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Are Players Born Earlier in the Calendar Year More Likely to Experience Elite Dropout?

Thesis presented by

Timothy Cathal Buckley

116320543

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University College Cork

Department of Economics

Head of Department: Prof Edward Shinnick

Supervisors: Dr David Butler, Dr Robert Butler and Dr Declan Jordan.

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Abstract

The relative age effect (RAE) has been consistently documented among elite football players at youth level but has been shown to dissipate at senior level. This research explores whether players born earlier in the calendar year, initially selected to play at an elite level, are more likely to be identified as dropouts at a later date. Statistical analysis is used to test for the presence and extent of RAE from a sample of almost 9,000 elite underage national league football players in the Republic of Ireland. Results reveal a bias towards players born early in the calendar year, and in the first quarter in particular. The bias is most pronounced at the youngest age group included in the analysis, at U15 level. Further statistical analysis assesses the differences between the observed distribution of births of 163 players who were identified as dropouts and the expected distribution of births. Players born earlier in the calendar year are also found to be more likely to be identified as dropouts from underage national league football in the Republic of Ireland. In comparison, their relatively younger counterparts, although less likely to be selected to play at an elite level initially, are significantly less likely to be identified as dropouts. Recommendations made based on the results include adopting a more strategic and long-term approach to be adopted during the initial player selection processes, and further education of coaches regarding youth development as well as the presence and consequences of RAE.

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1 INTRODUCTION

Making use of an extensive dataset provided by the Football Association of Ireland (hereafter FAI), this study examines the relationship between the relative age of players, grouped together in age specific cohorts, and player dropout levels among a sample consisting of almost 9,000 elite underage national league players in the Republic of Ireland (hereafter Ireland). Like previous studies on the relative age effect (hereafter RAE), this study finds that players born earlier in the calendar year are more likely than those born later in the year to be identified as talented at a young age, and thus be selected to play at an elite level. Analysis in this study, of players who have been identified as dropouts from elite level underage national league football in Ireland, reveals that players born earlier in the calendar year are more likely to be identified as dropouts from national league teams at a later stage.

1.1 Introduction to the Relative Age Effect

A vast body of literature exists examining the concept of an RAE in a variety of fields, but particularly in sporting and educational settings. RAE "refers to a bias towards relatively older children assembled collectively within a selection year" (Butler & Butler, 2015, p.511). When this is applied to Association Football, elite talent is commonly drawn from those born closest to the cut-off date, when players are assembled collectively within a predetermined selection year. The implication of this is an overrepresentation of players born in the first quarter of the calendar year, when compared to the distribution of births of the general population.

Importantly, RAE is not only evident in Irish football which means that this research, its results, and recommendations could be relevant for many members of Union of European Football Associations (UEFA), as well as for governing bodies of football in other nations around the world. RAE has previously been identified among youth football players in several European countries, including Germany (Cobley, Schorer, & Baker, 2008), Spain (Del Campo et al., 2010), Switzerland (Romann et al., 2020) and Turkey (Mulazimoglu, 2014), as well as in

Belgium, Denmark, England, France, Italy, the Netherlands, and Sweden as part of a larger scale European study conducted by Helsen, Van Winckel, & Williams (2005). Thus, the implications of RAE are also relevant to the governing bodies of football in these countries, and not just to the FAI, the governing body of football in Ireland.

Evidence from recent studies on the topic lends further support to the theory that RAE is manifested only in youth football and does not spill-over to the professional senior level of the game (González-Víllora, Pastor-Vicedo & Cordente, 2015). Therefore, there is reason to expect that, while being born earlier in the calendar year enhances one's chance of selection at an elite youth level, it significantly increases the likelihood of drop-out at a later stage of youth football. If this were not the case, RAE would be present among players at senior, or adult level. This idea forms the basis of this research. To the best of my knowledge, there has been no study to date which has found players born earlier in the calendar year to be more likely to be identified as dropouts from elite level sport. Despite the extensive body of research which is available on the topic of RAE, there is a noticeable lack of literature examining the relationship between dropout levels and the relative age of players. We also wish to consider the role of coaches in the player selection process and the prevention of RAE.

It is important to note that the players who form the basis of this study are not professional players. Throughout the study, the term 'elite' is used to refer to these players as they are playing for League of Ireland clubs in national league competition, which is the highest level of football in the Republic of Ireland.

While the term 'dropout' may be seen as pejorative term in a commonplace setting, in this research it is used as a captive term to refer to players who have ceased playing at underage national league level in Ireland, despite having been initially selected to play in the league. There are numerous reasons why players may cease their participation in the league (e.g., progression to senior level in the League of Ireland or transfers to professional clubs in another

country), but as the data has been anonymised, it is not possible to track players after they leave the league in order to identify the reasons for their cessation of play. The term is not perfect, it is the term which is used across the relevant literature and is therefore also used in this research. The limitations of the term 'dropout' are discussed further in section 6.5.

In the context of this research, the term 'underage' is used to refer to a player, or players, playing at a category of Under 19 or below. This is a colloquial term, used to refer to players playing in competitions which are categorised by age, rather than referring to players who are too young to compete at a given age category.

Understanding why players born earlier in the calendar year are more likely to dropout is important for a variety of reasons. It may be the case that significant amounts of time and resources are being dedicated to a group of players (i.e., those born earlier in the calendar year) who are statistically more likely to leave the elite levels of the game before reaching senior level. This raises questions about the importance and accuracy of talent selection at the earliest stages of players careers. Is it the case that a players' initial selection was misguided, or that the approach taken to develop these players is not appropriate for their needs? Coaches play an important role in the talent identification and talent development processes at youth levels. Most coaches involved in football in Ireland operate on a voluntary basis. Therefore, this study will also briefly consider the relationship between volunteerism and RAE.

1.2 The Relationship Between RAE and Player Dropout

Research on the topic of RAE commonly focuses on players who do not achieve selection for elite level teams due to their date of birth. These players can never be known and can only be identified as a collective at the aggregate level by comparing the distribution of their dates of birth across the calendar year. Little attention is paid to players who are initially selected to play at an elite level, before leaving elite level football at a later stage in their careers. While it is important to recognise and potentially attempt to eliminate any inherent bias in the selection

of young players, a greater focus also needs to be placed on players who do get the opportunity to play at an elite level at youth age groups, but subsequently leave the elite level football system. Investigating the process of attrition for players born earlier in the calendar year can yield fruitful policy insights for national associations.

This research places particular emphasis on the concept of the calendar year, as the 1st of January is the cut-off point for football in Ireland is the 1st of January. By means of an example, a player playing at the Under 15 age group must be under the age of 15 on the 1st of January in order to be eligible to compete at the Under 15 age group. Therefore, players born in January are the relatively oldest players within an age cohort, while players born in December are the relatively youngest.

This research can firstly help to inform policies directed toward supporting unsuccessful individuals, who drop out from the elite level of the sport at underage levels. It must be noted that some of the players which we have identified as dropouts may have progressed to play at a higher level, either abroad or at senior level in the League of Ireland. This potential issue is discussed at more length in section 6 of this paper. However, it is assumed that the majority of players identified as dropouts, have been correctly identified as players who have been deselected from elite level football. Studies have identified that elite level players, pursuing professional careers in their chosen sport, can suffer from various forms of psychological distress, such as anxiety and depression (Brown & Potrac, 2009) as a result of deselection. While many of these studies focus on players at professional football academies, it may be that players who experience deselection from non-professional underage national league teams in Ireland will experience similar psychological distress. Secondly, the findings should serve to aid policy formation related to the strategic allocation of resources; if relatively younger elite talent is more likely to progress, should they receive greater investment?

To date, much of the research on RAE in sport has focused on identifying the bias, as well as suggesting, and investigating solutions to negate the adverse effects associated with it. An investigation of the 'back-end' of RAE is required – focusing on players who are initially successful but then leave elite level football at a later stage. To my knowledge this would be an early attempt to examine the transition phase of the RAE in football in Ireland, by focusing on those players who do not progress to the next level in football, despite having had initial success at a young age.

1.2.1 The Role of Volunteer Coaches in Irish Football

While the main focus of this study is on players competing at an elite level, it is important to note the contribution of coaches at grassroots clubs, who are tasked with developing players from a very young age. In Ireland, there is a huge reliance on volunteers in sporting settings. The clubs who are under the umbrella of the governing bodies of the most popular team-based sports in Ireland, (based on data from Sport Ireland's 2019 Irish Sports Monitor (Sport Ireland, 2019)), the Gaelic Athletic Association (GAA), and the FAI, rely heavily on the activities of volunteers at a local level. With the exception the coaches of the 20 clubs participating in the senior divisions of the League of Ireland, and the coaches of some of the teams competing in the underage national leagues, most coaches and administrators involved in football in Ireland perform their roles on a voluntary basis.

There have been many studies investigating the motives of volunteer coaches involved in various sports, such as swimming (Burgham & Downward, 2005), rugby (Hoye et al., 2008) and football (Busser and Carruthers, 2010). Two of these studies have discovered that volunteers in sport are likely to have a previous connection to the sport i.e., being a former player, or have a child involved in the sport (Burgham and Downward, 2005; Busser and Carruthers, 2010).

It is important that coaches of all levels are provided with ample opportunity for coach education courses. Coaches and administrators need to be made aware of RAE for any serious attempt to be made to mitigate for it, as it is often the case that grassroots coaches nominate their players for trials for regional representative teams. The FAI offer coach education courses for coaches of all levels. These courses provide ample opportunity to educate coaches on the prevalence and consequences of the RAE bias. In particular it provides an opportunity to target coaches of elite level underage clubs, as they are the coaches who are involved in the selection process.

1.3 Overview of the Findings on the Relationship Between Dropout and RAE

There has been a number of studies which have assessed the relationship between RAE and player dropout levels in sport. Among the body of research are Delorme, Chalabaev & Raspaud (2011), who studied the relationship between RAE and dropout levels in French basketball, Lemez et al. (2014) who studied the relationship in Canadian ice hockey. Delorme, Boiché & Raspaud (2010a) and Delorme, Boiché and Raspaud (2010b) investigated the relationship between RAE and dropout levels among male and female French football players respectively. Helsen, Starkes & Van Winckel (1998) conducted a similar study, with the participants being drawn from a sample of male Belgian football players.

Delorme, Chalabaev & Raspaud (2011) found that, among French basketball players aged between nine and fifteen, there was an underrepresentation of dropouts among male players born in the first two quarters of the selection period, and an overrepresentation of dropouts among those born in the final three months of the selection period. Lemez et al. (2014) identified a similar pattern in their study of Canadian youth male ice hockey players – a higher percentage of dropout in the final two quarters of the selection year compared to the first two quarters.

Delorme, Boiché & Raspaud. (2010a), in their study of French male football players, identified an over-representation of dropouts among those born in the later part of the year, compared to their counterparts born in the earlier months of the year. Helsen, Starkes & Van Winckel (1998) identified that players born in the first three months of the selection period were more likely to be identified as 'talented', and thus more likely to be exposed to higher levels of coaching. They also found that it was more likely that these players would transfer to a top team, that they would play for national teams and become involved in the professional game. In contrast, it was found that, from as early as twelve years of age, the data showed an overrepresentation of dropouts among players born in the last three months of the selection year.

Delorme, Boiché & Raspaud. (2010b), identifying that the impact of sex on RAE was relatively unexplored, investigated a sample of French female football players. The study revealed an overrepresentation of players born in Q1 and Q2 for all youth categories within the sample and found an overrepresentation of dropouts were born in Q3 and Q4.

Thus, the evidence of previous papers appears to be inconsistent with the preliminary results in the case of Irish football, and this paper explores whether the experience of underage national league football in Ireland differs from the results described in the literature to date. There are two hypotheses which are to be tested in this research. The first hypothesis to be tested is that RAE is present among underage national league players. The second hypothesis to be tested is that underage national league players born earlier in the calendar year are more likely to be identified as dropouts.

1.4 Overview of the Remaining Sections of the Paper

The remaining sections of the thesis are as follows. The literature related to RAE, as well as the literature on the relationship between relative age and dropout, is discussed in section two of this paper, followed by an introduction to the data which are used as part of the analysis in section three. Section four outlines the method of analysis employed in the study, with section

five then presenting detailed breakdown of the results of the analysis. The final two sections of the paper include a discussion of the findings of the research, including some recommendations based on the results and implications of the results, followed by the conclusion of the paper in section seven, which includes some suggestions of avenues for future research.

2 LITERATURE REVIEW

There exists a vast body of literature examining the topic of RAE in various sports, including an extensive body of research on the effect in the sport of football. The body of literature examining the relationship between relative age and dropout levels in sport is smaller. While there has been some work done in this area, including a number of studies which make use of samples of football players in European countries, this is a topic which requires further investigation. The literature to date pertaining to RAE in sport, and the relationship between relative age and dropout levels in sport is reviewed in more detail in the following section. Firstly, there is a short history of the FAI, the governing body of football in Ireland, and a brief explanation of the structure of the underage national leagues in Ireland.

2.1 A Brief History of the Football Association of Ireland

The FAI is the governing body responsible for the administration of football in Ireland. Currently, unlike in other sports played on the island of Ireland, such as Rugby Union (which is administered across the thirty-two counties on the island of Ireland by the Irish Rugby Football Union) and Gaelic Games (which is administered across the thirty-two counties on the island of Ireland by the Gaelic Athletic Association (GAA)), there are two governing bodies for Association Football on the island of Ireland. The Irish Football Association (IFA) administers the game in the six counties of Northern Ireland, and the FAI does so in the south, in the twenty-six counties of Ireland.

Chambers and Gregg (2016, p.65) highlight how "the island of Ireland represents a unique setting as it comprises a hybrid jurisdiction of (a) the United Kingdom and Northern Ireland and (b) the Republic of Ireland." In the early days of football on the island, during the late nineteenth century, organised football was predominantly played in the Ulster region, in the north of the island. One explanation for this was the lack of competition from sports which were more popular in the south, such as Rugby Union, the other code of football which was

imported from Great Britain (Moore, 2015). Due to the rising popularity of the sport, in the Belfast region in particular, the Irish Football Association (IFA) was formed in 1880 by a number of clubs from the region and became the National Governing Body for football across the entire island of Ireland (O' Regan and Kelly, 2018). Three years passed before the first club outside of Ulster was formed, in Dublin. This proved to be the beginning of the growth of the sport outside of Ulster, eventually leading to the formation of the Leinster Football Association (LFA) in 1892 (The Football Association of Ireland, 2009a).

The initial development of the game on the island was affected by the fact that the game was seen as a promotion of a distinctive British sporting culture, the polar opposite of the objectives of rival sporting organisations, foremost among which was the GAA, which went as far as banning its members from participating in 'foreign' sports, such as Association Football (Hassan, McCullough & Moreland, 2009). It was not until the beginning of the 1970s, owing to pressure from several GAA county boards (including that of London), that the 'foreign games' rule was removed from the GAA rule book (Rouse, 1993), and players were free to compete in both sports without reprimand.

While the IFA remained as the governing body of football on the island until 1924, dissatisfaction with how the IFA was governing the game became apparent during the early twentieth century (O' Regan and Kelly, 2018). There was a belief that Belfast-based clubs were exerting an unfair influence on the decision-making processes of the IFA, particularly in relation to the selection of players for representative teams competing at international level. It was ultimately an unsuccessful request from Dublin-based club Shelbourne, that the replay of the 1921 Cup Final be played in Dublin, which proved to be the catalyst for the split in the IFA. The original fixture had been played in Belfast against Glenavon, a club based just outside of Belfast. According to O' Regan and Kelly (2018, p.183), "this was one of the greatest examples

of a southern-based club being neglected and restricted by the IFA". The controversy around the venue of the replay would ultimately lead to the LFA seceding from the IFA (Moore, 2015). On the 1st of June 1921, an historic meeting of southern-based clubs and associations took place in Molesworth Hall in Dublin. The outcome of the meeting, instigated by the LFA with the support of the Munster Football Association (MFA), was to irrevocably split from the IFA, thus resulting in the formation of the Football Association of Ireland to develop and administer the game throughout the thirty-two counties on the island of Ireland (O' Regan and Kelly, 2018). Following a letter from Dublin to Belfast in 1921, confirming disaffiliation with the IFA, there were now two organisations vying for control of football on the island of Ireland, with neither recognising the others existence (Rouse, 2016). Expressions of nationalism had been intensifying during this time, both in the lead up and aftermath of the Easter Rising of 1916, as well as the events in the following years, and many people viewed the split from the IFA as an example of this (O' Regan and Kelly, 2018).

The Molesworth Hall meeting was shortly followed by the establishment of the Football League of Ireland, which consisted of eight Dublin based teams in the first season, with Athlone becoming the first non-Dublin-based team in the second season (The Football Association of Ireland, 2009a). The International Football Association Board (IFAB), which was set up in 1886, and comprised of the Football Associations of England, Scotland, Wales and Ireland, were not comfortable with the establishment of the league (O' Regan and Kelly, 2018). Today, IFAB consists of the Football Associations of England, Scotland, Wales, and Northern Ireland, as Ireland lost its place after the introduction of their own national league. In 1923, at a conference of the home nations football associations in Liverpool, it was decided to reduce the jurisdiction of the FAI to the twenty-six counties of Ireland, thus giving birth to the Football Association of the Irish Free State (O' Regan and Kelly, 2018). The new association experienced difficulties securing recognition from FIFA, as the IFA was registered as the

governing body for football on the island of Ireland. Following assistance from France, who sent one of their leading clubs to Ireland in 1923 to play some challenge matches, FIFA accepted the FAI's membership application in August of that year (The Football Association of Ireland, 2009a).

The existence of two governing bodies on one island led to complications, and there were many instances of players who were representing both teams in international competition (O' Regan and Kelly, 2018). It took until 1953 for FIFA to rationalise the situation, when they ruled that in "international competition, the team representing the South would be recognised as the Republic of Ireland and the IFA's team would be designated Northern Ireland" (The Football Association of Ireland, 2009b). However, on the island of Ireland, the issue of player eligibility at international level remains an issue which causes much controversy (see Hassan, McCullough & Moreland, 2009).

2.2 The Structure of the Underage National Leagues in Ireland

In more recent years, the FAI have made changes to the structure of how the game is played in Ireland. The FAI's Player Development Plan (PDP), which was introduced by High Performance Director Ruud Dokter in early 2015, includes a set of recommendations for how the game should be played at underage level across the country. Recommendations outlined in the plan include "implement a player-focused model based on enjoyment and skill development to reduce the emphasis on winning at all costs" and to "restructure the playing model for underage football (boys/girls) to a clear policy on the best age-specific formats of the game to be implemented by all leagues" (The Football Association of Ireland, 2015, p.3 & p.6).

The Under 19 (U19) national league commenced in 2012, replacing the Under 20 (U20) and Under 21 (U21) leagues. In 2015, a national U17 league started, which was another of the recommendations in the PDP, identifying the need to "establish improved elite competition structures" (The Football Association of Ireland, 2015, p.15). This has also resulted in the

formation of two more elite level national league competitions - an U15 national league which was introduced in 2017 and the Under 13 (U13) national league which was introduced in 2019. A further elite level national league competition is set to be introduced for the 2021 season, with the formation of an Under 14 (U14) national league. Recent years have also seen the introduction of the women's Under 17 national league competition.

Prior to the Covid-19 pandemic affected 2020 season, the U17 and U19 national leagues consisted of two divisions, the Northern Elite Division, and the Southern Elite Division, with a playoff system used to determine the overall winner at each age group. For example, in the 2018 season, ten teams competed in the U19 Southern Elite Division, and eleven teams competed in the Northern Elite Division. The U17 league used a similar format for the 2018 season, with eleven teams competing in the Southern Elite Division, and eleven teams competing in the Northern Elite Division. The U15 national league ran with four groups of six teams, with the top two from each group progressing to the finals stage. The teams are divided based broadly on geographic location, with the large number of teams from the greater Dublin area being split between each of the two divisions at U17 and U19 level.

2.3 Introduction to Literature on RAE

In various activities, participation at youth levels is organised into groups based on the age of the participants, which are organised with the use of specific cut off dates (Cobley et al., 2009a). Such a policy tends to be used in a variety of fields, most commonly in the areas of sport, education, and epidemiology (Wattie, Schorer & Baker, 2015). Consecutive cut-off dates are commonly separated by a period of twelve or twenty-four months, with the 1st of January being a commonly adopted cut-off date in the field of sport. Meanwhile, cut-off dates for education tend to occur in the late summer or early Autumn, to coincide with the beginning of the new school year. However, a variety of other cut-off dates are also utilised in different locations across the world. In some cases, the cut-off dates for the same activity or program within a

country can be varied. One such example is within the education system in the United States (US), which is discussed in more detail below.

The implementation of these policies invariably leads to relative age differences between those within the selection period, with those born in the earlier months of the period being relatively older, by a potentially significant margin (as much as twelve months minus one day), than those born in the later months of the selection period (Wattie, Schorer & Baker, 2015). In some cases, particularly in underage elite level sport, consecutive cut-off dates can be separated by a longer period of twenty-four months, resulting in even greater relative age differences within the cohorts (as much as twenty-four months minus one day). It has been widely acknowledged in the literature that grouping participants with respect to age results in advantages for some and disadvantages for others (Wattie, Schorer & Baker, 2015).

Physical and anthropometric advantages remain central to the occurrence of a relative age effect but are not the only causal mechanism - cognitive factors are also important. These effects likely interact with the physical advantages of relatively older players. Typically, it is contended that advanced biological maturity allows relatively older players to form positive psychological states. As Helsen, Van Winckel & Williams (2005) suggest, a youth footballer's perception of success or failure assists the reinforcement of age effects. The implication is that players benefit from initial success, securing greater practice levels, supplementary playing time and access to improved mentoring. The role of coaches in identifying talent and eliminating the bias has also been subject to academic research. Mentoring perceptions of talent can be biased at early stages of a player's development. It has also been observed that there is a tendency from coaches to select bigger players, which are often those players born earlier in the calendar year, while smaller players, usually those born later in the calendar year, are excluded (Ramos-Filho & Ferreira, 2021). This bias might be rational, given that the measure of a coach's performance may be based on the team's success (Deaner, Lowen & Cobley,

2013), and that physical advantages of relatively older players at young age groups are more pronounced, meaning they are therefore more likely to achieve success in sports in which physical size and strength are important. Recent studies have assessed whether coaches' awareness of RAE can reduce the bias, from which evidence has shown that awareness fails to eliminate or reduce the bias, but it has been proven that the bias can be diminished with the salient use of information regarding the relative age of a player (Hill & Sotiriadou, 2016; Andronikos et al., 2016).

2.4 RAE in Education

RAE was first demonstrated in the field of education in the early twentieth century, when research revealed that those who excelled in academic settings tended to be born in the earlier months of the calendar year (Pintner & Forlano, 1934; Huntington, 1938). Subsequently, other terms have been used to refer to the RAE phenomenon in educational settings, such as 'birth-date effect' and 'age-position effect' (Cobley et al., 2009b). RAE in educational settings have been shown to have the same consequence as RAE in sport, in that "relatively younger children within a cohort are more likely to experience attainment and selection disadvantages compared to their relatively older peers" (Cobley et al., 2009b, p.520). For example, Bedard & Dhuey (2006, p.1,438) state that "children who are young at school entry are more likely to repeat a grade".

Like the policies adopted in sporting settings, education systems make use of cut-off dates for school eligibility, in order to group the students into age-specific cohorts (Bedard & Dhuey, 2006). Cut-off dates in educational settings tend to be in the later months of the year, coinciding with the beginning of the school year. In the US, individual states tend to select their own cut-off dates for entry into school. For example, in California, a child must have reached their fifth birthday on or before the second of December to be eligible to enrol in kindergarten in the Autumn of that year (Dickert-Conlin & Elder, 2010). In contrast, in the state of Illinois, children

must have reached their fifth birthday before the 1st of September, to be eligible to enrol in kindergarten in the Autumn of that year (Elder & Lubotsky, 2009). In Ireland, a child must have reached the age of four before the beginning of the school year (late August or early September, depending on the school), in order to enrol in primary school education. Despite this, compulsory education in Ireland does not begin until the age of six (The Department of Education and Skills, 2021), resulting in further potential for increased relative age differences, and thus more significant advantages for those who are relatively older. In the United Kingdom (UK), children have reached compulsory school age before the end of the year on the 31st of December, the 31st of March, or the 31st of August following their fifth birthday (Gov.uk, 2021). Children must begin full-time education at the beginning of the term immediately following the relevant date (e.g., if a child reaches the compulsory school age before the 31st of March, they are required to begin full-time education at the beginning of the next school term) (Gov.uk, 2021).

Like some studies conducted in sporting settings, studies completed in educational spheres identify that the relative age difference is most prevalent in the earlier years of school. For example, if children must be five years old on the 1st of September, then the relatively oldest can potentially be as much as 20% older than their relatively youngest counterpart in the same grade (Bedard & Dhuey, 2006). It has been well documented that performance of pupils in school correlates with their age position within the academic year (Bell & Daniels, 1990; Alton & Massey, 1998).

Many studies have revealed a relationship between time of birth and school success. Students who are relatively older tend to score higher on tests (Bedard & Dhuey, 2006). Child development research has indicated that "children's social, emotional, intellectual and physical maturity levels" are all important factors which have been linked with school success (Attar & Cohen-Zada, 2018, p.38). As a result, an increasing number of parents, particularly in the US,

have begun to voluntarily delay sending their children to school (McEwan & Shapiro, 2008; Graue & DiPerna, 2000).

2.5 RAE in Sport

RAE were first observed in sporting settings in the mid-1980s in studies conducted by Grondin, Deshaies & Nault (1984) and Barnsley, Thompson & Barnsley (1985). Grondin, Deshaies & Nault (1984) examined the distribution of birth dates among ice-hockey and volleyball players in Canada, participating across three different levels – recreational, competitive, and senior professional level. Both studies identified that being relatively older within an age-specific group of players provided significant advantages when compared to relatively younger players (Cobley et al, 2009a). There is now a wide body of literature documenting RAE, with studies having identified similar birth-date related patterns across all youth levels of competition in many different sporting fields, in various locations.

Since these early studies, the literature has revealed RAE to be present in all age categories and have been observed to increase with age (Romann et al., 2020). Cobley at al. (2009a) identified RAE in fourteen different sports (ice hockey, volleyball, basketball, American football, Australian rules football, baseball, soccer, cricket, swimming, tennis, gymnastics, netball, Rugby Union, and golf), having analysed data from male and female athletes ranging from the age of four years old, right through to senior or adult level.

The cut-off dates utilised to organise participants into age-dependent cohorts can vary from country to country, within the fields of both sport and education. For example, the cut-off date for grouping youth players for competitive football in England is the 1st of September (The Football Association, 2020), whereas in Ireland, the cut-off date for competitive football is the 1st of January. This date changed from the original cut-off date of the 1st of August in the aftermath of a policy change in 1997 (Butler & Butler, 2015).

The organisation of youth level sport participation into annual (or bi-annual) cohorts is a policy which is implemented in the interest of facilitating developmentally appropriate instruction (Musch & Grondin, 2001), promoting fairer competition, and providing all participants with an equal opportunity of participation (Romann & Fuchslocher, 2013) and success (Barnsley, Thompson & Legault, 1992). Despite this, some of the literature on the topic, such as an early study conducted by Barnsley, Thompson, & Barnsley (1985), suggests that such a policy remains insensitive to subtle chronological age differences between participants who are grouped together in an annual-, or bi-annual cohort. Wattie, Schorer & Baker (2015, p.84) opine that "discrepancies in age between those born immediately after and those born immediately before the date used to group learners into cohorts (i.e., relative age) lead to significant differences in social evaluations". Such differences have been discovered in the field of education, in terms of having effects on the grading of students (Thompson, 1971; Cobley et al., 2009b), and also in terms of influencing talent identification in sporting fields (Wattie, Cobley & Baker, 2008). These significant differences have been shown to be associated with immediate and long-term consequences, commonly known as RAE's (Cobley et al., 2009a). RAE has been shown to exist among elite youth sportspersons, from very young ages at the beginning of sporting careers, right through to late adolescence, in many different sports in various countries and across larger geographic regions (Helsen, Van Winckel & Williams, 2005; Barnsley & Thompson, 1988; Cobley et al., 2009a).

It has been suggested in the literature that age-based comparisons can last into adulthood (Wattie, Schorer & Baker, 2015). Some of the research to date suggests that the effects are at their most significant among athletes at the point of puberty (Delorme & Raspaud, 2009), as a one-year age difference can heighten physical (Baxter-Jones et al., 1995) and performance (Malina, Bouchard & Bar-Or, 2004; Levfvre et al., 1990) differences (Cobley et al, 2009a).

Sierra-Díaz et al. (2017) conclude that RAE in football increases at young categories, but decreases in elite categories, when compared to the footballing population, rather than the national population. Other studies have identified that the influence of relative age differences, which benefit players born earlier in the year, tend to decrease with the mental and physical maturation of players (Gibbs, Jarvis & Dufur, 2012; McCarthy & Collins, 2014).

Along with the increased likelihood of selection to play at higher levels comes another significant advantage for relatively older players - exposure to greater resources such as higher levels of coaching (Helsen, Starkes & Van Winckel, 1998). Consequently, and coupled with the fact that players who are selected to play at a higher level experience "higher competition and more rewards, it is quite predictable that they should continue with the sport and gain more long-term success" (Barnsley, Thompson & Legault, 1992, p. 84).

Wattie, Schorer & Baker (2015), put forward the example of the relatively oldest nine-year-old participant, who is potentially almost 10% older than the relatively youngest participant within the cohort. The physical and psychological advantages this nine-year-old would possess, in comparison to the relatively youngest nine-year-old are substantial. Taking the example of sixteen-year-olds, the relatively oldest participant would be only approximately 6% older, meaning the gap in terms of the physical and maturational advantages may have been narrowed as time has progressed. While these examples would be at the most extreme ends of the scale, when basing the comparison purely on physical maturation, it serves to highlight how relative age differences are present to a greater extent at a younger age.

One sport in which RAE tend to be less evident at some age categories is artistic gymnastics, a sport where physical traits such as height and mass impede important attributes such as flexibility, rotational speed, and the strength to mass ratio (Cobley et al, 2009a). Hancock, Starkes & Ste-Marie (2015) identified a "flip-flop" effect among gymnasts, whereby, when analysing data relating to gymnasts under fifteen years of age, their study revealed that

relatively older gymnasts were advantaged. In contrast, when they turned to their attention to analysing data pertaining to gymnasts over fifteen years of age, it was found that relatively younger athletes were advantaged.

A wealth of research in the area has (i) identified the robust nature of the bias, (ii) investigated the underlying causes and (iii) considered the effects of this research (Verhulst, 1992; Brewer, Balsom & Davis 1995; Helsen, Van Winckel & Williams, 2005; Cobley, Schorer & Baker, 2008; Helsen et al., 2012). In the case of European football, recent evidence has confirmed that the bias exists among participants in underage football but fades at senior level (González-Víllora, Pastor-Vicedo & Cordente, 2015). While the skewed distribution of births disappears at senior level, in their study of Italian football, Fumarco & Rossi (2018) identified that relatively younger players, born later in the calendar year receive lower wages when compared to relatively older players born in the earlier months of the calendar year. This occurs despite their finding that there is no RAE on performance among their sample.

In recent times, academic research tends to reflect a division among researchers as to the "respective importance of environmental and biological (i.e., genetic) contributions to exceptionality" (Baker & Horton, 2004, p.211). Among the primary factors affecting, or impeding an athlete's journey, as identified by Baker & Horton (2004), are genes, psychological characteristics, and training, i.e., the quantity and quality of the training undertaken by the athlete. The same study also identifies secondary factors which affect the type, amount and quality of the training attained by an athlete during their development. Such factors include the cultural importance of the chosen sport, as well as instructional resources, which refers to factors such as access to essential resources including knowledgeable coaches (Baker & Horton, 2004), and parental support (Baker et al., 2003). The impact of these factors is discussed at length in Baker & Horton (2004).

Hancock, Starkes & Ste-Marie (2015), find that as the body of literature in the field of RAE has expanded, some of the research in the area (e.g., Helsen et al., 2000; Sherar et al., 2007) has shown that coaches are liable to mistake physical maturity for talent, an assertion which was previously put forward by Starkes (2000). The same studies also identify that physical maturity is associated with enhanced performance among youth athletes. Romann et al., (2020) state that, in sport in particular, studies have revealed that social agents such as parents, coaches, and athletes (Cobley et al., 2009a) can also have a significant influence on the presence of RAE, as social agents tend to falsely associate physical maturity with skill advantages, or differences, as well as through accelerated RAE.

RAE tend to occur during the earlier stages of the development of youth sport participants (Cobley et al., 2009a; Smith et al., 2018) and can lead to coaches making biased decisions on the potential of children within their chosen sport. Various studies in recent years have revealed that relatively older athletes within an annual cohort are more likely to be identified as more talented, in comparison to the relatively younger counterparts (Cobley et al., 2009a; Gil et al., 2014; Wattie, Schorer & Baker, 2015; Smith et al., 2018). Cobley et al (2009a) identified that relatively younger athletes within annual cohorts were "(i) less likely to participate in recreational and competitive sport from under fourteen years of age; (ii) certainly less likely to participate on representative teams during the fifteen- to eighteen-year-old bracket; and (iii) less likely to become an elite athlete in the sport contexts examined". From this, along with a study by Helsen, Starkes & Van Winckel (1998), they drew the conclusion that "sport is less likely to be an activity or career pathway for relatively younger individuals", meaning those who are born in the last quarter of the selection period (Cobley et al., 2009a).

Using a case study of the U15, U17 and U19 elite level national leagues in Ireland, this study seeks to identify whether players who are relatively younger are less likely to be identified as talented, or to be selected to play at an elite level at a young age. Along with this, the study

will seek to understand whether relatively younger players are statistically less likely to be identified as dropouts from elite level football later.

The topic of RAE has been subject to extensive research in soccer on a European level, and in various countries, for example, in Germany by Cobley, Schorer & Baker (2008) in Switzerland by Romann et al. (2020), and across Europe by Helsen, Van Winckel & Williams (2005) and Helsen et al. (2012). Many of these studies have sought to understand why the bias exists.

While research concerning the dropout of initially successful players is undeveloped, a recent examination of RAE by Skorski et al. (2016) has highlighted the relevance of same with respect to the topic of player development. Specifically, the study shows that relatively younger players who are chosen for their national teams have an improved chance of becoming professionals later in their career (Skorski et al., 2016).

2.5.1 Overview of Literature on the Relationship Between RAE and Dropout in Sport

Studies on the rate of attrition among youth athletes have identified many reasons leading to player dropout. A large proportion of youth athletes drop out of sport before they reach adulthood (Fraser-Thomas, Côté & Deakin, 2008; Fraser-Thomas and Côté, 2009). Despite the obvious and well-known links between physical activity and both physical and mental health, there has been a big decline in the levels of adult physical activity in recent years (Slater & Tiggemann, 2010). Kirshnit, Ham & Richards (1989) identified that around 80% of all children stop participating in organised sports programmes between the ages of twelve and seventeen. They identified two major categories of reasoning behind dropout from sport – interest in, or conflict with other activities, and the overly professionalised nature of modern-day youth sports programmes.

Included in the latter are aspects such as lack of playing time and pressure to win, two aspects which the FAI's PDP seeks to address in Ireland in the coming years. It appears a large proportion of young people are not comfortable with the ever-growing levels of commitment,

in terms of both time and finance, which can be associated with youth level sport. The PDP addresses this issue, by recommending that less emphasis be placed on winning at all costs, and more on development of the individual.

RAE as a factor contributing to dropout levels in sport has received increased levels of attention in academic research in more recent years. Studies have been conducted on the relationship in ice hockey (Lemez et al., 2014), basketball (Delorme, Chalabaev & Raspaud, 2011), and football (Delorme, Boiché & Raspaud, 2010a; Delorme, Boiché & Raspaud, 2010b; Helsen, Starkes & Van Winckel, 1998). Table 1 below provides an overview of each of these studies, giving an insight into the participants in each study, their methodologies and the results and conclusions of their analysis. The studies report that RAE can be linked to an increased level of dropout from sport and indicate that levels of dropout tend to be higher among the relatively younger participants within an age-specific cohort.

Lemez et al. (2014) employed a goodness of fit chi-square test to compare the distribution of births of their sample of 14,325 male youth ice-hockey players in Ontario, Canada, to their theoretical distribution of 25% of births per quartile. The analysis revealed an overrepresentation of players born in the second quarter and an underrepresentation of players born in the fourth quarter of the selection year. A second goodness of fit chi-square test was conducted to examine player dropout across a five-year period. This test revealed that the highest percentage of dropouts occurred in the fourth quarter, followed by the second highest percentage in the third quarter.

Delorme, Chalabaev & Raspaud (2011) conducted their analysis among over 70,000 French male and female youth basketball players of mixed levels, who had dropped out at the end of, or during, the 2005-2006 season. Similar to Lemez et al. (2014), Delorme, Chalabaev & Raspaud (2011) conducted chi-square tests, which revealed an overrepresentation of dropouts among players aged between nine and fifteen, born in the last quarter of the selection period.

Table 1: Literature on the Relationship Between RAE and Dropout

Authors	Aim of the study	Participants	Method	Results	Conclusions
Helsen, Starkes & Van Winckel (1998).	To investigate whether asymmetries similar to those which emerge in the birth-date distributions of senior professional soccer players emerge through youth categories in soccer.	Participants from 4 categories of players in Belgium. 408 first division professional players between 1993 and 1996, 369 youth players (ten to sixteen years old) selected to play for the 1989-1995 national teams, 485 youth players (six to sixteen years old) transferred to a first division youth team by an official youth transfer in 1995 and 483 youth players from regular youth leagues.	Conducted K-S tests to assess differences between the observed distribution of births, drawn from the birth distribution of players across the 4 categories, with the expected distribution of births, which was calculated from births of the general Belgian population for the corresponding years.	Players born early in the selection year are more likely to be identified as talented, while from the age of 12 years on, there were a higher number of dropouts among players born towards the	The result of the research indicates that there is a relationship between RAE and dropout, as well as identifying that players born earlier in the year are more likely to be identified as talented, and therefore be exposed to better levels of coaching.
Delorme, Boiché & Raspaud (2010a).	To examine the birthdates distribution of French male soccer players who ceased their participation in the sport during the 2006-2007 season, in order to test whether RAE is linked to dropout patterns.	363,590 French male soccer players licensed during the 2006-2007 season, who had not reiterated their license for the following season. Age categories included in the sample were U7, U9, U11, U13, U15, U18 and adults.	Employed a chi-square test to determine whether the observed distribution of births, drawn from French male footballers who dropped out from the sport, differed from the theoretical distribution of births, which was generated from the population of licensed players.	At U9, U11, U13, U15 and U18 categories, players born in the third and fourth quartiles were overrepresented in the dropout figure, when compared to the whole population of licensed players. No significant difference was found between the theoretical and observed distribution for the U7 and adult categories.	The overrepresentation of players born late in the selection period, and an underrepresentation of players born early in the selection period found among dropouts confirms that RAE can act as a dropout factor.

Delorme, Boiché & Raspaud (2010b).	To investigate whether RAE was present among a sample of French female football players, and subsequently assess the birth distribution of players identified as dropouts.	57,892 French female players affiliated to the French Soccer Federation for the 2006-2007 season, with categories ranging from <8 years old through to adults. Dropouts were those who did not reiterate their affiliation for the 2007-2008 season.	Employed a chi-square test to compare the distribution of French female football players with their theoretical distribution of female births in France during the corresponding time period. Second chi-square test used to compare the distribution of births of dropouts with the distribution of births of all licensed female players, using weighted mean scores.	Statistical differences between the observed and expected distributions were found at all age categories, with an overrepresentation of players born in Q1 and Q2 found at all youth categories. A significantly biased distribution of births of dropouts was found for the <10, <14 and <17 age categories, with players born in Q1 and Q2 underrepresented, and players born in Q3 and Q4 overrepresented.	RAE appears to decrease with the level among females. There was a higher rate of dropout among players born later in the competitive year. The results contradict results of some previous studies conducted among samples consisting of female participants.
Delorme, Chalabaev & Raspaud (2011).	To investigate the relative age effect as a factor of basketball dropout.	44,498 male and 30,147 female French basketball players who dropped out from the sport during or at the end of the 2005-2006 season. Age categories included in the data were less than "7 years old", "7-8 years old", "9-10 years old", "11-12 years old", "13-14 years old", "15-17 years old" and "over 18 years old".	Conducted chi-square tests comparing the distribution of births of French basketball players identified as dropouts with a theoretical distribution of births based on the births of all licensed basketball players in France during the corresponding time period.	Concerning males, the dropout rate was at its highest in the "15-17 years old" category. The "9-10 years old", "11-12 years old" and "13-14 years old" categories revealed an overrepresentation of dropouts born in the fourth quartile and an underrepresentation of dropouts born in the first two quartiles. Considering females, the "9-10 years old", "11-12 years old", "13-14 years old" and "15-17 years old" categories had an overrepresentation of dropouts born in the fourth quartile and an underrepresentation of players born in the first and second quartiles.	Findings of the study lead to the conclusion that RAE should be taken into consideration in studies pertaining to dropout levels in sport. It is a variable which may have a significant influence on the level of dropout.
Lemez et al. (2014).	To examine the distribution of birth dates of players who ceased their participation in a particular sport, in this case: ice-hockey	14,325 Ontario Minor Hockey Association male ice-hockey players, ranging in age from ten to fifteen years.	Conducted chi-square tests comparing the distribution of births of ice-hockey players with a theoretical distribution (25% born per quartile). Second chi-square test used to examine the relationship between dropout and quarter of birth across a five-year period.	Dropout levels were highest among players born in quartiles three and four. Compared to those born in the first quartile, those born in the fourth quartile are 1.17 times more likely to dropout. Players born in the second and third quartiles were not significantly more or less likely to drop out.	Identified that there is a relationship between relative age and dropout levels in ice-hockey, with the relatively younger more likely to dropout from ice-hockey.

Unlike previous studies which had compared the distribution of their samples to that of the general population, Delorme, Chalabaev & Raspaud (2011) took their theoretical distribution to be the total population of licensed players, comparing this to the observed distribution of dropouts using weighted mean scores. The study found the overrepresentation of final quarter births among dropouts to be present between the age categories of U9 and U18, while also noting an underrepresentation of dropouts among their counterparts who were born earlier in the competitive year.

Delorme, Boiché & Raspaud (2010a) employed a chi-square test to assess whether the observed distribution of births, generated from the birth distribution of 363,590 French male footballers who dropped out from the sport, differed from the theoretical distribution of births, which was generated from the population of licensed players.

Delorme, Boiché & Raspaud (2010b), in their analysis of over 50,000 French female football players, made use of chi-square tests to again report an overrepresentation of dropouts among those born later in the competitive year. Similar Delorme, Boiché & Raspaud (2010a, the study chose to compare the distribution of births of players identified as dropouts with the theoretical distribution of births of all licensed players during the corresponding period.

By means of analysis using Kolmogorov-Smirnov (K-S) one sample tests, Helsen, Starkes & Van Winckel, (1998) noted, based on their sample of over 1,700 Belgian football players, which included both youth players and professional first division players, that those born later in the selection period tended to drop out from the sport as early as at the age of twelve. The sample consisting of players competing at an elite level means that this study may be the one with the most basis for comparison with the current research.

All the above studies have reported a common trend - players born later in the calendar year are overrepresented in their samples of dropouts. Preliminary analysis of the dataset provided by the FAI suggests that this is not the case for elite underage national league players in Ireland.

Thus, the second hypothesis to be tested in this study is that underage national league players born earlier in the calendar year are more likely to be identified as dropouts.

2.5.2 The Role of Coaches in the Development of Young Players

While this study concentrates on elite level football, the "significance of the nexus between volunteers and sport organizations should not be underestimated", as volunteer activity plays a significant role in the delivery of organised sport in communities across the globe (Cuskelly, McIntyre and Boag, 1998, p.181). For example, in most sports, almost all grassroots coaches involved in the development of skillsets of young athletes will be volunteers. In the case of Irish football, these coaches perform their volunteer activities in clubs affiliated with the FAI, who provide support in the form of coach education courses, among other services. Football clubs around the country work in tandem with the FAI to ensure that their coaches are in a position to deliver a safe environment, and good quality of coaching for young players.

The activities undertaken by volunteers at all levels play a key role in the provision of organised sporting activity throughout the world (Cuskelly, Hoye & Auld 2006). For example, The Children's Sport Participation and Physical Activity Study (CSPPA) identified that 97% of the total workforce involved in junior sport in Ireland were unpaid volunteers (Walsh, Tannehill & Woods, 2011). Therefore, the role of volunteers is critical in the provision of organised sport in Ireland, with those involved in a coaching role playing a particularly key role when it comes to the development of the skillsets of young athletes.

In sport in Ireland, clubs and organisations rely heavily on the activities of volunteers at a local level, with 12% of the Irish population aged sixteen and over regularly volunteering for sport (Sport Ireland, 2019). A further two-fifths indicated that they had previously volunteered for sport, a third of which, equating to 13% of the population, reported that they had volunteered for sport in the previous twelve months. Aggregating these figures reveals that approximately

a quarter of the population aged over sixteen, or one million people, responded to say that they had volunteered for sport in the twelve months preceding the 2019 Irish Sports Monitor.

While it is important to note that the coaches of underage national league teams tend to have completed coaching education courses (FAI National D Licence, UEFA A/B Licence etc.), and thus will be able to offer better quality of coaching, it is grassroots coaches and clubs who nurture the talented young players in their early days playing football, before they reach an age where the opportunity to play at an elite level arises.

2.6 Summary and Conclusion

The individual topics of RAE and player dropout have been the central motivation of much research in the field of sports research, while a number of studies have also sought to understand the relationship between them. However, there is a gap in the research when it comes to exploring this relationship regarding elite level underage players in Ireland. Exploring the relationship between RAE and player dropout at elite levels should give an insight into why the phenomenon of RAE dissipates at senior international level. Therein lies the aim of this research.

3 DATA

The data used in this research are drawn from two sources, from a dataset provided by the FAI and from the Central Statistics Office (CSO), Ireland's national statistical office. The dataset provided by the FAI consists of data relating to all players who competed in any one of three different age groups of the underage national leagues in Ireland, across a nine-year period. Data collected from the Central Statistics Office includes birthdate data for the male population in Ireland, for those who were born in the same years as the players included in the FAI dataset. The data are used to draw comparisons between the distribution of births of the players and the wider population of males.

3.1 Introduction to Player Data and Male Population Data

Using official data received from the FAI, we analyse player selection patterns at underage national league level, across the age groups of U15, U17 and U19, from 2012 to 2020. Following consultation with the Director of High Performance and the Head of Research within the FAI, we access a database containing data on almost 9,000 elite level player registrations, for players who had competed in underage national leagues in Ireland during the period. These are players who transition across age groups rather than almost 9,000 independent players. The reasoning for this decision is clarified in section 6 of the paper.

Included in the database are basic details relating to players who were registered with an U19 national league team between 2012 and 2020, players registered with an U17 national league team between 2015 and 2020 (the shorter time period is a result of the U17 national league competition not being introduced until the 2015 season), and players registered with an U15 national league team between 2017 and 2020 (the shorter time period is a result of the U15 national league competition not being introduced until the 2017 season).

Using this dataset, it is possible to track player progression through time. We access a database of 8,971 elite Irish player registrations for players who competed in the domestic national

league. The FAI established a national U19 league for the first time in Ireland in 2012, with 3,989 player registrations in this league in the period up to the end of the 2020 season. The formation of the U19 league was shortly followed by the introduction of a national U17 league in 2015, with 2,967 player registrations recorded with this league up to the end of the 2020 season. The U15 national league had its first season in 2017, and the remaining 2,015 player registrations are at this age group of national league football. Table 2 provides a breakdown of the number of player registrations in each of the underage leagues per season.

Table 2: Number of Players Registered by Year in Each National League Age Group from 2012 to 2020

	U15	U17	U19
2012	-	-	232
2013	-	-	377
2014	-	-	395
2015	-	335	577
2016	-	582	475
2017	469	536	527
2018	522	505	523
2019	507	538	505
2020	517	471	378
Total	**2,015**	**2,967**	**3,989**

Source: Football Association of Ireland

The teams participating in the underage leagues are based in the twenty-six counties of Ireland, with the single exception of Derry City, which is located in one of the six counties of Northern Ireland. In the national leagues in Ireland, many of the teams are located in the greater Dublin area in the east of the country, the country's major urban centre.

Twenty clubs compete in the two senior divisions of the national league in Ireland – the SSE Airtricity League Premier Division and the SSE Airtricity League First Division. There is a promotion and relegation system operated between these two leagues, however there is no relegation from the first division, meaning the same twenty teams compete in each season,

unless a new club is introduced, or an existing team leaves. Table 3 gives the breakdown of the number of clubs which registered a team in the U15, U17 and U19 leagues in each of the seasons in question.

Table 3: Number of Teams Competing in the Underage National Leagues from 2012 to 2020

	U15	U17	U19	Total
2012	-	-	15	**15**
2103	-	-	15	**15**
2014	-	-	16	**16**
2015	-	16	17	**33**
2016	-	23	20	**43**
2017	24	22	21	**67**
2018	24	22	21	**67**
2019	24	24	22	**70**
2020	25	23	20	**68**
Total	**97**	**130**	**167**	**394**

Source: Football Association of Ireland

These figures consist of teams representing the twenty Premier Division and First Division League of Ireland clubs, as well as some schoolboy leagues representative teams. Grassroots football in Ireland is played on a regional basis, with a total of 32 league associations throughout the country. Some of these leagues have entered representative teams in underage national leagues, such as Mayo Schoolboys and Youth Association Football League, Kildare and District Underage League (playing under the name of Klub Kildare) and Cavan-Monaghan Underage Leagues, among others. As well as this, a new club, Carlow Kilkenny Football Club have also joined the leagues.

Included in the anonymised dataset were the dates of birth of the players, the names of the clubs with which they were registered, their contract status at the time of the data collection and the seasons in which they were registered as a player in one of the underage national leagues in Ireland. Further tracking of the players upon the cessation of their participation in the underage national leagues is not possible due to the anonymisation of the data.

Table 4 shows the average squad size across the three age groups in each season. The data presented in Table 4, along with the data pertaining to the total number of player registrations presented in Table 3, shows how the average squad sizes and the total number of player registrations have fluctuated across the study period.

Table 4: Underage National League Average Squad Size from 2012 to 2020 (Number of Players)

	U15	U17	U19	Total
2012	-	-	15.47	**15.47**
2103	-	-	25.13	**25.13**
2014	-	-	24.69	**24.69**
2015	-	20.94	25.35	**23.15**
2016	-	25.30	23.75	**24.53**
2017	19.54	24.36	25.10	**23.00**
2018	21.75	22.95	24.90	**23.20**
2019	21.13	22.42	22.95	**22.17**
2020	20.68	20.48	18.90	**20.02**
Total	**20.77**	**22.55**	**22.96**	**22.10**

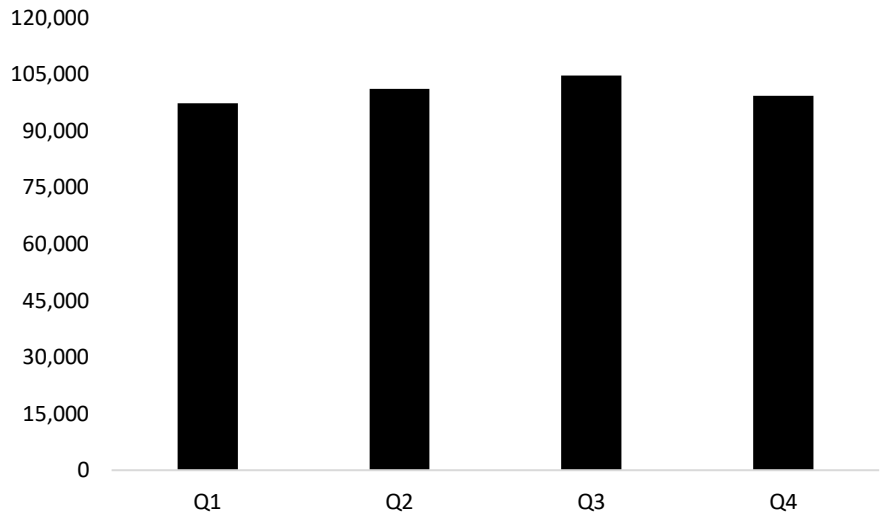
Source: Football Association of Ireland

U19 player registrations decreased significantly for the 2020 season (down to 378 from 505 in 2019), as the average squad size was reduced significantly from 22.95 in 2019 to 18.90 in 2020. The number of player registrations at U17 level also dropped in the 2020 season, with just 471 player registrations, down from 538 in the previous season, in 2019. The average squad size fell slightly from 22.42 in 2019 to 20.48 in 2020. The total number of U15 players has remained quite constant across the three seasons from 2018 to 2020, after an initial increase between the first season at this age group in 2017 and the second season in 2018.

The analysis in this study is carried out by drawing comparisons to further data, which were obtained from the CSO, pertaining to the birth date patterns of the male population in Ireland. The data, which were collected from the Report on Vital Statistics 2001 (The Central Statistics Office, 2003) and the VSA 19 databank table, includes the number of male births per day in each of the years in question, 1993-2006 (data.cso.ie, 2021). This range of years are chosen as

they correspond to the period within which all of the players included in the dataset were born. We then analyse these figures to generate monthly and quarterly totals and distributions for each individual year, to make it possible to draw comparisons to the distribution of births of the underage national league players. There are a total of 401,982 male births recorded in Ireland during the period between 1993 and 2006. Figure 1 shows the quarterly distribution of births of all males born in Ireland between the years of 1993 and 2006.

Figure 1: Distribution of Male Births in Ireland by Quarter of the Year From 1993 – 2006 (Number of Births)



Source: Football Association of Ireland

Data for the total number of male births in Ireland between 1993 and 2002 are used to compare the distribution of births of the U19 players to that of the wider male population, as this is the period during which all U19 players were born. In similar fashion, as all U17 players were born between 1998 and 2003, data for the total number of male births in Ireland between the years 1998 and 2003 are used for the comparison with the distribution of births of the U17 players. The distribution of male births between 2002 and 2006 is used for comparison with the distribution of births of the U15 players, as all U15 players were born during that period.

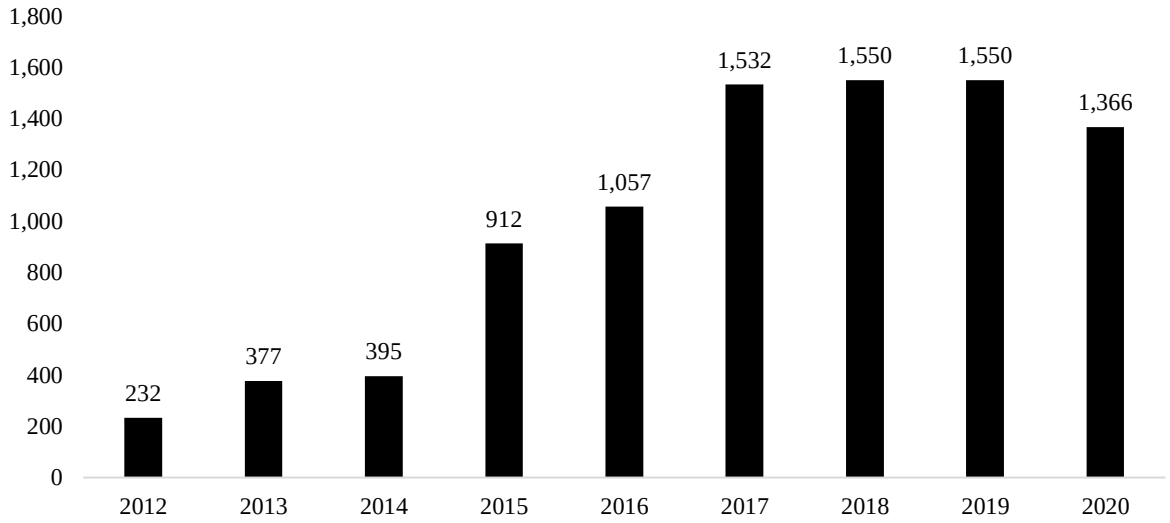
In the coming years, similar data will become available for the younger age groups of U13 and U14, which will provide opportunity for further research, in terms of analysing player selection

patterns as well as progression from a younger age, right through to the oldest age group of U19. Based on the literature, which suggests that RAE are stronger among players as they reach the point of puberty, it would be expected that a greater proportion of U13 and U14 players were born in the earlier months of the calendar year, in comparison to the U17 and U19 players in particular. As more data becomes available, both for the male and female underage national leagues, there should be scope for more in-depth studies to be conducted to assess player progression through all age groups, and through to senior national league level, as well as dropout levels at each age group.

3.2 Detailed Description of the Player Data

Figure 2 provides a graphical representation of the total number of players involved in the U15, U17 and U19 national league competitions in Ireland, in each of the individual seasons between 2012 and 2020.

Figure 2: Number of Player Registrations - U15, U17 and U19 National Leagues 2012 - 2020

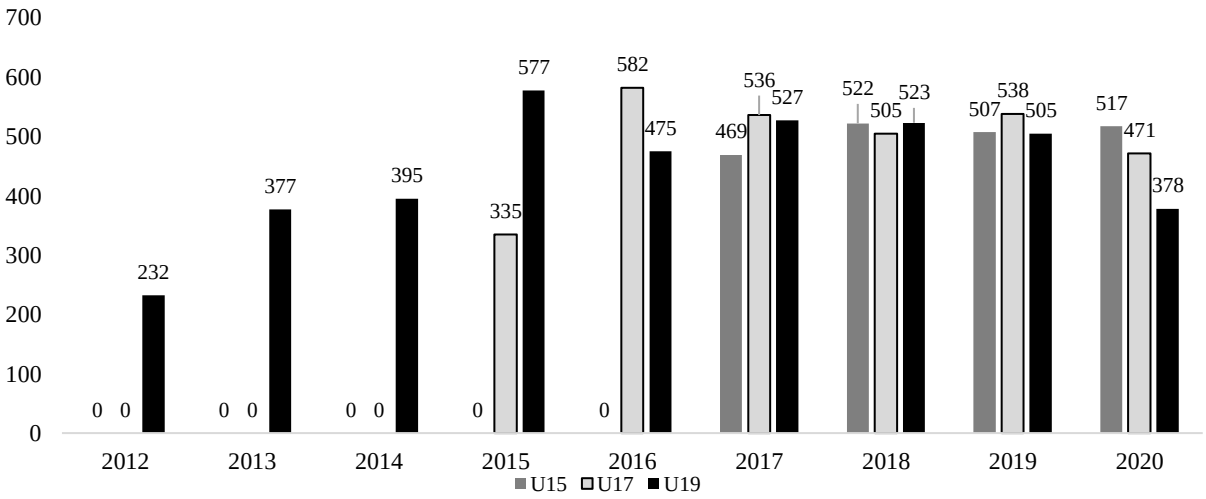


Source: Football Association of Ireland

The total number of player registrations is at its lowest in 2012, as this season was the year in which the underage national league system was introduced, with the introduction of the U19 league only. The total number of players registered to play in the leagues between 2012 and

2020 was at its highest during the 2018 and 2019 seasons, with a total of 1,550 players registered to compete across the U15, U17 and U19 national leagues in each of these seasons. The significant increase in the total number of players for the 2015 season is explained by the introduction of the U17 national league in that year, with the first games taking place in August of that year, as part of a truncated season which ended in December, to allow the 2016 season to run in parallel to the U19 national league season. The first U17 season in 2015 being a truncated season explains the slightly increased number of registrations in 2016, as less players would have been registered to compete in such a short season. The factor which led to the significant increase in the total number of registered players in the 2017 season is the introduction of the U15 national league in that season. Since then, the total number of players involved across U15, U17 and U19 level has remained relatively stable, with the exception the Covid-19 affected 2020 season, during which there was a decrease in the number of players at both U17 and U19 level. Figure 3 provides a further breakdown of the number of players involved in each of the respective age groups and shows how the total number of players at each of the age groups increased during the first few seasons of each age group, before stabilising.

Figure 3: Number of Player Registrations - U15, U17 and U19 National Leagues 2012-2020



Source: Football Association of Ireland

The season with the most U15 players was the 2018 season, in which there were 522 registered players. The number of U17 players registered to play with the national league was at its highest in the 2016 season at 582 registered players, while the number of U19 players registered to play in the national league was at its highest in the 2015 season, with 577 registered players.

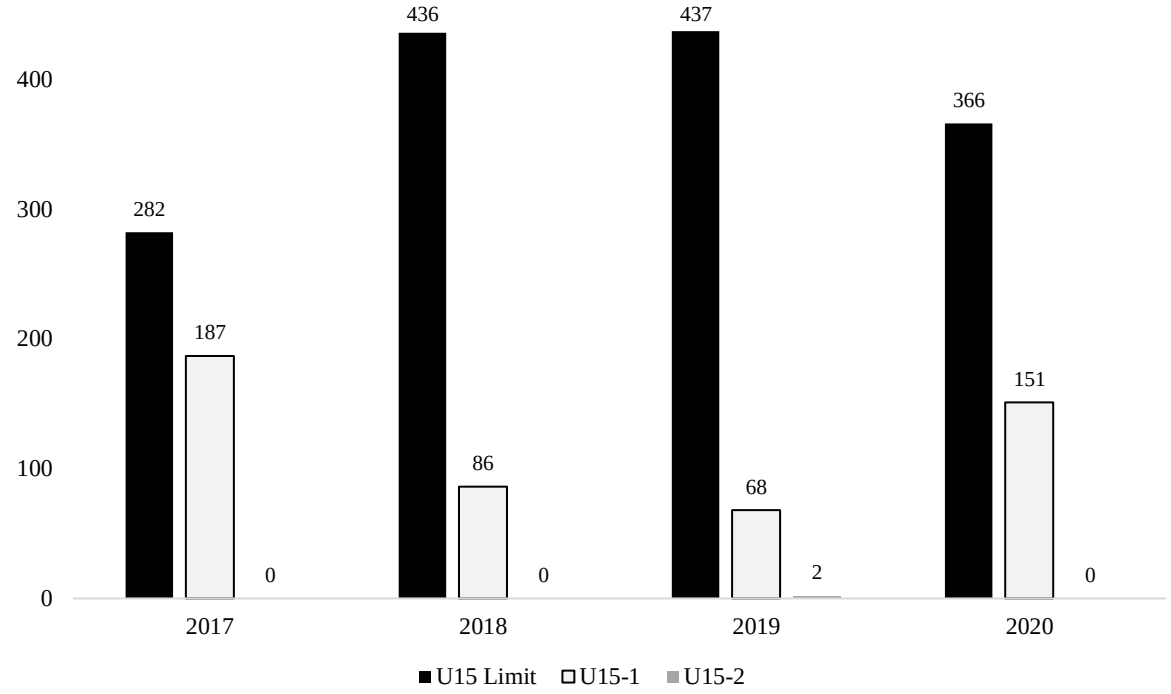
The introduction of the U13 and U14 national leagues will result in an even larger pool of players being introduced to the elite level underage football system in Ireland, which should serve to aid player development in the country in the coming years, as more players are exposed to higher levels of competition and coaching from a young age. It will also provide further scope for a larger scale study on dropout levels and the prevalence of RAE in underage national league competition.

The dataset outlined above allows for the use of statistical analysis to identify the prevalence of RAE within the sample of players. It is also possible to identify the rate of dropout among players, and to investigate whether there is a relationship between relative age and dropout levels. The data collected from the CSO are used to draw comparisons to the birth distributions of the players, to identify whether RAE were present, while analysis is conducted within the sample to identify dropout patterns.

As there is currently no U18 league, players who would be competing at that age group will be selected to play at U19 level. Similarly, as there is no U16 national league, and there had been no U15 national league until 2017, players at these two age groups competed at the U17 national league level. Figures 4, 5, and 6, below, present an insight into the total number of player registrations within each of the outlined age categories within each of the individual national league age groups across the period between 2012 and 2020.

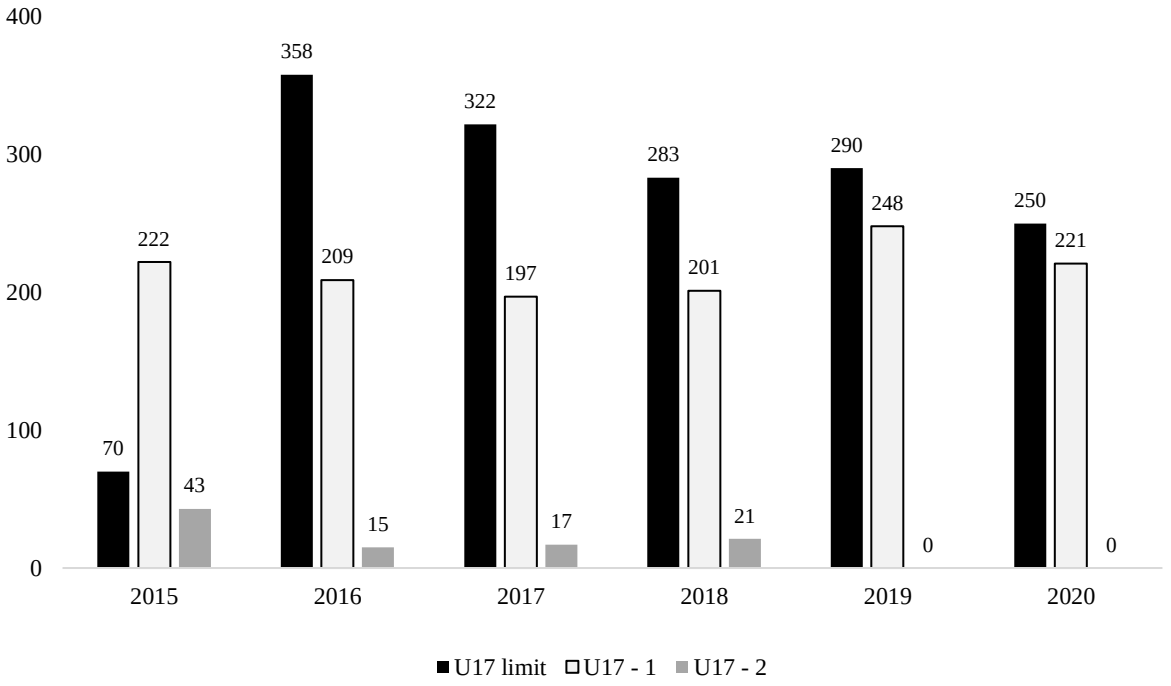
“U15 limit”, “U17 limit” and “U19 limit” (hereafter collectively referred to as the “limit” categories) are terms used to refer to a player who is on the age threshold for that age group.

Figure 4: Age Distribution - U15 National League Players



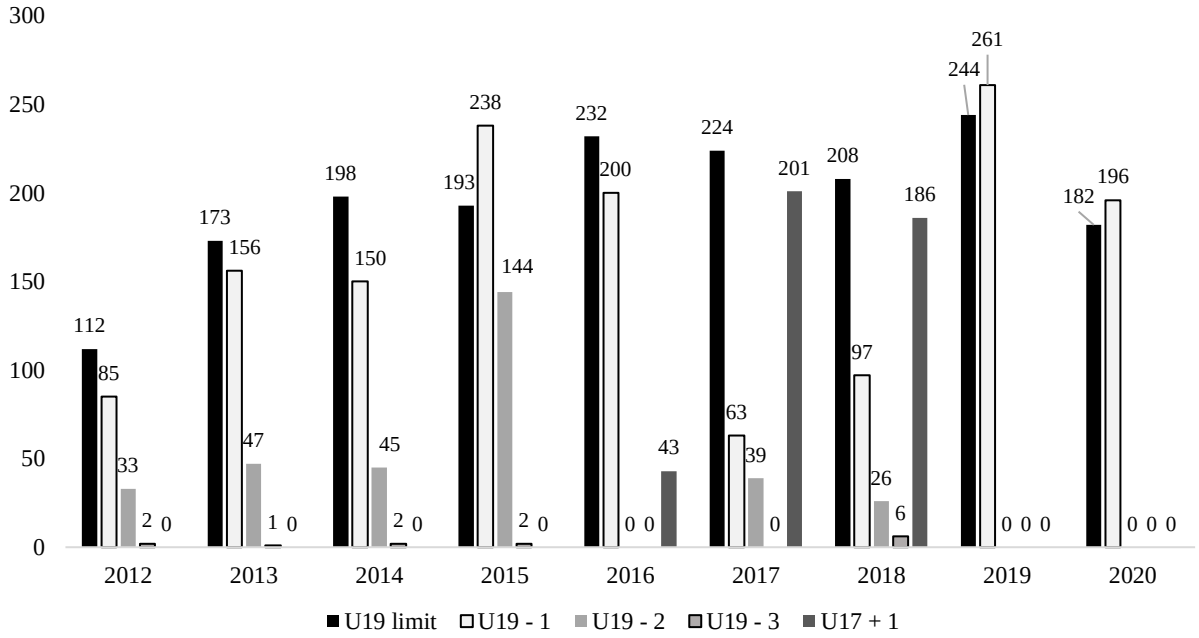
Source: Football Association of Ireland

Figure 5: Age Distribution - U17 National League Players



Source: Football Association of Ireland

Figure 6: Age Distribution - U19 National League Players



Note: *U17+1 represents 18-year-olds who have progressed from playing at U17 level in the previous season. U19-1 represents 18-year-olds joining the national league system for the first time at the U19 age group.*

Source: Football Association of Ireland

For example, a player on the "limit" of the age group will no longer be able to play at that same age group in the following season, due to their date of birth being before the cut-off date for the age group in the next season. Across all three age groups, most of the players registered to play in the underage national league system fell into the category of "limit". The exceptions to this were the 2015 season, in which the majority of players at U17 and U19 level were drawn from the "U17-1" and "U19-1" categories, respectively, and the 2019 and 2020 seasons in which the majority of U19 players were drawn from the "U19-1" category.

"U15-1", "U17-1" and "U19-1" refer to players who were born in the calendar year following that in which those on the "limit" were born, meaning that these players can continue to play at the age group for one further season, before they are no longer eligible due to their age.

Players in the "U17+1" category are the same age as those in the "U19-1" category, with the difference being that "U17+1" players have previously been registered with the national league system at U17 level and made the progression to the U19 age group, whereas players in the

"U19-1" category joined the national league system for the first time at the U19 age group. "U15-2", "U17-2" and "U19-2" refer to players who will remain eligible at the age group for a further two seasons, and "U19-3" refers to players eligible for a further three seasons at the U19 age group.

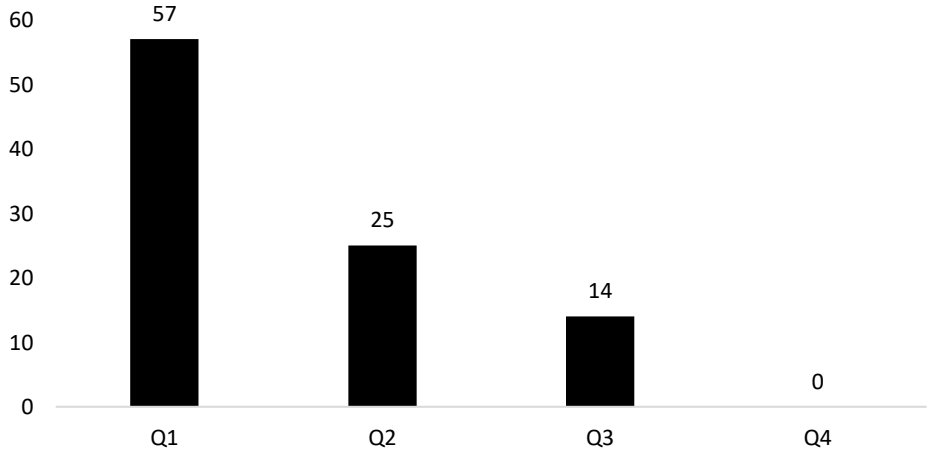
Subsequently, the term "U15 age outliers" will refer to thirteen-year-olds, U15-2, registered to play in the U15 national league. The term "U17 age outliers" will refer to fifteen-year-olds, U17-2, registered to play in the U17 national league. In similar fashion, the term "U19 age outliers" will refer to sixteen- and seventeen-year-olds, U19-3, and U19-2, respectively, registered to play in the U19 national league.

Those classified as U15 age outliers, U17 age outliers and U19 age outliers are treated as such, since they are still eligible to play at a younger age group (i.e., U17 age outliers are eligible to play at U15 level for a further season, and U19 age outliers are eligible to play at U17 level for a further season). Treating players in the minus 1 categories as age outliers is not appropriate, as there is no league for this age group, meaning these players have to move up (i.e., there is no U18 league, so the best U18 players play in the U19 league). Thus, these players, who we classify as age outliers, have been identified by a coach as being significantly talented players and are selected to play at an older age group from a young age. For this reason, this research places a lot of emphasis on players in these age categories. There is a possibility that these players are only chosen to play at older age groups due to their increased physical size rather than based on quality alone.

As previously seen in Figure 4 above, U15 age outliers were a rare occurrence, with only two thirteen-year-olds having played at U15 national league level in Ireland. Interestingly, these two players were born relatively later in the calendar year, in Q2 and Q3, in the months of June and September respectively. As seen in Figure 5 above, at U17 level, age outliers were again in the minority, accounting for just under 5% of the total number of players registered between

2015 and 2017. Analysis of dates of birth of these players reveals RAE to be evident, with almost 60% of U17 age outliers being born in Q1, rising to 85% if you consider the first six months. Figure 7 shows the distribution of births of U17 age outliers. Highlighting the prevalence of the RAE in the sample of players, no fifteen-year-old players born in Q4 of the calendar year were registered to play in the U17 national league between the years of 2015 and 2020. In contrast, 57 fifteen-year-old players (59.38% of all fifteen-year-old players) born in Q1 of the calendar year were registered to play in the U17 national league during the same period.

Figure 7: Quarterly Distribution of Births - Fifteen-year-old U17 Age Outliers

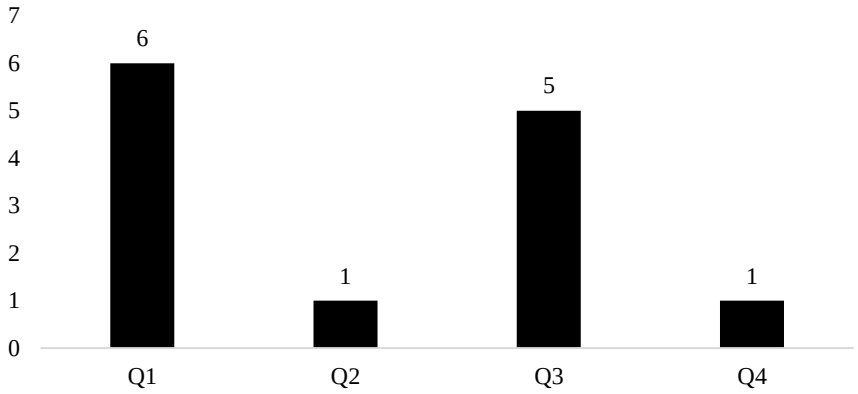


Source: Football Association of Ireland

82 fifteen-year-old players (85.42%) born in the first six months of the calendar year were registered to play in the U17 league. This suggests that there is a strong presence of RAE among this sample of players, as there is a significant, yet unintended, bias towards the relatively older players born earlier in the calendar year. During the 2019 and 2020 seasons there were no fifteen-year-old players registered to play in the U17 league.

As seen in Figure 6 above, a significant number (347) of U19 age outliers have been registered to play in the U19 national league. Figures 8 and 9 show that analysis of U19 age outliers yielded similar results in terms of revealing the presence of RAE.

Figure 8: Quarterly Distribution of Births - Sixteen-year-old U19 Age Outliers

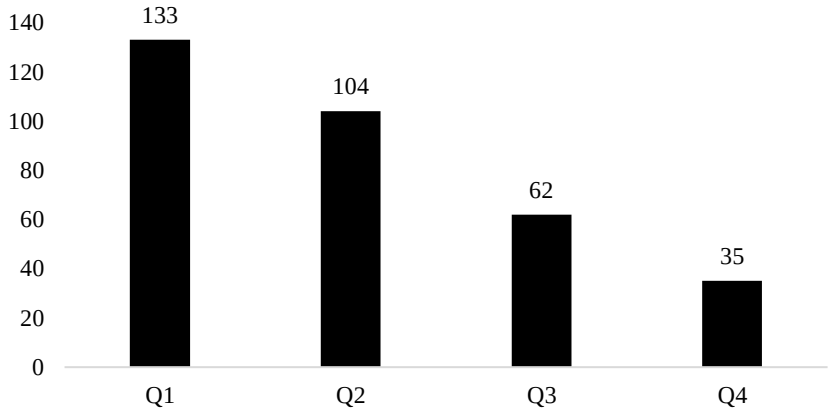


Source: Football Association of Ireland

U19 age outliers represent just over 11% of the total number of U19 players. Firstly, taking the example of players in the "U19-3" category (see Figure 8), who accounted for just under 0.5% of the total number of U19 players, exactly half of the players were born in Q1. Interestingly, one sixteen-year-old (7% of all sixteen-year-olds registered to play in the U19 league) born in December has played at U19 national league level.

Taking the case of the seventeen-year-old players who have played at U19 national league level (see Figure 9), who account for just under 11% of all players, it can again be seen that RAE are present. Almost two-fifths of this age category were born in Q1, with only 10% born in Q4.

Figure 9: Quarterly Distribution of Births - Seventeen-year-old U19 Age Outliers



Source: Football Association of Ireland

Interestingly, similar to the case of age outliers U17 level, in the 2019 and 2020 seasons, no players classified in the U19 age outliers group competed in the U19 league. This was also the

case in the 2016 season, which may be explained by the fact that this was the first full season of the U17 league.

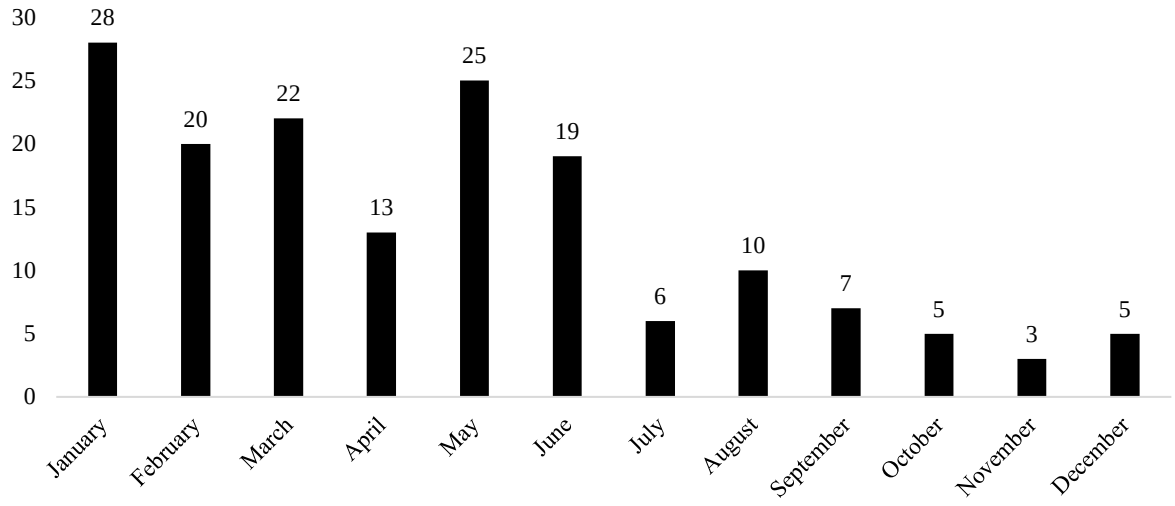
3.2.1 Detailed Description of Dropout Player Data

As well as assessing the extent of the RAE present among the sample of players, we also investigate whether there is a relationship between dropout and relative age among underage national league players. While many studies have identified the prevalence of RAE among football players of various ages, we felt there is space to add to the body of literature examining the relationship between relative age and dropout from elite level football.

One of the benefits of being granted access to the FAI dataset is the ability to track the progression of players through the various age groups, thus allowing us to identify players who have dropped out of the national league system. We have identified 163 players who have dropped out from elite level underage national league football in Ireland during the period in question. The dropout figure is calculated by identifying U17 players, who were initially selected to play at U17 national league level but subsequently did not return to play at national league level. It is important to note that some of the players identified as dropouts may have transferred to an academy in the UK or Europe or may have progressed to senior level in the League of Ireland. In the period between 2011 and 2020, there were 188 outgoing transfers of Irish players under the age of eighteen (Federation Internationale de Football Association, 2021). Given that our sample of dropouts were identified between the years of 2015 and 2018, it is likely that only a small proportion have transferred to clubs in the UK or further afield. It is therefore expected that most of the players we have identified as dropouts, have dropped out from the elite levels of the sport.

Figure 10 shows the distribution of births of the players who have been identified as dropouts, using the criteria outlined above.

Figure 10: Monthly Distribution of Births - Dropouts from the U17 National League



Source: Football Association of Ireland

In particular, this research wishes to investigate these 163 players who make up the dropout figure, while paying particular attention to the 127 (78%) who were born in the first six months of the calendar year.

3.3 Summary and Conclusion

Using the extensive dataset provided by the FAI, combined with the data collected from the CSO, statistical analysis is to be performed to test for the presence of RAE. It is also possible to identify a number of players who dropped out of the national leagues at a young age, and thus assess the distributions of the months of births of these players, in order to investigate whether there is a relationship between player dropout and relative age.

4 METHOD

In the initial stages of the analysis of the data, the study looks to determine the presence and extent of the RAE among the players included in the sample. We test the hypothesis that RAE is present in the sample of underage national league players. RAE have been identified in previous studies by determining whether there is a statistically significant difference between the observed number of players born per quarter, or per month, and the theoretical or expected number of players born per quarter, or per month. The same method will also be adopted as a part of this research, by comparing the distributions of player births with the expected distributions, which will be generated using the births of the male population during the corresponding time periods. To ensure the analysis of the sample is as robust as possible, the analysis will be conducted across four different categories of players, using both monthly and quarterly categories. The four categories to be tested are each of the individual age groups, U15, U17, U19, and across all three of the age groups combined.

The second hypothesis to be tested is that underage national league players born earlier in the calendar year are more likely to be identified as dropouts. Chi-square tests will be employed to test for the presence of RAE within our sample of players identified as dropouts. The distribution of player births of U17 players will be used for this analysis, as this is the age group at which all players identified as dropouts were participating immediately prior to leaving the underage national league system. A Kolmogorov-Smirnov (K-S) test is also conducted to test for the presence of RAE within our sample of players identified as dropouts. Such analysis of a topic important to RAE can offer insights to not just all UEFA members, but also many FIFA members throughout the world. Furthermore, it provides a level of granularity which focuses on those who are initially successful in Irish football but have then left the underage system at a later point in their careers.

These two testing methods (chi-square tests and K-S tests) were employed in the only previous study to date which has studied the presence of RAE in Irish football (Butler & Butler, 2015). Chi square tests have also been used, across a variety of sports, in numerous studies in order to compare a distribution of player births with various theoretical distributions (e.g., Barnsley & Thompson, 1988; Lemez et al., 2014; Delorme, Chalabaev & Raspaud, 2011). Chi-square tests were also employed by (Delorme, Boiché & Raspaud, 2010a; Delorme, Boiché & Raspaud, 2010b & Delorme, Chalabaev & Raspaud, 2011 & Lemez et al., 2014) in their studies comparing their distributions of players identified as dropouts and their chosen theoretical distributions. As three of these studies (Delorme, Boiché & Raspaud, 2010a; Delorme, Boiché & Raspaud, 2010b & Delorme, Chalabaev & Raspaud, 2011) chose the general population of licensed players as their theoretical distribution for comparison with their distributions of dropouts, the decision was taken to adopt this method for our analysis of players identified as dropouts. Thus, we take the distribution of all U17 players as our theoretical distribution for comparison with the observed distribution of players identified as dropouts.

K-S tests were employed by studies comparing distributions of players identified as dropouts with theoretical distributions (e.g., Helsen, Starkes & Van Winckel, 1998 & Butler & Butler, 2015). For this reason, it was decided that K-S tests would also be conducted, in order to ensure that the analysis conducted was as robust as possible.

4.1 Introduction to Chi-Square Tests and Kolmogorov-Smirnov Test

As per past studies on the topic, RAE is shown to be present when there is a statistically significant difference identified between the expected or theoretical monthly and/or quarterly distribution of births and the observed monthly and/or quarterly distribution of births of the players within the sample. In this research, the birthdates of underage national league players are analysed by grouping the birthdates of both the players and the wider male population using

the four quarters of the calendar year, due to the cut-off date for football in Ireland being the 1st of January.

On this basis, player births for four age categories, U15, U17, U19 and All Age Groups (U15, U17 and U19 combined), and the births of the wider male population were grouped using quarterly categories, using Q1 to represent January, February, and March, Q2 to represent April, May, and June, Q3 to represent July, August, and September and Q4 to represent October, November, and December. To ensure robustness, chi-square tests are also performed to compare the monthly distribution of player births with the monthly distribution of births of the male population in the corresponding time periods.

As per some past studies seeking to identify the presence and extent of RAE, the theoretical distribution of births is calculated based on the distribution of birthdates of the wider population of the country in question, in this case in Ireland. Data for the births of the wider population are collected from the CSO for the years which correspond to the years of birth of the players represented in the sample. The observed distribution refers to the distribution of the births of the players within the sample.

Chi-square tests and a K-S test are also conducted to determine whether those born earlier in the calendar year are more likely to be identified as dropouts.

4.2 Detailed Description of Chi-Square Tests and Kolmogorov-Smirnov Test

As part of the analysis of the dataset, a total of ten separate chi-square analyses were conducted, followed by a single K-S test. Eight of the chi-square tests are conducted to test for the presence, and the extent of RAE within the sample, with the remaining two chi-square tests employed to test for the presence of RAE among the players identified as dropouts. A K-S test is also used to test for the presence of RAE among the sample of players identified as dropouts.

4.2.1 Chi-Square Tests

A chi-square test is used in order to measure how a model compares to the actual observed data (Investopedia, 2022). The chi-square statistic compares the size of any differences between the expected distribution and the actual distribution, given the size of the sample and the number of variables present. The larger the sample the more reliable the results (Investopedia, 2022), making this type of test appropriate, given the large size of the sample of players observed in this research. Degrees of freedom are employed to determine if a pre-determined null hypothesis can be rejected. In this research chi-square tests are used for two reasons: to determine whether RAE is present in the sample, and to compare the birth distribution of our sample of dropouts with the birth distribution of the entire sample of players.

Firstly, four tests were conducted using quarterly categories, testing for the presence of RAE within the samples of U15, U17 and U19 players respectively, as well as across the three age groups combined. For each of these four tests, the null hypothesis stated that there would be no significant difference observed between the expected distribution of births per quarter and the actual distribution of births per quarter. Four tests were also conducted using monthly categories for each of the individual age groups, as well as across all three combined. In each of these chi-square tests, the null hypothesis stated that there would be no significant difference observed between the expected distribution of births per month and the actual distribution of births per month.

The distribution of male births in Ireland between the years of 2002 and 2006 formed the theoretical distribution for comparison with the U15 players. In the case of the analysis of the U17 distribution, the theoretical distribution is based on the distribution of births of males in Ireland between the years of 1998 and 2003. For analysis of the U19 age group, the theoretical distribution is generated using data for male births in Ireland between 1993 and 2002. For

analysis across all age groups combined, the theoretical distribution is generated using data for male births in Ireland between 1993 and 2006.

Using a second set of chi-square tests, the research tests the hypothesis that elite level underage players born earlier in the calendar year are more likely to be identified as dropouts. To date, a total of 163 players have been identified (see Figure 10), who have dropped out from the elite level U17 national league in Ireland between the years of 2015 and 2018. Seventy-seven of these players exited during the 2015 and 2016 seasons, with just twelve returning to play in the national U19 league later.

In similar fashion to the tests employed to test for the presence of RAE, chi-square tests are conducted using both quarterly and monthly categories to ensure the analysis is robust. For the tests conducted using quarterly categories, the null hypothesis stated that there would be no significant difference between the expected distribution of births per quarter and the actual distribution of births per quarter. A chi-square test was also conducted using monthly categories, with the null hypothesis stating that there would be no significant difference between the expected distribution of births per month and the actual distribution of births per month. As mentioned above, the theoretical distribution in this case is generated from data for the birth distributions of U17 players.

4.2.2 Kolmogorov-Smirnov Test

K-S tests are used to determine whether two distributions differ and can also be used to determine whether data is normally distributed. It is used to compare a known hypothetical distribution with an observed distribution generated by the data collected. A predetermined null hypothesis is required in order to conduct the test, as well as a predetermined level of significance. In the context of this research our null hypothesis assumes no difference between distributions and the level of significance is set to $P < .05$. The test reports the maximum difference between the two distributions, calculating a P value based on the maximum

difference and the sample size. A small P value indicates a significant difference between two distributions. We use this K-S test to identify whether RAE is present among the sample of players we have identified as dropouts.

Our K-S test is carried out using monthly categories, in order to compare the observed monthly birth-date distribution of players identified as dropouts with the expected monthly birth-date distributions, which in this case is taken to be the distribution of births of U17 players. Again, the expected monthly distribution in this case is generated by grouping the dates of birth of the players who had been identified as dropouts from underage national league level. The observed distributions are based on the player data of those who have been identified as dropouts from the U17 age group.

In the case of the K-S test, the null hypothesis states that there is no significant difference between the expected distribution of births per month and the observed distribution of births per month.

4.3 Summary and Conclusion

The chi-square analyses provide conclusive data pertaining to the presence and the extent of RAE within the sample of underage national league players in Ireland. The subsequent chi-square analyses and the accompanying K-S test also allow us to assess the hypothesis mentioned earlier in the paper, that elite level underage players born earlier in the calendar year are more likely to be identified as dropouts. From the results of the tests, a conclusion is drawn as to whether a relationship exists between relative age and dropout levels. From the results and the conclusions drawn, recommendations are be made to governing bodies throughout Europe and the world as to the relationship between RAE and dropout levels.

5 ANALYSIS AND RESULTS

The results of the tests for the presence of RAE are presented first, with the results of the chi-square tests using quarterly categories followed by the results of the chi-square tests conducted using monthly categories. The results of the chi-square tests, using both quarterly and monthly categories, are presented in order of age group, starting with the youngest age group, the U15 age group, followed by U17, U19 and finishing with the results of the tests conducted on the sample of players as a whole, across all three age groups combined. The results of the chi-square tests using quarterly categories on the sample of dropouts are then presented, followed by the results of the chi-square tests using monthly categories on the distribution of births of the dropouts. Finally, the results of the K-S test comparing the distribution of births of the dropouts and the distribution of births of U17 players are then presented.

5.1 Introduction to the Results

As previously mentioned in section one, the cut-off date for grouping players by age group in football in Ireland is the 1st of January, meaning all players within each age group are born in the same calendar year. However, in the current structure of the underage national leagues, there is currently a two-year gap between cut-off dates for age groups. As a result, there is an opportunity for younger players to play at an older age group. This means that players born in as many as four different calendar years can have played at the same age group in the same season.

If the results of this study support those of previous RAE studies, the analysis will reveal an unintended selection bias towards players born in Q1, or the earlier months of the calendar year in comparison to those born in Q4, or the later months of the calendar year. Analysis of the sample revealed that there is an overrepresentation of players born in the first six months of the calendar year, among all individual age groups, and across all age groups combined. Among the sample of dropouts, there is also an overrepresentation of players born in Q1 and Q2.

5.2 Detailed Analysis of Results

Chi-square tests for the presence and prevalence of RAE were conducted to a 1% level of significance. Chi-square tests comparing the sample of dropouts to the sample of U17 revealed the distributions did not differ at the 1% level of significance. However, the distributions did differ significantly at the 5% level of significance. Therefore, the results of chi-square tests to a 5% level of significance are presented in section 5.2.2.

5.2.1 The Prevalence of RAE in Underage National Leagues (Quarterly Categories)

In order to test for the presence of RAE, chi-square tests are conducted within and across the sample. As outlined in section four above, the null hypothesis for the first set of chi-square tests assumes no difference between the expected distribution of births per quarter (which is generated using the data for total male births, collected from the CSO) and the actual distribution (which is generated using the player data provided by the FAI) of births per quarter in each case.

As seen in Table 5 below, the calculated value for chi-square exceeds the decision rule for each individual age group, as well as across the three age groups combined.

Table 5: Results of Chi-Square Tests for the Presence of RAE (Quarterly Categories)

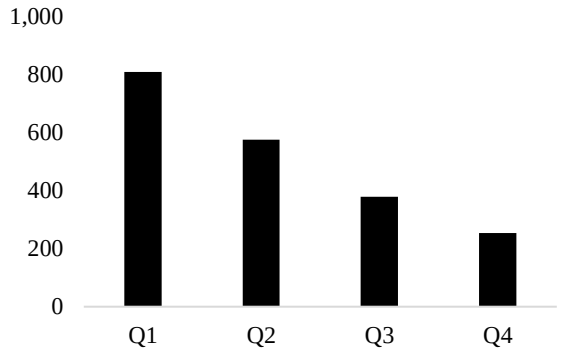
	U15	**U17**	**U19**	**All Age Groups**
Significance Level	0.01	0.01	0.01	0.01
Decision Rule	11.345	11.345	11.345	11.345
$\chi 2$	394.38	400.38	175.92	860.13
Reject / Accept H0	Reject H0	Reject H0	Reject H0	Reject H0
Significant Difference	Yes	Yes	Yes	Yes

Therefore, in each case the predetermined null hypothesis is rejected, confirming that there is a statistically significant difference between the expected distribution of births and the actual distribution of births for each of the age groups, U15, U17, U19 and combined across the three age groups for the entire period in question. These results confirm the presence of RAE at all age groups when viewed individually, as well as across the sample as a whole. The distribution

of player births is skewed, with significantly more players born in Q1 and Q2 of the calendar year when compared to Q3 and Q4 of the calendar year, indicating that players born earlier in Q1 and Q2 are more likely to be selected to play elite level football in Ireland.

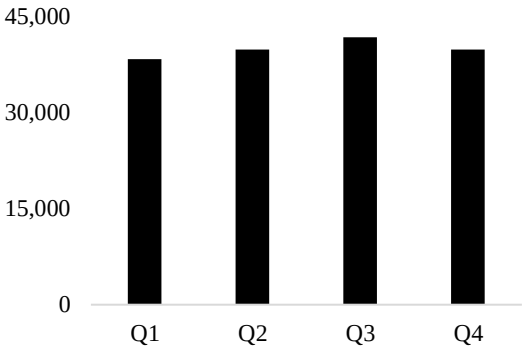
Figure 11 shows the distribution of births by quarter for the U15 age group. Figure 12 is the expected distribution, calculated based on the data obtained from the CSO pertaining to the distribution of male births in the period during which the U15 players were born, between the years of 2002 and 2006. As mentioned above, the chi-square test for this age group ($p<0.01$, d.f. = 3, χ^2 = 394.38) revealed that the actual distribution of births per quarter differed significantly from the expected distribution of births per quarter.

Figure 11: Quarterly Distribution of Births - U15 National League Players 2017 – 2020



Source: Football Association of Ireland

Figure 12: Quarterly Distribution of Births - Male Population 2002 - 2006



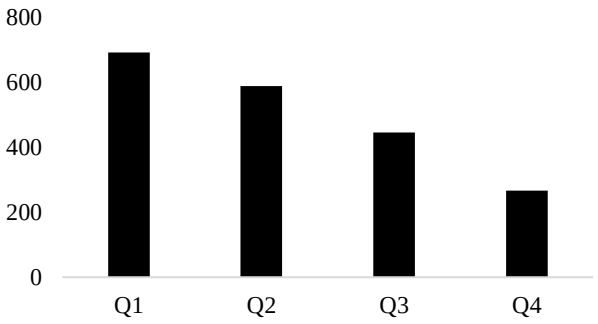
Source: Football Association of Ireland

40.10% of U15 players were born in Q1, with 68.63% born in the first two quarters, Q1 and Q2 combined, compared to just 12.61% in Q4 and 31.37% in the final 2 quarters of the calendar year, Q3 and Q4 combined. In comparison, 23.98% of all males born between the years 2002 and 2006 were born in Q1, with 48.92% in the first two quarters, Q1 and Q2 combined. 24.95% were born in Q4, with 51.08% born in the final two quarters, Q3 and Q4 combined. As would be expected, the distribution of births of males born in the period is very evenly distributed between the four quarters of the calendar year. In contrast, the distribution of births of U15 players is skewed, with a very large proportion of the players born in the first two quarters of

the calendar year. In this context, the term ‘skew’ is used in this thesis to describe the distributions.

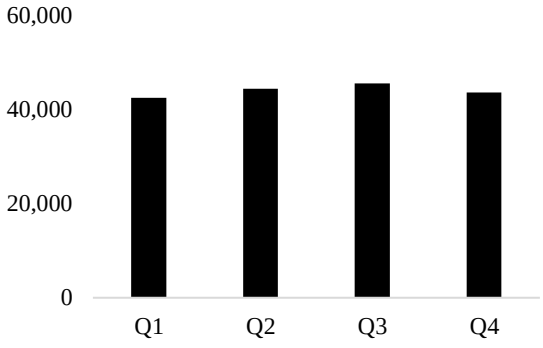
Figure 13, below, shows the distribution of births by quarter for the U17 age group. Figure 14 shows the distribution of births of the male population in the years between 1998 and 2003, which, in similar fashion to that of the distribution of male births between 2002 and 2006, is very evenly distributed between the four quarters. In contrast, the distribution of the player dates of birth is again skewed, with the majority of players born in the first two quarters of the calendar year.

Figure 13: Quarterly Distribution of Births - U17 National League Players 2015 - 2020



Source: Football Association of Ireland

Figure 14: Quarterly Distribution of Births - Male Population 1998 - 2003

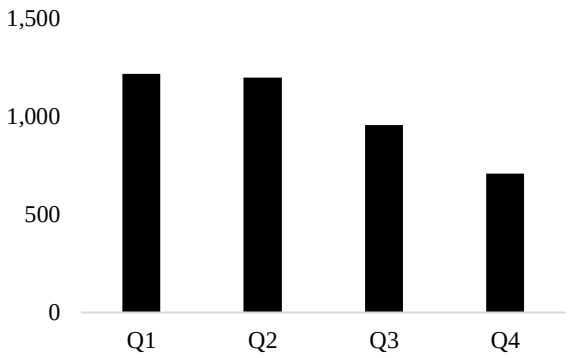


Source: Football Association of Ireland

As mentioned above, the chi-square test for this age group ($p<0.01$, d.f. = 3, $\chi^2 = 400.38$) indicated that the actual distribution of births per quarter differed significantly from the expected distribution of births per quarter. 36.81% of U17 players were born in Q1, while just 13.44% of the players were born in Q4. Among all males born in the same period, between 1998 and 2003, 24.13% were born in Q1, with 24.79% born in Q4. 63.65% of U17 players were born in the first two quarters of the year, Q1 and Q2 combined, compared to 36.35% born in the final two quarters, Q3 and Q4 combined. Contrastingly, 49.32% of all males born in the same period were born in the first two quarters of the calendar year, with 50.68% born in the final two quarters of the calendar year.

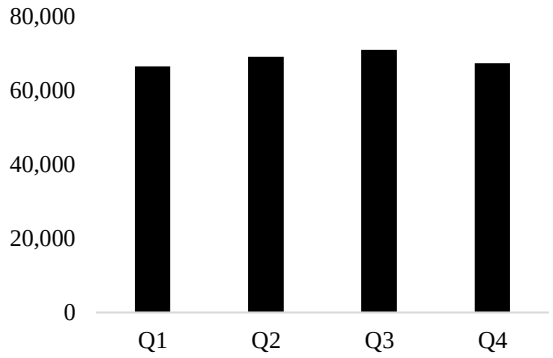
Figure 15 shows the distribution of births by quarter for the U19 age group. Figure 16 shows the quarterly distribution of births of the male population in the years between 1993 and 2002, which, similar to that of the distribution of male births seen in the comparisons for U15 and U17 above, is very evenly distributed between the four quarters. In contrast, the distribution of the player dates of birth is again skewed, with the majority of players born in the first two quarters of the calendar year.

Figure 15: Quarterly Distribution of Births - U19 National League Players 2012 – 2020



Source: Football Association of Ireland

Figure 16: Quarterly Distribution of Births - Male Population 1993 - 2002



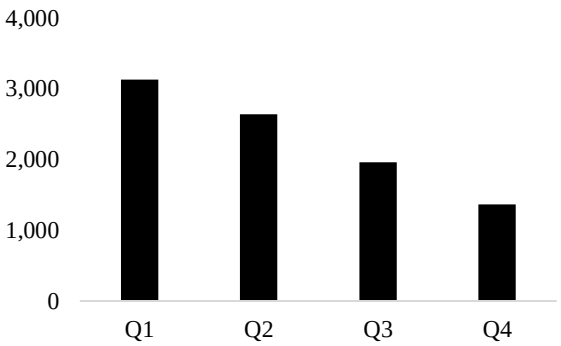
Source: Football Association of Ireland

At the U19 age group, the chi-square test ($p<0.01$, d.f. = 3, $\chi^2 = 175.92$) revealed that the actual distribution of births differed significantly from the expected distribution. 29.82% of the players were born in Q1 of the calendar year, with 17.34% born in Q4 of the calendar year. 24.26% of all males born in the same period were born in Q1, with 24.60% born in Q4. 59.20% of U19 players were born in the first two quarters of the year, with 40.80% born in the final two quarters, compared to 49.49% of all males born in the first two quarters and 50.51% in the final two quarters. The proportion of players born in the first two quarters is much lower than the proportion of U15s born in the first two quarters, and slightly lower than the proportion of U17s born in the first two quarters.

Across the three age groups combined, the chi-square test ($p<0.01$, d.f. = 3, $\chi^2 = 860.13$) revealed that the actual distribution of births differed significantly from the expected distribution. Figure 17 shows the distribution of births of all underage players, across the age

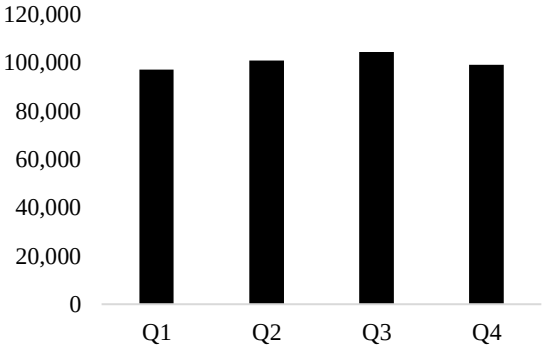
groups of U15, U17 and U19 in the seasons between 2012 and 2020. This distribution is again skewed, with the majority of players born in the first two quarters of the calendar year, Q1 and Q2. Figure 18 shows the distribution of births among the male population between the years of 1993 and 2006, the period in which all players who have played in the U15, U17 and U19 national leagues were born. As would be expected, this distribution is evenly distributed between the four quarters.

Figure 17: Quarterly Distribution of Births - All Underage National League Players 2012 – 2020



Source: Football Association of Ireland

Figure 18: Quarterly Distribution of Births - Male Population 1993 - 2006



Source: Football Association of Ireland

34.41% of players across all age groups were born in Q1, compared to 15.00% in Q4. 63.32% of players were born in the first two quarters of the calendar year, with 36.58% born in the second two quarters of the calendar year. In comparison, 24.19% of all males born in the same period were born in Q1, with 24.67% born in Q4. 49.32% were born in the first two quarters with 50.68% born in the final two quarters of the year.

5.2.2 The Prevalence of RAE in Underage National Leagues (Monthly Categories)

The second set of chi-square tests conducted within the sample is conducted using monthly categories, in order to identify whether RAE is present. As seen in Table 6, the calculated value for chi-square again exceeds the decision rule for each of the individual age groups, as well as across the three age groups combined.

Table 6: Results of Chi-Square Tests for the Presence of RAE (Monthly Categories)

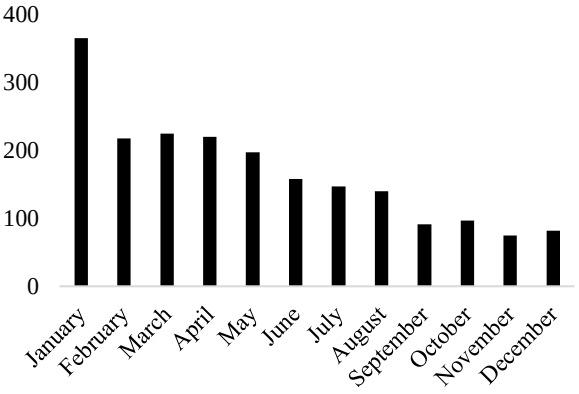
	U15	U17	U19	All Age Groups
Significance Level	0.01	0.01	0.01	0.01
Decision Rule	24.725	24.725	24.725	24.725
χ2	503.40	317.19	213.82	997.33
Reject / Accept H0	Reject H0	Reject H0	Reject H0	Reject H0
Significant Difference	Yes	Yes	Yes	Yes

Therefore, in each case the null hypothesis is rejected, thus confirming that there is a statistically significant difference between the expected distribution of births and the observed distribution of births for each of the age groups, U15, U17, U19 and combined across the three age groups for the entire period in question. These results further confirm the presence of RAE at all age groups when viewed individually, as well as across the sample as a whole. The distribution of player births is skewed, with significantly more players born in the first 6 months of the calendar year when compared to the last 6 months of the calendar year, indicating players born in the first 6 months of the calendar year are more likely to be selected to play elite level football in Ireland.

Figure 19 shows the distribution of births by month for the U15 age group. As seen in the above table, the chi-square test for this age group ($p<0.01$, d.f. = 11, $\chi^2 = 503.40$) revealed that the observed distribution of births per month differed significantly from the expected distribution of births per month. Figure 20 represents the expected distribution, calculated based on the data obtained from the CSO pertaining to the distribution of male births in the period during which the U15 players were born, between the years of 2002 and 2006.

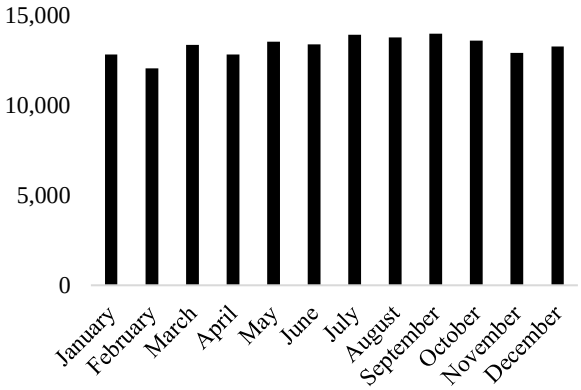
As can be seen from the graphs below, the distribution of births of the male population between 2002 and 2006 is quite evenly distributed across the twelve months, whereas the distribution of U15 player births is skewed, with significantly more births in the earlier months of the year, compared to the later months of the year.

Figure 19: Monthly Distribution of Births - U15 National League Players 2017 – 2020



Source: Football Association of Ireland

Figure 20: Monthly Distribution of Births - Male Population 2002 - 2006

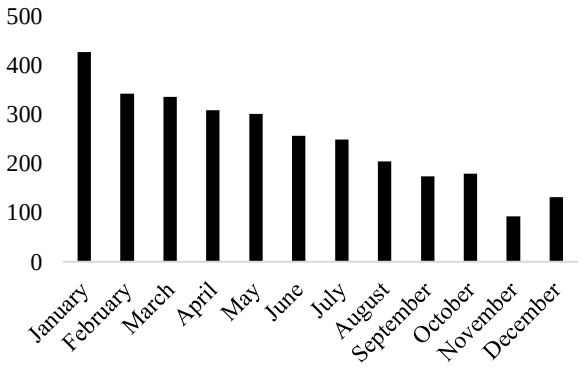


Source: Football Association of Ireland

There is an overrepresentation of players born in the month of January at this age group, with 18.11% of U15 players born in January, compared to an underrepresentation of players born in the month of November in particular, with 3.72% of U15 players born in that month. In comparison 8.04% of the male population were born in January during the same period, with 8.11% born in the month of November.

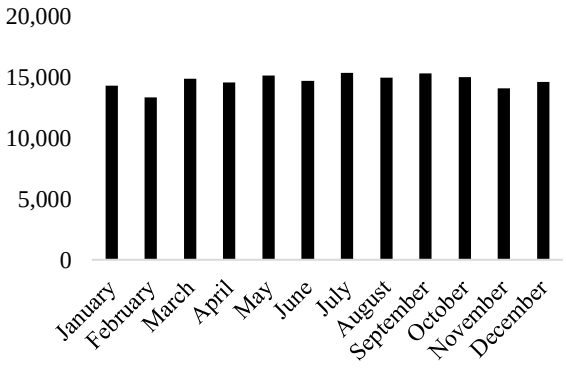
Figure 21 gives a graphical representation of the distribution of U17 player births per month. Figure 22 represents the distribution of male births in the period during which the U17 players were born, between the years of 1998 and 2003.

Figure 21: Monthly Distribution of Births - U17 National League Players 2015 - 2020



Source: Football Association of Ireland

Figure 22: Monthly Distribution of Births - Male Population 1998 – 2003

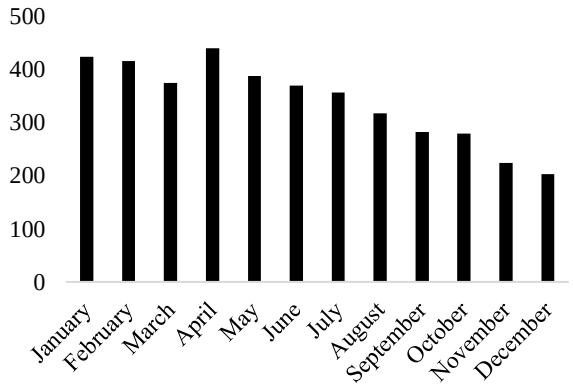


Source: Football Association of Ireland

The chi-square test for the U17 age group ($p<0.01$, d.f. = 11, $\chi^2 = 317.19$) revealed that the actual distribution of births differed significantly from the expected distribution of births per month. The distribution of births of the male population between 1998 and 2003 is quite evenly distributed across the twelve months, in comparison to the distribution of U17 player births, which is skewed, with the majority of player births occurring in the earlier months of the year. The U17 age group had an overrepresentation of player births in the month of January, with 14.24% of U17 players born in January. 8.12% of the male population were born in January during the same period. There is an underrepresentation of players born in November, with just 3.07% of U17 players born in November, compared to 8.00% of the male population born in the month of November during the same period.

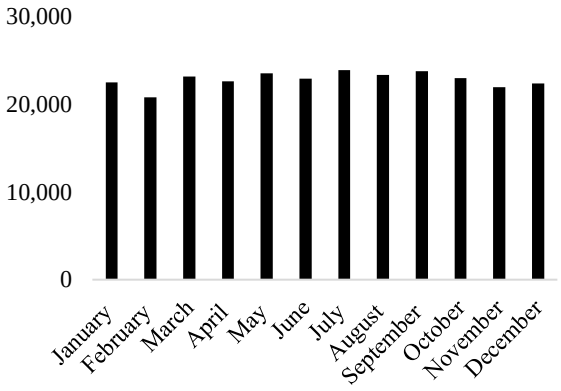
The distribution of U19 player births per month can be seen below in Figure 23. Figure 24 is a graphical representation of the distribution of male births in the period during which the U19 players were born, between the years of 1993 and 2002. The chi-square test for the U19 age group ($p<0.01$, d.f. = 11, $\chi^2 = 213.82$) revealed that the observed distribution of births differed significantly from the expected distribution of births per month.

Figure 23: Monthly Distribution of Births - U19 National League Players 2012 – 2020



Source: Football Association of Ireland

Figure 24: Monthly Distribution of Births - Male Population 1993 – 2002



Source: Football Association of Ireland

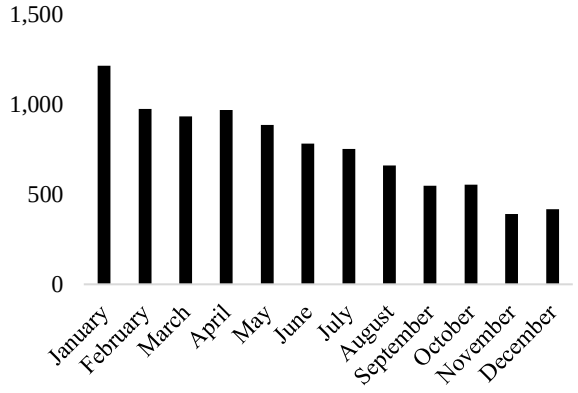
As would be expected, the distribution of births of the male population between 1998 and 2003 is quite evenly distributed across the twelve months of the calendar year, in comparison to the

distribution of U19 player births, which is skewed, with most player births occurring in the earlier months of the year. However, the distribution of U19 player births is noticeably more evenly distributed than the U15 and U17 distributions of player births per month. The results reveal that the younger the age group, the higher the prevalence of RAE in the sample. This would be expected, based on previous literature, which suggests that RAE are at their most prominent among younger athletes, or around the age at which players reach the point of puberty.

At the U19 age group, the month in which the most players were born is the month of April, with 10.80%, closely followed by January with 10.42%, compared to 8.27% and 8.20% among the male population, for the same two months respectively. There is an underrepresentation of player births in the month of December, with 4.99% of player births occurring in this month, compared to 8.18% of the general population born in December.

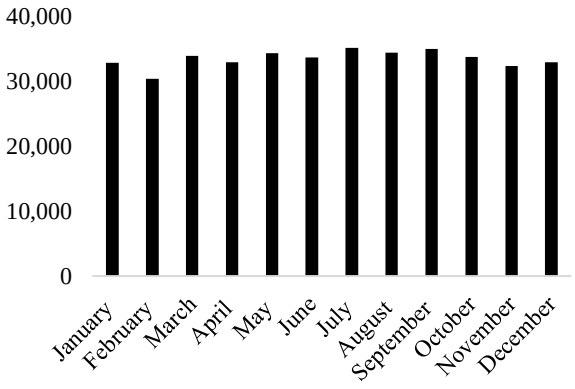
The distribution of all player births, across the three age groups of U15, U17 and U19, on a per month basis, can be seen below in Figure 25. Figure 26 is a graphical representation of the distribution of male births in the period during which all players who competed in the U15, U17 and U19 national leagues were born, between the years of 1993 and 2006.

Figure 25: Monthly Distribution of Births - All Underage Players 2012 – 2020



Source: Football Association of Ireland

Figure 26: Monthly Distribution of Births - Male Population 1993 – 2006



Source: Football Association of Ireland

The chi-square test across all age groups ($p<0.01$, d.f. = 11, $\chi^2 = 997.33$) revealed that the observed distribution of births per month differed significantly from the expected distribution of births per month. The distribution of births of the male population between 1993 and 2006 is again quite evenly distributed across the twelve months of the calendar year. As expected, the distribution of all player births is skewed, with an overrepresentation of players born in the earlier months of the calendar year, and an underrepresentation of players born in the later months of the calendar year.

Across all age groups combined there is an overrepresentation of births in the month of January, with 13.38% of players born in January, compared to 8.18% among the male population across the same time period. There is an underrepresentation of player births in the month of November, with 4.30% compared to 8.05% across the general male population.

As is clearly seen from the above results of several chi-square tests, RAE can be seen throughout each age group, across the period between 2012 and 2020 in the case of the U19 league, between 2015 and 2020 in the case of the U17 league, and between 2017 and 2020 in the case of the U15 league. There is an unintended selection bias toward players born earlier in the calendar year at U15, U17 and U19 level, as well as across the three age groups combined. Therefore, our hypothesis, that RAE is present among underage national league players, cannot be rejected. The practical implication of these results is that players who are born earlier in the calendar year are more likely to be selected to play at an elite level, while their counterparts, who are born in the later stages of the calendar year are much less likely to be selected to play at an elite level.

5.2.3 Analysis of Players Identified as Dropouts

Having first identified RAE to be present within the sample at both age groups for the entire period, and across each individual season, the intention of this research is to identify any possible relationship between RAE and player dropout levels. In order to do so, several chi-

square tests are conducted in the sample, comparing the distribution of births of players identified as dropouts with the distribution of births of U17 players (as all dropouts came from this age group) using both quarterly and monthly categories. For the first chi-square test, using quarterly categories, the null hypothesis stated that there is no significant difference between the quarterly distribution of births of players identified as dropouts, and the quarterly distribution of births of all U17 players. Table 7 presents the results of this chi-square test.

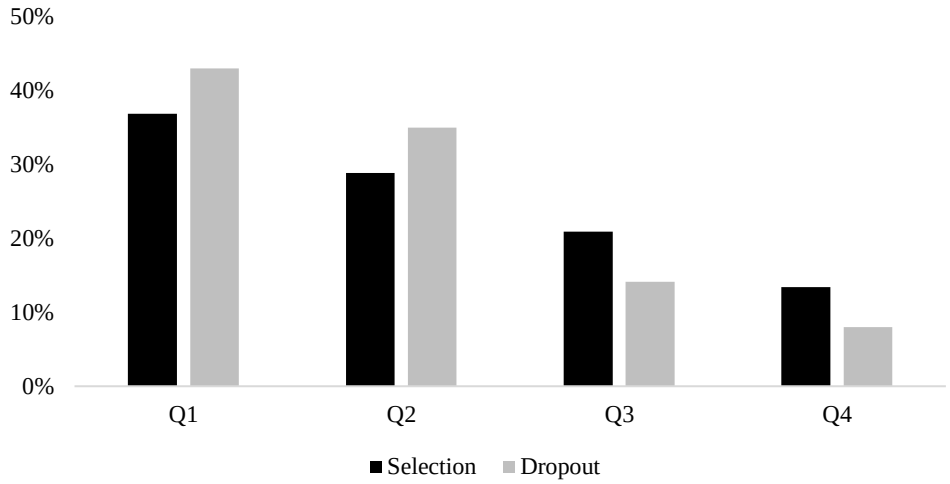
Table 7: Results of Chi-Square Test on the Relationship Between RAE and Dropout (Quarterly Categories)

	Dropouts
Significance Level	0.05
Decision Rule	7.8147
$\chi 2$	11.01
Reject / Accept H0	Reject H0
Significant Difference	Yes

The chi-square test ($p<0.05$, d.f. = 3, $\chi^2 = 11.01$) revealed that there is a statistically significant difference between the expected distribution and the actual distribution. Therefore, in each case the null hypothesis is rejected, meaning RAE is present in our sample of players identified as dropouts, or in practical terms, that players born earlier in the calendar year are more likely to be identified as dropouts.

Figure 27 shows the quarterly percentage distribution of U17 player births (black bars), as well as the quarterly percentage distribution of births of players identified as dropouts (grey bars). 42.94% of the players who have been identified as dropouts were born in Q1, with only 7.98% of dropouts born in Q4. 127 of the 163 players (77.91%) were born in the first half of the calendar year. This is compared to 36.81% of all U17 players born in Q1, with 63.65% of all U17 players born in the first two quarters, and 13.44% born in Q4.

Figure 27: Quarterly % Distribution of Births - U17 National League Players (Black) and Dropouts (Grey)



Source: Football Association of Ireland

The above chi-square test results reveal that players born earlier in the calendar year, are statistically more likely to be identified as dropouts from elite level national league football in Ireland. It would also indicate that those born later in the calendar year are less likely to drop out from the elite level of the sport once they have been initially selected to represent underage teams in the national leagues.

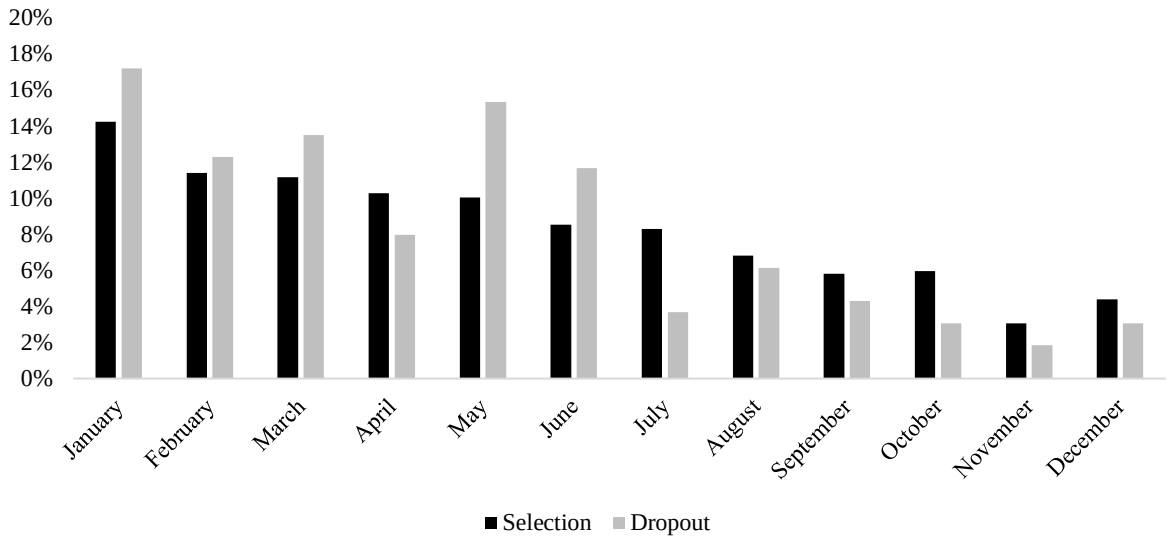
A second chi-square test is conducted in the sample to compare the distribution of births of dropouts with the distribution of births of U17 players (as all dropouts came from this level) using monthly categories. In this case, the null hypothesis assumes no significant difference between the monthly distribution of births of players identified as dropouts, and the monthly distribution of births of all U17 players. Table 8 presents the results of this chi-square test.

Table 8: Results of Chi-Square Test on the Relationship Between RAE and Dropout (Monthly Categories)

	Dropouts
Significance Level	0.1
Decision Rule	17.275
$\chi 2$	17.84
Reject / Accept H0	Reject H0
Significant Difference	Yes

The chi-square test ($p<0.01$, d.f. = 11, $\chi^2 = 17.84$) revealed that there is a statistically significant difference between the expected distribution and the actual distribution, thus meaning the null hypothesis is rejected, meaning RAE is present among our sample of players identified as dropouts. Combined with the results of the test conducted using quarterly categories, this result reveals that players born earlier in the calendar year are more likely to be identified as dropouts. Figure 28 is a graphical representation of the monthly distribution of births of U17 national league players (black bars) and the players who have been identified as dropouts (grey bars).

Figure 28: Monthly % Distribution of Births - U17 National League Players (Black) and Dropouts (Grey)



Source: Football Association of Ireland

There is an overrepresentation of dropouts born in the month of January, with 17.18% of dropouts born in this month. There is an underrepresentation of dropouts born in the month of November, with just 3 of the 163 (1.84%) of players identified as dropouts born in the month of November. In comparison, 14.24% of all U17 players were born in the month of January, while 3.07% were born in the month of November.

While the results of this chi-square tests were significant to a lesser extent, the results indicate that our original hypothesis, that underage national league players born earlier in the calendar

year are more likely to be identified as dropouts, cannot be rejected. The results also indicate that those born later in the calendar year are less likely to be identified as dropouts.

Finally, a K-S test is conducted within the sample, in order to compare the distribution of births of the dropouts and the distribution of births of the total sample of U17 players. The test is conducted using monthly categories. It is revealed that there is a significant difference between the observed and the expected distributions ($p<0.05$). This again confirms that our hypothesis, that players born earlier in the calendar year are more likely to be identified as dropouts, cannot be rejected. In comparison, their relatively younger counterparts born later in the calendar year, appear less likely to be identified as dropouts.

5.3 Summary and Conclusion

Using chi-square tests, it is determined that our hypothesis, that RAE is present in the sample of underage national league players, cannot be rejected. There is an unintended selection bias towards players born in Q1 and Q2, meaning it is more likely that relatively older players will be selected to play at elite underage national league level, in comparison to their relatively younger counterparts, born in Q3 and Q4.

The results of further chi-square tests, combined with a K-S test, confirm that our hypothesis, that underage national league players born earlier in the calendar year are more likely to be identified as dropouts, cannot be rejected. These results differ significantly from anything seen in RAE and dropout level literature to date, finding an overrepresentation of dropouts born in Q1 in particular, and even more specifically, in the month of January. In contrast, it is found that an underrepresentation of players identified as dropouts are born in the later months of the calendar year, in particular in Q4, and the month of November. Such findings add a new dimension to the literature and should lead to further research on the topic.

6 DISCUSSION

Two main factors led to this study investigating RAE as a factor in dropout from the Irish underage national league football system. The first factor is the limited number of studies which exist on the topic of the relationship between RAE and dropout in Irish sport. While a number of studies have assessed the relationship between relative age and dropout in other European countries, to the best of our knowledge, this is the first to focus on elite level Irish footballers. Secondly, it has been shown that there is a lack of RAE observed in senior international football, despite a number of studies to date having identified RAE among younger players. This leads to the question of why relatively older players, who are initially identified as talented, fail to make it at the senior level of the game. The logical conclusion is that these players have dropped out from the sport at a young age. Despite this, much of the research to date has continued to identify that at underage level, players born later in the calendar year, or selection period, are more likely to dropout from sport at a young age.

The main findings of this study are: (i) RAE are present at each of the individual age groups, at U15, U17, U19, as well as across all three age groups combined and (ii) among our sample of players identified as dropouts, there is an overrepresentation of players born in the first six months of the calendar year. As a result, we cannot reject the hypothesis, that underage national league players born earlier in the calendar year are more likely to be identified as dropouts. By extension, those who are relatively younger, born later in the calendar year, who have been initially selected to play at an elite level, are less likely to be identified as dropouts at a later date. These findings help to lend an explanation as to why the bias towards players born earlier in the calendar year has been proven to dissipate at the senior level of the game. Based on these findings, players born earlier in the calendar year are likely to have already dropped out from the elite level of the sport before reaching senior level. Meanwhile, the number of active players

born in the final six months of the calendar year will have only slightly decreased due to the lower level of dropout among these players.

To the best of our knowledge, the findings of this study differ significantly from the findings of the studies on the relationship between RAE and dropout which have gone before it. The previous literature found that players born later in the calendar year were more likely to be identified as dropouts, while players born earlier in the calendar year were found to be underrepresented among samples of players identified as dropouts. Therefore, this study adds significantly to the body of literature on the topic of the relationship between relative age and dropout in football. Further research on the topic will be required to determine whether similar situations exist in other UEFA member countries, to determine whether these findings are merely outliers within the body of research.

6.1 The Presence of RAE in the Sample

The initial stages of this study focused on establishing whether RAE were present within the sample. The method employed followed the lead of previous studies in the area, making use of chi-square tests. Results of the chi-square tests confirmed the presence of RAE at all three Irish national league underage age groups, when analysed on an individual basis, and across all three age groups combined. Findings reveal that RAE were more pronounced at the youngest age group within the sample, at U15 level, with the bias becoming less pronounced with progression upwards through the age groups. This result agrees with the proposals of previous literature that the effect is prominent at younger age groups, when relative age differences within the groups are at their highest (See Musch & Grondin, 2001; Cobley et al. 2009a).

Analysis confirmed the bias to still be present at the U19 age group, however results indicate that the bias is less pronounced than at the U17 age group, and significantly less pronounced than at the U15 age group. This is in line with the findings of some of the literature mentioned in section two, which suggests that RAE are at their strongest close to the point of puberty (

usually reached at around 13-15 years of age for boys; Cobley et al., 2009a). Our findings would suggest that relatively older players, born earlier in the calendar year drop out from elite level football as they get older. This could occur due to post-puberty dissipation of physical and cognitive advantages possessed by the relatively older players.

The decrease in the presence of RAE at the older age groups of U17, and U19 in particular, is similar to the pattern found by Sierra-Díaz et al (2017) in their extensive review of studies on the topic of RAE in football. It would be expected that if future research on Irish underage national league footballers was extended to include players from the U13 and U14 national leagues, that RAE would be even more pronounced at these age groups.

It is possible that RAE is an unavoidable consequence of competitive sport, particularly at elite levels, where coaches select players with the intention of winning games immediately, rather than thinking about longer term goals, such as the long term development of players. The possibility that some coaches are more focused on winning in the immediate future, combined with the physical and cognitive advantages possessed by relatively older players can lead to the presence of significant RAE, particularly at younger age groups. While this significantly disadvantages relatively younger players during the initial talent identification process, it ultimately becomes a disadvantage for relatively older players when their physical and cognitive advantages begin to dissipate.

6.2 Relationship Between Relative Age and Dropout Levels

Acknowledging the presence of physical and cognitive advantages for relatively older players, past literature has hypothesised that a biased distribution would be found among a sample of dropouts, with an overrepresentation of players born later in the calendar year or selection period. Research to date concludes that relatively younger players dropout out due to one of, or a combination of factors, including frustration stemming from a lack of opportunity to play as a result of their slower physical development, particularly around the time of puberty. Due

to the lack of RAE among players at senior international level, we hypothesised that the distribution of births of dropouts would show an overrepresentation of players born earlier in the calendar year. Following chi-square tests and a K-S test among our sample of dropouts, we found a significant bias towards players born earlier in the calendar year. Thus, we fail to reject the hypothesis that underage national league players born earlier in the calendar year are more likely to be identified as dropouts. This is a significant finding, as we believe this is the first study of its kind to find RAE to be present among dropouts from sport.

This finding, combined with the lack of RAE identified by many studies at senior level, opens up the possibility of concluding that players born later in the calendar year may possess superior technical ability than their counterparts born in the earlier part of the year, which proves to be of benefit to them in the long run, if they are fortunate enough to be initially selected to play at an elite level. Further analysis of the players within the sample, as well as extensive interviews with coaches and scouts would be required in order to develop an impression of whether the relatively younger players in the underage national leagues possess skill advantages over their relatively older counterparts, and whether they are more productive. Answers to these questions could help to explain why players born later in the calendar year are less likely to dropout from national league football in Ireland.

6.3 Implications of the Results in Conjunction with Previous Literature

The body of literature on the topic of the relationship between RAE and dropout has expanded in recent years. An early study by Helsen, Starkes & Van Winckel (1998) concluded that there is a relationship between RAE and dropout, supported by a more recent study conducted by Delorme, Chalabaev & Raspaud (2011), concluding that RAE is a variable which can have a significant influence on dropout levels in sport.

Helsen, Starkes & Van Winckel (1998), Delorme, Boiché & Raspaud (2010a), Delorme, Boiché & Raspaud (2010b), Delorme, Chalabaev & Raspaud (2011) and Lemez et al. (2014)

all found that there is an overrepresentation of dropouts among those born later in the selection period. Their studies considered samples of Belgian football players, French male football players, French female football players, French basketball players, and Canadian male youth ice-hockey players respectively. The findings of the current study are of a different nature, showing an overrepresentation of dropouts born earlier in the calendar year, rather than later in the calendar year.

The results indicate that we cannot reject the hypothesis that underage national league players born earlier in the calendar year are more likely to be identified as dropouts. The statistical analysis reveals that there is an overrepresentation of dropouts born earlier in the calendar year, with 42.94% of dropouts born in Q1, and 77.91% born in the first two quarters of the calendar year combined.

One possible explanation for this would be that relatively younger players possess technical, or skill advantages over their relatively older counterparts, which would become more apparent when the physical advantages of the relatively older begin to dissipate. Schorer et al. (2009) investigated this hypothesis at a German handball selection camp and found no significant difference in technical skills between relatively older athletes and relatively younger athletes. McCarthy & Collins (2014) also raised the possibility of skill advantages for players born later in the calendar year but dismissed the possibility after their study found that scouting and reports upon recruitment, as well as retrospective analysis, revealed no significant difference in skill or fitness levels between players born earlier in the calendar year and players born later in the calendar year, at least as perceived by the club data.

In contrast, Ramos-Filho & Ferreira (2021), in their study of players in the Brazilian National League in 2015, found that players born later in the year were identified to achieve better sports performance. This complements the work of Deaner, Lowen & Cobley (2013), who analysed National Hockey League players, finding that players born in the third and fourth quarters were

more productive, based on career benchmarks reached, such as number of games played, and number of points scored. Further player data would need to be obtained to assess whether relatively younger players in underage national leagues in Ireland are more productive or perceived by coaches to be more skilled than their relatively older counterparts.

As part of their review of the literature on the topic of RAE in sport, Musch & Grondin (2001) highlighted that previous RAE studies had identified several psychological and sociological factors which may contribute to dropout from sport. While some previous studies (e.g., Helsen et al., 1998; Delorme, Boiché & Raspaud, 2010a) have already concluded that RAE is a significant factor in dropout from sport, it was felt that it was necessary to extend the body of research on the topic.

6.4 Recommendations to Reduce the Prevalence of RAE and Dropout Levels

In the past it has been suggested that it is in the interest of policy makers and governing bodies to attempt to minimise the presence of RAE, to provide all players with equal opportunity to play the game. It should also be in their interest to improve talent identification systems within their jurisdictions. Governing bodies such as the FAI should consider reviewing the content of their coach education programmes to incorporate material related to RAE. Coaches should be made aware of RAE, and its potential consequences, particularly in relation to the selection of players to participate in elite squads or to move to national league clubs.

Musch and Grondin (2001) suggest that it is imperative that coaches be made aware of the RAE, if attempts are to be made to ensure equal treatment and fairer competition in youth level sports. To do so, Mulazimoglu (2014) suggests that coaches involved in selection processes need to be educated on aspects of child and youth development, to increase the selection chances of talented players who may experience late maturation. If underage national league coaches in Ireland remain unaware of the unintentional bias towards players born earlier in the calendar year, or continue to knowingly select relatively older players, players born later in the

calendar year will continue to be disadvantaged in terms of selection for elite level participation, and players born earlier in the calendar year will remain more likely to be identified as dropouts from elite level football in Ireland. However, the responsibility to eliminate the bias should not lie solely with coaches themselves. Governing bodies and sporting organisations across the world need to implement policies which seek to limit the presence of the bias and engage in regular discourse with their members as to the possible consequences of the bias.

Recommendations five and six of the FAIs PDP state that the National Sport Campus should be used for "elite player development and coach education programmes" and that the coaching standards need to be increased (The Football Association of Ireland, 2015). An aspect which should be included in the coaching education process is educating coaches who are involved in elite selection processes on both the process of child and youth development, as well as alerting them to the RAE bias present among footballers in the underage national leagues in Ireland, as well as further afield.

Previous suggestions which have been put forward as a possible attempt to mitigate for RAE include altering the annual cut-off dates from year to year (Barnsley & Thompson, 1988). This system would be fairer, providing all participants with an opportunity to be among the oldest within the cohort, regardless of their month of birth (Müller et al., 2016). While this may alter the prevalence of RAE within samples of underage sportspersons, the practical implementation of such a strategy would be difficult from an administrative point of view.

Barnsley & Thompson (1988) also propose that quotas of children born throughout the activity year should be necessary during the selection process for higher-calibre teams. This would ensure that a proportionate number of relatively younger players would gain an opportunity to play at a higher level. However, this would again be difficult to implement on a practical level, particularly in countries which have smaller pools of players to choose from.

Brewer et al. (1995) argued that a one or two-year gap between consecutive cut-off dates is too large for team sports. While smaller age bands would be successful in reducing relative age differences between those at opposite extremes of the period, practical implementation of such a strategy would again be difficult from an organisational perspective. Reducing the age bands to a shorter period would also result in a smaller pool of players eligible to play at each individual age group, which may not be practical in areas with smaller player populations.

A question posed earlier in the paper was whether relatively younger players, selected to play at an elite level, should receive greater investment, if it proved to be the case that these players are less likely to dropout. The findings did reveal this to be the case. Currently, it appears that a significant number of resources are being dedicated to a group of players (those born earlier in the calendar year) who are statistically more likely to drop out from the underage national leagues. Cut off dates are implemented in the interest of promoting fairer competition and providing all participants with an equal opportunity for success, so such an approach would go against this aim. If these aims of equal opportunity for success and fairer competition are to be achieved, biased allocation of resources, however well intentioned, should be avoided, as it may just result in a shift to an inverse RAE, whereby players born later in the calendar year would become advantaged. Musch and Grondin (2001) stated that competition is one of the necessary conditions for RAE to emerge. Does this mean that it needs to be accepted that RAE and unequal distribution of resources are simply a consequence of the nature of competitive sport?

From the point of view of a governing body, which is concerned with seeking to achieve success on an international level, it may be beneficial to invest more time and coaching resources in relatively younger players who are selected to play at an elite level from a young age, as these players are more likely to stay involved in the sport. Based on our research, these are the players who are likely to progress through the age groups, and thus become the players

who may become available for national team selection later in their careers. However, this goes against the suggestion outlined above, that biased allocation of resources should be avoided.

6.5 Limitations of the Study

One of the limitations of this study arises from the necessity to anonymise the player data contained within the dataset. As a result, players cannot be identified and interviewed, meaning the reasoning behind the players dropping out are unknown, and it is not possible to track the footballing careers of the players after they have left the Irish underage national league system. While it is likely that most have been correctly identified as dropouts from elite level football, there are other possible reasons why players may have left the Irish underage national league system. It could be the case that some of the players who have been identified as dropouts in this research, may actually have progressed straight to senior level League of Ireland football, a league for which player data have not been obtained.

Another possibility is that players identified as dropouts in this research may have gone overseas to pursue a career in football. As a result, the number of players identified as dropouts may include some players who are still playing the game at a different level, or in a different league in Europe or further afield. However, as mentioned above, 188 players under the age of eighteen transferred to a club overseas between the years of 2011 and 2020 (Federation Internationale de Football Association, 2021). As our sample of dropouts come from the 2015 to 2018 seasons, the number of outgoing transfers in this time period is even smaller. It is therefore expected that most of the players identified as dropouts have been correctly identified as players who leave the elite levels of the sport, but there is a possibility that a small number of our sample of dropouts have progressed to a higher level.

Another limitation is the observations being made on players who transition across age groups rather than almost 9,000 independent players. Given the size of the dataset, as well as the anonymity of the data, it was not feasible to track individual players across age groups within

the short time frame available to the author to complete this research. This does mean that there is scope for further studies to conduct similar analysis on independent players if the time frame allows.

A further limitation of the study is the criteria used to identify age outliers at U15, U17 and U19 level. We identified these to be those players who have played in the league despite being two years younger than the cut off age, and still being eligible to play at a younger age group. We cannot say anything as to the quality of these players, as we have no way of identifying them. However, we expect that these players are significantly talented, as they are capable of playing at a higher level. It is only possible for us to assess the birth distributions of the players, which reveals that there is an unintentional selection bias towards players born earlier in the calendar year. This suggests that these players may be selected to play due to their physical maturity rather than based on talent alone. Future analysis could look to identify these players, and through discussions with coaches, assess whether they are selected to play due to their physical size, or based on talent alone.

More recent studies on RAE (Sierra-Díaz et al, 2017; Romann & Fuchslocher, 2013; Delorme, Chalabaev & Raspaud, 2011) have suggested that, when conducting analysis regarding the prevalence of RAE, the population of licensed players in the given sport should be taken as the theoretical distribution rather than the distribution of the population. They suggest that if there were to be a biased distribution among the entire body of players, then a biased distribution of players would also be expected among players at elite level. In the case if this study, the birthdates of all players registered to play football at all levels in Ireland were not available. Therefore, adopting the method used by other previous studies (Helsen et al, 1998; Delorme, Chalabaev & Raspaud, 2011; Romann et al., 2020, etc), the decision was taken to take the distribution of births of the general population for the relevant years as the theoretical distribution used for comparison.

6.6 Summary and Conclusion

The study identified a pattern which differed significantly from the findings in the research to date. Unlike previous studies investigating the relationship between relative age and dropout levels, which found an overrepresentation of dropouts born later in the calendar year, or selection period (Helsen, Starkes & Van Winckel, 1998; Boiché & Raspaud, 2010a; Delorme, Boiché & Raspaud, 2010b; Chalabaev & Raspaud, 2011; Lemez et al, 2014), this study identified an overrepresentation of dropouts among players born earlier in the calendar year.

7 CONCLUSION

The current research confirms that RAE were present across all age groups individually, and combined, among a sample of players which included U15, U17, and U19 national league players from Ireland in the period between 2012 and 2020. Furthermore, analysis of players identified as dropouts revealed, what is to the best of our knowledge, a new finding in the field of RAE in underage football – that players born earlier in the calendar year have been shown to be more likely to be identified as dropouts.

7.1 Summary of the Research

Using chi-square tests and a K-S test, an unintended selection bias towards players born earlier in the calendar year (i.e., born in Q1 and Q2) is found to be present at U15, U17 and U19 level when analysed in isolation, as well as when analysis is conducted across the entire sample - all three age groups combined. This means our first hypothesis, that RAE is present among underage national league players, cannot be rejected. The bias is most prevalent at the youngest age group of U15, becoming less prevalent as age increases. The bias is least prevalent at U19 level; however, it is still shown to be present to a statistically significant extent. This is in line with much of the previous literature on the topic, suggesting that RAE are at their strongest either at younger age groups when exclusively considering physical development, or close to the stage of puberty, when physical and cognitive differences between relatively younger and relatively older players are more pronounced.

Further chi-square tests conducted on the sample of players identified as dropouts reveal that players born earlier in the calendar year are significantly more likely to drop out from elite underage football in Ireland. There is an overrepresentation of players born in Q1 and Q2 of the calendar year among the sample of players identified as dropouts. This means that our second hypothesis, that underage national league players born earlier in the calendar year are more likely to be identified as dropouts, cannot be rejected.

7.2 Avenues for Future Research

In the coming years, the size of the player pool in the underage national league system in Ireland will continue to grow, particularly with the introduction of leagues at new age groups. With the recent introduction of the U13 national league, and the planned introduction of the U14 national league in 2021, it should be possible to gain anonymised player data for a significantly larger sample of players and investigate whether the trend of RAE being more pronounced at younger age groups continues. Based on previous studies on the topic, it would be expected that this would be the case.

The introduction of leagues at further age levels should also provide an avenue for further research in terms of tracking player progression through the age groups over time. The sample of dropouts investigated in this research was relatively small and were all identified as dropouts from the U17 age group. With time, it should become possible to identify more players who dropout, at both younger (U13, U14 and U15) and older (U19) age groups, and thus it will be possible to conduct a more extensive analysis of the monthly and quarterly birth distributions of dropouts, in comparison to the birth distributions of the wider sample of players.

In their review of RAE in sport, Musch and Grondin (2001) state that little is known about the role of sex in the RAE. Any further research to be conducted among elite level underage footballers should also seek to include player data from girls' and women's leagues. Baxter-Jones (1995) identified nonsignificant RAE among girls, citing the earlier maturation of girls as one of the possible reasons for higher levels of RAE among boys. In contrast Sierra-Díaz et al. (2017) identified two studies (Romann & Fuchslocher, 2011; Delorme, Boiché, & Raspaud, 2010b) which confirmed the presence of a traditional RAE distribution in their samples of Swiss female players and French female players respectively. Romann & Fuchslocher (2013), in their analysis of the FIFA U-17 Women's World Cups from 2008 and 2010 found that RAE levels varied between geographic regions. The Irish national team was one of two teams

identified which had an overrepresentation of players born earlier in the year. Future research could attempt draw comparisons between the levels of RAE among males compared to females and attempt to identify any possible reasons behind any potential differences. This would be of particular interest in Ireland, with the recent introduction of the U17 women's national league, the same age group for which it was found that there was a biased distribution within the Irish national team over a decade ago. Analysis of dropouts from this age category of the women's national league would be a good comparison to the current research, as it would involve analysis of dropouts of the same age as those considered in this research.

Delorme, Boiché & Raspaud (2010a) noted that the dropout rate constantly increased with age among youth categories in French male football. Future research could gain access to dropout data for all age groups in the Irish underage national leagues, in order to identify whether the same trend is observed. If this is the case, and similar trends emerge in studies in other locations, then UEFA member associations may need to consider addressing the question of why players are dropping out of the sport as they get older.

This study focused on the timing of the births of players within the calendar year, rather than within the selection period, which spanned a two year period. Nonetheless, the analysis identifies an unintentional bias towards players born earlier in the calendar year, though this may not necessarily correspond to being born earlier in the selection period. Future studies may wish to conduct analysis based on distance of births from the cut-off date rather than positioning of births within the calendar year. Furthermore, future research should consider biological age and maturation phases. Age is used as a proxy from physical attributes, and it may be the case that those elite players born later in the year simply mature earlier and have older biological ages than the average underage player.

As mentioned earlier, in section six of this paper, further analysis would be needed to determine the reasons behind the significant bias towards players born earlier in the calendar year among

the sample of players identified as dropouts. In order to develop an understanding of this, coaches of teams, as well as the players themselves, would need to be consulted, and reasons identified for the deselection of players. Hypotheses to be tested could include players born later in the year possessing skill advantages over their relatively older counterparts, or players born in the later months of the year having superior sporting performance compared to relatively older players.

As outlined above, this study took the distribution of births of the general population as the theoretical distribution when testing for the presence of RAE, as birth data for all registered football players was not available. If the data for player births for all registered underage football players in Ireland were to become available, it could prove to be worthwhile to conduct the same analysis, this time taking the theoretical distribution to be the birth distribution of all registered players at the corresponding age groups.

7.3 Conclusion of Thesis

Results confirmed biased distributions at U15, U17 and U19 level of underage national league football in Ireland, and across all age groups combined across a time period from 2012 to 2020. Recommendations are proposed which could help to avoid RAE, but further research is required to assess whether these recommendations would have any effect. It may be the case that RAE is simply an unavoidable consequence of competitive sport.

Our hypothesis, that underage national league players born earlier in the calendar year are more likely to be identified as dropouts, cannot be rejected. This differs from previous research which has highlighted RAE as an issue due to the bias disadvantaging players born later in the calendar year, leading to overrepresentations of relatively younger players among samples of dropouts. While players born earlier in the calendar year are disadvantaged during the initial selection process for Irish underage national league teams, we find that players born later in

the calendar year who are fortunate enough to be initially selected, become more likely to stay involved in elite level football.

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