	**141.19 (8.75)**	**139.89 (8.41)**	**138.72 (8.13)**	**137.17 (8.03)**	**4.02**	**Q1>Q2>Q3>Q4 (p < 0.0001)**
Mini-poussins						
8 years old	132.54 (8.06)	131.15 (7.47)	130.30 (7.93)	128.62 (7.23)	3.92	Q1>Q2>Q3>Q4 (p < 0.01)
7 years old	127.25 (8.20)	126.23 (8.13)	124.48 (8.15)	123.64 (8.46)	3.61	Q1>Q2>Q3>Q4 (p < 0.0001)
Total	**130.23 (8.53)**	**129.00 (8.14)**	**127.73 (8.53)**	**126.42 (8.18)**	**3.81**	**Q1>Q2>Q3>Q4 (p < 0.0001)**

Table 3. Season of birth of young male players compared against the French male corresponding population.

	Q1 (%) (expected)	Q2 (%) (expected)	Q3 (%) (expected)	Q4 (%) (expected)	Total	χ^2	*P*
Cadets							
17 years old	2458 (25,44) (2353)	2602 (26,93) (2463)	2381 (24,64) (2471)	2221 (22,99) (2375)	9662	25.740	< 0.0001
16 years old	2887 (25,23) (2737)	3102 (27,11) (2970)	2835 (24,78) (2881)	2618 (22,88) (2854)	11442	34.269	< 0.0001
15 years old	3263 (25,60) (3058)	3392 (26,60) (3252)	3201 (25,10) (3272)	2895 (22,70) (3169)	12751	44.910	< 0.0001
Total	**8608 (25,43)**	**9096 (26,87)**	**8417 (24,86)**	**7734 (22,84)**	**33855**	**101.283**	**< 0.0001**
Minimes							
14 years old	4084 (25,58) (3839)	4278 (26,80) (4047)	4016 (25,16) (4143)	3586 (22,46) (3935)	15964	63.638	< 0.0001
13 years old	4139 (26,54) (3843)	4185 (26,83) (3955)	3849 (24,68) (4000)	3423 (21,95) (3798)	15596	78.862	< 0.0001
Total	**8223 (26,06)**	**8463 (26,82)**	**7865 (24,92)**	**7009 (22,20)**	**31560**	**141.832**	**< 0.0001**
Benjamins							
12 years old	3734 (25,48) (3519)	3948 (26,94) (3721)	3732 (25,47) (3816)	3241 (22,11) (3599)	14655	64.390	< 0.0001
11 years old	3618 (24,56) (3473)	3922 (26,62) (3777)	3746 (25,42) (3757)	3448 (23,40) (3727)	14734	32.500	< 0.0001
Total	**7352 (25,02)**	**7870 (26,78)**	**7478 (25,44)**	**6689 (22,76)**	**29389**	**93.433**	**< 0.0001**
Poussins							
10 years old	4005 (24,87) (3799)	4242 (26,33) (4036)	4039 (25,07) (4191)	3822 (23,73) (4082)	16108	43.835	< 0.0001
9 years old	3924 (25,72) (3671)	3966 (25,98) (3857)	3787 (24,81) (3908)	3586 (23,49) (3827)	15263	39.407	< 0.0001
Total	**7929 (25,28)**	**8208 (26,16)**	**7826 (24,95)**	**7408 (23,61)**	**31371**	**81.118**	**< 0.0001**
Mini-poussins							
8 years old	3300 (24,92) (3177)	3491 (26,36) (3396)	3317 (25,05) (3369)	3139 (23,67) (3302)	13244	16.526	< 0.001
7 years old	3022 (25,52) (2843)	3038 (25,66) (2962)	2999 (25,33) (3092)	2781 (23,49) (2943)	11840	24.839	< 0.0001
Total	**6322 (25,20)**	**6529 (26,03)**	**6316 (25,18)**	**5917 (23,59)**	**25084**	**40.528**	**< 0.0001**
TOTAL	**38434 (25,41)**	**40166 (26,55)**	**37902 (25,06)**	**34757 (22,98)**	**151259**	**435.561**	**< 0.0001**

Table 4. Average heights of young male players.

	Q1 (s.d.)	Q2 (s.d.)	Q3 (s.d.)	Q4 (s.d.)	Q1 - Q4	*Post-Hoc*
Cadets						
17 years old	179.39 (8.93)	179.01 (9.05)	178.44 (9.10)	178.10 (8.91)	1.29	Q1,Q2>Q4 (p < 0.01)
16 years old	177.93 (9.53)	177.45 (9.48)	176.72 (8.99)	176.17 (9.21)	1.76	Q1,Q2>Q3,Q4 (p < 0.05)
15 years old	174.36 (10.32)	174.29 (9.71)	172.60 (10.19)	171.48 (10.29)	2.88	Q1,Q2>Q3>Q4 (p < 0.001)
Total	**177.02 (9.90)**	**176.72 (9.65)**	**175.67 (9.81)**	**174.97 (9.95)**	**2.05**	**Q1,Q2>Q3>Q4 (p < 0.001)**
Minimes						
14 years old	170.02 (10.44)	168.54 (10.64)	166.90 (10.45)	165.24 (10.18)	4.78	Q1>Q2>Q3>Q4 (p < 0.0001)
13 years old	163.26 (10.68)	161.88 (9.77)	159.87 (9.75)	158.05 (9.67)	5.21	Q1>Q2>Q3>Q4 (p < 0.0001)
Total	**166.62 (11.09)**	**165.25 (10.75)**	**163.45 (10.70)**	**161.74 (10.56)**	**4.88**	**Q1>Q2>Q3>Q4 (p < 0.0001)**
Benjamins						
12 years old	155.63 (9.78)	154.14 (9.17)	152.78 (8.76)	151.16 (8.44)	4.47	Q1>Q2>Q3>Q4 (p < 0.0001)
11 years old	149.61 (8.71)	148.46 (8.30)	146.85 (8.29)	146.12 (8.16)	3.49	Q1>Q2>Q3>Q4 (p < 0.01)
Total	**152.68 (9.74)**	**151.27 (9.19)**	**149.79 (9.03)**	**148.56 (8.67)**	**4.12**	**Q1>Q2>Q3>Q4 (p < 0.0001)**
Poussins						
10 years old	143.83 (8.63)	143.04 (8.32)	141.82 (8.44)	140.78 (8.91)	3.05	Q1>Q2>Q3>Q4 (p < 0.01)
9 years old	139.34 (8.35)	138.39 (8.69)	137.11 (8.24)	135.96 (8.67)	3.38	Q1>Q2>Q3>Q4 (p < 0.0001)
Total	**141.62 (8.79)**	**140.83 (8.81)**	**139.58 (8.67)**	**138,46 (9.12)**	**3.16**	**Q1>Q2>Q3>Q4 (p < 0.0001)**
Mini-poussins						
8 years old	133.58 (9.01)	132.27 (8.52)	130.74 (8.70)	129.59 (8.15)	3.99	Q1>Q2>Q3>Q4 (p < 0.0001)
7 years old	127.79 (8.47)	127.02 (9.14)	125.75 (9.14)	124.86 (9.82)	2.93	Q1>Q2>Q3>Q4 (p < 0.05)
Total	**130.85 (9.23)**	**129.88 (9.19)**	**128.41 (9.25)**	**127.40 (9.27)**	**3.45**	**Q1>Q2>Q3>Q4 (p < 0.0001)**