# The Relative age Effect in Spanish High-Level Rink Hockey

## El Efecto de la Edad Relativa en el Hockey Patines de Alto Nivel en España

***Guillem Trabal***[1,2]
***Jordi Arboix-Alió***[3,4,5]
***Dani Moreno***[1,2]
***Vasco Vaz***[6,7]
***Hugo Sarmento***[6,7]
***Javier Peña***[1,2]

[1] Department of Physical Activity Sciences, University of Vic – Central University of Catalonia, Vic, Spain
[2] Research group Sport, Exercise, and Human Movement (SEaHM), University of Vic – Central University of Catalonia, Vic, Spain
[3] Department of Sports Science, FPCEE Blanquerna, Ramon Llull University, Barcelona, Spain
[4] School of Health Sciences, FCS Blanquerna, Ramon Llull University, Barcelona, Spain
[5] FC Barcelona, Sport Performance Area, Barcelona, Spain
[6] Faculty of Sport Sciences and Physical Education, University of Coimbra, Coimbra, Portugal
[7] Research Unit for Sport and Physical Activity (CIDAF), University of Coimbra, Coimbra, Portugal

**Correspondence:**
Guillem Trabal
guillem.trabal@uvic.cat

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## Abstract

The influence of athletes' birth distribution across different year periods on sports performance is called the relative age effect. The present research aims to identify this bias in the top male and female national rink hockey competitions in Spain, as well as to assess this effect on variables such as level of competition, gender playing position, nationality, team standings, individual performance (goals scored), and international player status. The relative age of athletes in the first and second top Spanish national male ($n$ = 499) and female ($n$ = 358) competitions in the 2022-23 season was analysed. The results reveal the absence of a relative age effect in any of the analysed variables, indicating the independence of this variable from gender and competitive level. The nature of the sport, its organization, and the competitive structure designed in rink hockey indicate that athletes achieving higher performance were not selected based on biological maturation criteria.

***Keywords:*** Relative age, roller hockey, talent identification, sports performance.

## Resumen

La influencia de la distribución de los nacimientos de los deportistas en los diferentes períodos del año sobre el rendimiento deportivo se llama efecto de la edad relativa. La presente investigación tiene como objetivo identificar el efecto de la edad relativa en las máximas competiciones nacionales masculinas y femeninas de hockey patines en España, así como valorar este efecto sobre las variables: competición, género, posición en pista, nacionalidad, clasificación del equipo, rendimiento individual (goles marcados) y condición de jugador internacional. Se analiza la edad relativa de deportistas de la primera y segunda máxima competición nacional española masculina ($n$ = 499) y femenina ($n$ = 358) en la temporada 2022-23. Los resultados revelan la no existencia de efecto de la edad relativa en ninguna de las variables analizadas, mostrando independencia de esta variable del género y el nivel competitivo. La naturaleza del deporte, su organización y la estructura competitiva diseñada en el hockey patines muestra que en este deporte los deportistas que obtienen mayor rendimiento no han sido seleccionados teniendo en cuenta criterios madurativos de tipo biológico.

***Palabras Clave:*** Edad relativa, hockey sobre patines, identificación de talento, rendimiento deportivo.

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## Introduction

In order to organise and balance the formative competitions of rink hockey (RH), in Spain the categories are structured and divided according to the athletes' birth age of the, typically grouping two different and consecutive birth years into each category. Despite this age-based structuring to bring together athletes with similar capabilities and skills, there are conditions of inequality that affect athletes' performance and participation, which is described by the concept of the relative age effect (RAE) (Barnsley et al., 1992). The concept of RAE in the sports field is described as the advantage in the performance of athletes born at the beginning of the year, after the cut-off date of the structure of the categories organized by age (Barnsley et al., 1985; Lovell et al., 2015). This RAE translates into a more significant presence of athletes born in the first quarters of the year compared to those born at the end of the year in teams and categories linked to performance (Barnsley et al., 1985; Prieto et al., 2015; Rodríguez-Lorenzo & Martín-Acero, 2019).

The age distribution of the sports regulations generates positive and negative effects on athletes' chances of success, favoring those born at the beginning of the year and disadvantaging those born later. During their developmental phase, athletes born early in the year tend to exhibit greater physical and cognitive development, which translates into better immediate performance. This advantage makes them more likely to be identified as talented early on, leading to better experiences and learning opportunities throughout their sporting careers. These favorable conditions increase the likelihood of achieving higher performance compared to those born later in the year (Delorme & Raspaud, 2009; Helsen et al., 1998; Yague et al., 2018). Late-developing players are often excluded from talent selection processes, and in some cases, this leads to dropout from sports due to perceived lack of competitiveness and lower self-confidence (Helsen et al., 1998; Thompson et al., 2004). The practice and competition environment surrounding young athletes plays a crucial role in shaping their development and performance. Positive and high-quality external reinforcements from parents and coaches (Helsen et al., 2005), along with greater training and competition volume (Barnsley et al., 1992; Helsen et al., 1998, 2005), contribute to this. Despite widespread agreement on these factors, the influence of RAE is not consistently observed across all contexts and disciplines, and authors such as Sæther (2016) have not found a relationship between participation time in youth competitions and long-term performance outcomes in sports like football.

Studies that have addressed RAE confirm that this impact is present in a variety of sports, taking into account different characteristics and demands (Cobley et al., 2009; De la Rubia et al., 2020), and is more pronounced in lower categories, decreasing as the age of the athletes and the qualitative and competitive level of the competition increases (Cobley et al., 2009; Doncaster et al., 2020; Rodríguez-Lorenzo &Martín-Acero, 2019; Sierra-Díaz et al., 2017). The adolescence stage generates the most suitable conditions for the RAE to be more significant due to the differences in the physical and cognitive development of the athletes (Cobley et al., 2009).

Despite the evidence of widespread RAE in various high-level sports and competitions, the opposite has also been observed, where RAE is absent or even reversed, showing a greater presence of athletes born later in the year. This reversed RAE, particularly in non-youth categories, is often a result of the challenges faced by athletes born at the end of the year during their development. In many cases, their later maturation has been an obstacle in early developmental stages, and their resilience has made them more capable of performing well in the long term (Cobley et al., 2009; Lago-Fuentes et al., 2019).

A comprehensive review of the literature reveals a wide range of contextual and personal variables associated with RAE, including: a) the player's position and role (De la Rubia et al., 2021; Prieto et al., 2015; Sierra-Díaz et al., 2017; Yague et al., 2018), b) the level of the club and the competition (Cobley et al., 2009; Salinero et al., 2013), c) selection competition, with teams having a larger pool of athletes to choose from showing a greater prevalence of early-year athletes (Lesma et al., 2011), d) the popularity of the sport (Cobley et al., 2009; Doncaster et al., 2020), e) the country of competition (Sierra-Díaz et al., 2017) and the athletes' nationality, with no conclusive results but indicating that RAE may occur in athletes from various countries (Lesma et al., 2011; Sánchez-Rodríguez et al., 2012), f) the characteristics of the sport, showing that in sports where physical abilities are not as critical for performance, RAE may not be identified (Sierra-Díaz et al., 2017), or a reversed RAE may appear, with an overrepresentation of late-year athletes when technical skills are more important than physical abilities (Delorme & Raspaud, 2009; Fumarco et al., 2017), g) the gender of the athletes, with RAE being less frequent and less studied in female sports (Helsen et al., 2005; Sierra-Díaz et al., 2017; Vincent & Glamser, 2006), h) birthplace characteristics, such as the population size of the city or country (Ribeiro-Junior et al., 2023; Sierra-Díaz et al., 2017), i) team and individual performance, or specific performance metrics per game (De la Rubia et al., 2021; Fumarco et al., 2017), j) athletes' economic income (Fumarco et al., 2017), and k) the various stages and ages of the athletes (Doncaster et al., 2020).

In Spain, RAE has been researched for years, demonstrating its impact across various sports (De la Rubia et al., 2021; Lesma et al., 2011; Rodríguez-Lorenzo & Martín-Acero, 2019; Salinero et al., 2013; Sánchez-Rodríguez et al., 2012; Sierra-Díaz et al., 2017; Yague et al., 2018). In RH, and to our knowledge, only one study has examined the influence of RAE. This study analyzed the professional and youth categories of FC Barcelona (Spain), revealing a greater presence of early-born players in all of the club's youth categories, with a significant effect in the U14 and U16 categories. However, this influence was no longer present in the senior professional team (Doncaster et al., 2020).

Given the growing interest in RH within the research field in recent years (Arboix-Alió et al., 2023; Fernández et al., 2023; Ferraz et al., 2024), and the lack of studies investigating the RAE effect in the top national men's and women's competitions in this sport, the objective of this study is to identify the influence of RAE on men's and women's teams in Spanish top RH based on: a) team competitive level; b) player position; c) team final ranking; d) player nationality; e) individual performance (goals scored), and f) international player status.

## Material and Methods

### Participants

The sample consisted of all participants in the two top men's and women's RH competitions in Spain in the 2022-23 season (*n* = 857): *OK Liga Masculina* (14 teams), *OK Liga Plata Masculina* (24 teams), *OK Liga Feminina* (14 teams) and *OK Liga Plata Feminina* (14 teams) (Table 1). The sample selection was done for convenience, using as a reference the best national women's championship and the second-best men's championship in the world (Arboix-Alió et al., 2023).

**Table 1**
*Sample distribution by category and gender*

| Competition | Male | Female | Total |
|---|---|---|---|
| OK Liga Masculine (1st category) | *n* = 181 | | |
| OK Liga Plata Masculine (2n category) | *n* = 318 | | |
| OK Liga Feminine (1st category) | | *n* = 184 | |
| OK Liga Plata Femenine (2n category) | | *n* = 174 | |
| Total | *n* = 499 | *n* = 358 | *n* = 857 |

### Instruments

The observation instrument consisted of the following variables: a quarter of the year of birth, player position, athlete nationality, competition, final team classification, individual performance (goals scored), and international player status (Table 2). The recording instrument was created using an Excel table with each variable.

**Table 2**
*Description of the variables analyzed*

| Variable | Category and description |
|---|---|
| Birth quarter | Q1: first trimester born<br>Q2: second trimester born<br>Q3: third trimester born<br>Q4: fourth trimester born |
| Player position | Goalkeeper<br>Forward / defender |
| Nationality | Spanish<br>Foreign |
| International player status [a] | International<br>No international<br>OK Liga Masculine |
| Competition | OK Liga Plata Masculine<br>OK Liga Feminine<br>OK Liga Plata Feminine |
| Final team classification | G1: 1t to 4th<br>G2: 5th to 8th<br>G3: 9th to 11th<br>G4: 12th to 14th |
| Individual performance (goals scored) | First 20 top scored players<br>No first 20 top scored players |

*Note:* a The absolute international variable has only been analyzed in the highest national male and female categories: OK Liga Masculine and OK Liga Feminine.

## Procedure

The data was provided by the Royal Spanish Skating Federation, which owns the competition and is responsible for incorporating the licenses of all participants. The Federation gave written permission to use this data, which is public and available on its website.

## Statistical Analysis

The SPSS v29.0 statistical package was used to perform the statistical analysis. Frequencies and percentages of the different variables were obtained. To analyze the homogeneity of the distribution across the four quarters (Q1, Q2, Q3 and Q4), a chi-square test was performed to compare the differences between the observed and expected distributions. Statistical significance was set at $p < .05$. Statistical analysis of the four grouped competitions was performed. All analyses have been performed accepting a sample distribution of 25% for each quarter (Yague et al., 2018). The odds ratio was calculated for the different quarters to evaluate potential differences in the distribution of dates between subgroups, with Q4 as a reference. A higher odds ratio value indicates a greater probability of members of this group belonging to this category than the reference group.

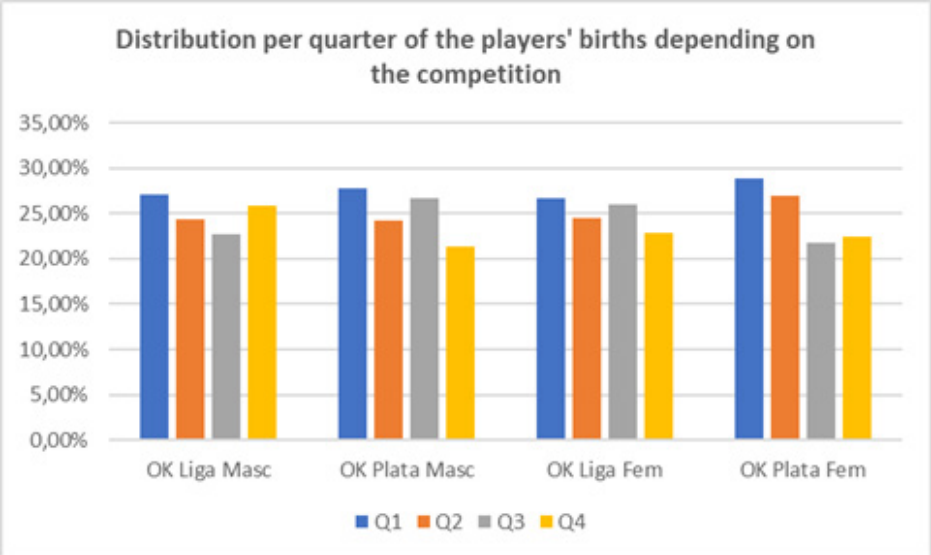
# Results

The sample comparison does not show significantly different distributions in the births' quarters in relation to the expected uniform distribution (Table 3 and Figure 1), so no RAE is observed in the top national RH competitions. Despite this lack of significance, there is a percentage greater than 25% of births in Q1 in all competitions. The comparison between groups shows in practically all cases odds ratio values very close to 1, and it can be established that there is no effect with practical significance of the RAE in any of the categories or quartiles compared (Table 3).

**Table 3**
*Frequency distribution and percentages of player distribution per quarter depending on the competition*

| | Number and y % of players per trimester | | | | | | | Odds ratio (CI 95%) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Competition | Q1 | Q2 | Q3 | Q4 | Total | $\chi^2$ | p | Q1-Q4 | Q2-Q4 | Q3-Q4 |
| OK Liga Masc | 49 (27.1%) | 44 (24.3%) | 41 (22.7%) | 47 (25.9%) | 181 | 0.812 | .817 | 1.04 (0.53-2.04) | .94 (0.47-1.87) | .87 (0.43-1.76) |
| OK Plata Masc | 88 (27.8%) | 77 (24.2%) | 85 (26.7%) | 68 (21.4%) | 318 | 3.031 | .387 | 1.29 (0.68-2,47) | 1.13 (0.51-2.21) | 1.25 (0.65-2.41) |
| OK Liga Fem | 49 (26.7%) | 45 (24.5%) | 48 (26%) | 42 (22.8%) | 184 | 0.652 | .884 | 1.17 (0.58-2.34) | 1.07 (0.53-2.18) | 1.14 (0.57-2.33) |
| OK Plata Fem | 50 (28.8%) | 47 (27%) | 38 (21.8%) | 39 (22.4%) | 174 | 2.414 | .491 | 1.28 (0.64-2.56) | 1.21 (0.6-2.43) | .97 (0.46-2.04) |
| Total | 236 (27.5%) | 213 (24.8%) | 212 (24.7%) | 196 (22.8%) | 857 | | | | | |

**Figure 1**
*Chart showing the percentage distribution of players by birth quarter*



Detailed analyses of the variables in the top competition of Spanish RH: player position, nationality, final team classification, individual performance (goals scored), and international status confirm the non-existence of RAE in Spanish RH, as homogeneous distributions of athletes are observed in the four quarters of birth (Table 4). A detailed analysis of the different distributions by quarter allows us to observe a tendency towards a greater number of athletes in Q1, even though this has not presented statistically significant differences in the distributions. The comparison between groups again shows, in practically all cases, odds ratio values close to 1, and it can be established that there is no effect on the practical significance of the RAE in any of the categories or quartiles compared (Table 4).

**Table 4**

*Distribution, frequency and percentage of the distribution of players per quarter based on the player position, the nationality of the athletes, the final team classification, the individual performance of the players and the international player status * in the four top national competitions of Spanish RH*

| | | Number and % of player per trimester | | | | | | | Odds ratio (CI 95%) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Q1 | Q2 | Q3 | Q4 | Total | $\chi^2$ | *p* | Q1-Q4 | Q2-Q4 | Q3-Q4 |
| Player's position | Goalkeeper | 47 (25.8%) | 47 (25.8%) | 38 (20.8%) | 50 (27.55) | 182 | 1.780 | .619 | .94 (0.48-1.83) | ,94 (0.48-1,.3) | .76 (0.37-1.54) |
| | Forward / defender | 189 (28%) | 166 (24.6%) | 174 (25.8%) | 146 (21.6%) | 675 | 5.705 | .127 | 1.29 (0.71-2.36) | 1.14 (0.61-2.11) | 1.19 (0.65-2.20) |
| Nationality | Spanish | 219 (27.8%) | 192 (24.4%) | 197 (25%) | 179 (22.8%) | 787 | 4.233 | .237 | 1.22 (0.68-2.20) | 1.07 (0.58-1.97) | 1.10 (0.60-2.01) |
| | Foreign | 17 (24.2%) | 21 (30%) | 15 (21.4%) | 17 (24.3%) | 70 | 1.086 | .781 | 1 (0.42-2.40) | 1.24 (0.54-2.84) | .88 (0.36-2.18) |
| Final team classification | G1 | 70 (30%) | 53 (22.7%) | 60 (25.7%) | 50 (21.4%) | 233 | 4.064 | .255 | 1.40 (0.72-2.72) | 1.06 (0.52-2.15) | 1.20 (0.60-2.38) |
| | G2 | 57 (25.4%) | 60 (26.9%) | 56 (25%) | 51 (22.8%) | 224 | 0.750 | .861 | 1.12 (0.57-2.21) | 1.18 (0.60-2.30) | 1.10 (0.55-2.17) |
| | G3 | 52 (25.2%) | 55 (26.7%) | 49 (23.8%) | 50 (24.3%) | 206 | 0.408 | .939 | 1.04 (0.53-2.05) | 1.10 (0.56-2.15) | .98 (0.49-1.95) |
| | G4 | 57 (29.5%) | 45 (23.3%) | 46 (23.8%) | 45 (23.3%) | 193 | 2.130 | .546 | 1.27 (0.65-2.47) | 1 (0.49-2.03) | 1.02 (0.51-2.07) |
| Individual performance of the players | Top scorer | 26 (28.9%) | 14 (15.5%) | 30 (33.3%) | 20 (22.2%) | 90 | 6.533 | .088 | 1.30 (0.58-2.90) | .75 (0.30-1.91) | 1.50 (0.69-3.27) |
| | Non top scorer | 212 (27.3%) | 202 (26%) | 184 (23.7%) | 178 (22.9%) | 776 | 3.835 | .280 | 1.19 (0.66-2.15) | 1.13 (0.62-2.06) | 1.03 (0.56-1.90) |
| International player status * | Internacional | 20 (29.5%) | 14 (20.9%) | 18 (26.8%) | 15 (22.4%) | 67 | 1.358 | .715 | 1.33 (0.56-3.17) | .93 (0.36-2.39) | 1.20 (0.49-2.91) |
| | Non international | 80 (26.4%) | 75 (24.8%) | 73 (24.2%) | 74 (24.5%) | 302 | 0.384 | .944 | 1.08 (0.57-2.04) | 1.01 (0.53-1.93) | .99 (0.52-1.89) |

*Note:* * Analyzed in the highest national category for men (OK Liga Masculine) and women (OK Liga Female).

## Discussion

The main objective of this study was to identify the existence of the RAE in the top-tier Spanish men's and women's RH teams. The results obtained allow us to affirm the non-existence of the RAE neither in the top national competitions nor in any of the variables analyzed in the athletes: track position, nationality, the final team classification of the teams, individual performance (goals scored,) and international status. The novelty of this research and the limited number of studies for RAE in RH requires comparing our results with other sports.

The main result of our research has been that no RAE effect was observed in any of the top national RH competitions in Spain, which has also been evidenced in the top national competitions of other sports (Cobley et al., 2009; De la Rubia et al., 2020; Smith et al., 2018).

Our results in top-level RH are similar to those of Doncaster et al. (2020) who also found no RAE effect in a top-tier Spanish RH club. The absence of RAE in in RH may be due to multiple factors, one of t which is the sport's high technical complexity (Trabal, 2016) meaning that athletes' and teams' performance is not exclusively dependent on physical abilities but rather on a complex response that integrates various skills and abilities (Trabal, Daza, & Arboix-Alió, 2020; Trabal, Daza,

& Riera, 2020). This phenomenon has been observed in other sports, where, when technical and tactical demands are predominant, RAE is either not identified or a reverse RAE is observed, with an overrepresentation of athletes born later in the year (Delorme & Raspaud, 2009). It is possible that in the talent identification process, RH coaches and experts, who are aware of these individual characteristics related to performance, do not favor players who may initially stand out solely due to their greater physical development, which can be advantageous in the early stages of training (Larkin & O'Connor, 2017). This differs from talent identification in other sports where anthropometric characteristics can play a more prominent role (Lovell et al., 2015).

Another possible explanation is related to the popularity of the sport. RH is not one of the most popular sports in Spain, and this lack of interest translates into a lower number of federation licenses compared to other more popular sports with higher participation and viewership, particularly in female RH (Consejo Superior de Deportes, 2023). The greater the popularity and practice of a sport, the greater the number of practitioners and, consequently, an increase in competitiveness to be part of the main teams and competitions, directly related to the appearance of the RAE (Doncaster et al., 2020).

The initiation process in RH in Spain is characterized by early hyper-specialization, with athletes starting the sport at ages ranging from three to five years. We believe this factor directly influences RAE because, prior to talent identification, there is an extended period for developing technical skills, allowing young athletes to compensate for physical limitations.

## RAE and Gender

Neither the male nor female competitions showed an RAE effect. Regarding female RH, our results follow a general trend in the relationship between RAE and gender since the latter is less present and has a smaller impact in women's sports (Figueiredo et al., 2021; Helsen et al., 2005; Sierra-Díaz et al., 2017; Smith et al., 2018) or is even non-existent (Orozco et al., 2022; Smith et al., 2018; Vincent & Glamser, 2006). Despite the limited scientific evidence in female RH (Arboix-Alió et al., 2023), the lower influence of physical attributes on performance, combined with the smaller numberof girls participating in the sport, may reduce the level of competition for reaching the elite level, a fact also observed in other sports (Vincent & Glamser, 2006). This may help explain the absence of RAE when analyzedby gender. In Catalonia, the region of Spain with the most RH licenses, 76% of these are processed to boys and 24% to girls (Consejo Superior de Deportes, 2023).

## RAE and Player Position

Our research has also focused on the study of variables that are likely to be influenced by the RAE playing position, nationality, team ranking, individual performance measured by goals scored, and international player status. Regarding the playing position, several sports have shown the existence of the RAE about the player position or court of the athletes, although no conclusive results are determining which positions are most affected in these sports: goalkeepers (Ferragut et al., 2021), goalkeepers, midfielders and defenders (Lesma et al., 2011), defenders and forwards (Lago-Fuentes et al., 2019; Prieto et al., 2015; Salinero et al., 2013), or the absence of RAE (Salim de Souza et al., 2020). One reason that may explain the lack of influence in RH could be the less pronounced differences in the physical condition of the athletes, depending on the role and the technical and tactical complexity required in all positions. Studies in RH have only shown differences in physical demands between goalkeepers and outfield players, and between outside and inside players, with inside players, who have a more static role near the opposing goal, representing less than 20% of the team's positions (Fernández et al., 2023; Trabal, 2016). Another possible explanation is the limited specialization in positions in RH, except for goalkeepers and a few specific inside players or defenders, who tend to hold these defensive positions more consistently. For this reason, no role differences are observed among outfield players, who take on various roles and positions within the same match, a concept known as "universal" or "mixed" players in this sport. Even in the case of goalkeepers, who exhibit clear differences in their physical demands (Trabal, Daza, & Arboix-Alió, 2020), no effect of the RAE has been observed either, results in line with other research (De la Rubia et al., 2021; Prieto et al., 2015; Salim de Souza et al., 2020; Salinero et al., 2013; Yague et al., 2018).

## RAE and Nationality

Regarding the nationality of the athletes, we have not observed any difference in the influence of the RAE on this variable. Our results are in line with existing research that does not show significant RAE differences based on the origin of the athletes (Lesma et al., 2011; Orozco et al., 2022; Sánchez-Rodríguez et al., 2012). The lack of an effect based on nationality may be explained by the fact that the requirements for participation in Spain's top national competitions are the same for all athletes, regardless of nationality, even though the recruitment of foreign players is uncommon due to the high costs involved. RH clubs usually recruit foreign players only when they are exceptionally skilled and can make a significant impact, which is not a frequent occurrence in Spain's national competitions.

## RAE and Individual Performance

The individual performance variable, analyzed through goals scored, has not shown any effect of the RAE either, a finding that contrasts with results from the top ice hockey competition (NHL), where an inverse RAE (underdog effect) has been

observed, with Q4-born players scoring more goals (Fumarco et al., 2017). This effect is justified by the fact that these athletes born in Q4 and who have reached elite competitions have had to overcome greater adversity, which has favored their development and learning. In RH, the top scorers tend to be the forward players, and as has been observed, there is no RAE by playing position to differentiate these players from the rest.

### RAE and International Player Status and Final Team Classification

The last two variables analyzed and those that have not observed an effect of the RAE on the RH are team ranking and the international player status. These results align with those observed by Fonseca et al. (2019) in handball and the international status of the player, with results opposite to those observed by Ferragut et al. (2021) who showed an RAE in high-level female handball players on national teams. The absence of RAE in both variables may be due to the same argument previously presented regarding the inherent characteristics of RH, which require athletes whose physical condition is important but also integrated with other skills and abilities, a factor that may reduce the influence of RAE compared to talent selection in other sports.

Despite these results indicating the absence RAE in this specific context of the Spanish RH, several limitations of this study must be acknowledged. First, the sample was focused only on top-level competitions, possibly excluding other categories where RAE might be more pronounced. Furthermore, the analysis was limited to a single season and the evolution of RAE over time was not considered. To further understand RAE in RH, other dimensions and variables such as the relationship between previous experience in lower categories and performance at the top level, could be explored. Moreover, extending this type of research to other geographic regions and age categories would help determine the generalizability of the results and provide a better understanding of RAE dynamics in RH globally. Finally, it would be interesting to analyze the influence of RAE in relation to the physical demands and conditional requirements of RH, particularly considering the high intensity of the sport.

## Conclusions

This research shows that there is no RAE in Spanish national RH competitions in any of the variables studied: playing position, athlete nationality, competition, team ranking, individual performance (goals scored), and international player status. This research allows us to lay the foundations on which RAE research in RH can evolve and and provides valuable data for federations and organizations responsible for structuring and organizing national RH, as the current competitive structure and talent identification process do not discriminate players based on their birth date.

## Ethics Committee Statement

It has not been necessary due to the public nature of the data.

## Conflict of Interest Statement

We declare that there is no conflict of interest, including any personal situation or interest that may be perceived as influencing the presentation or interpretation of the results.

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## Authors' Contribution

Conceptualization Guillem Trabal, Vasco Vaz, Hugo Sarmento & Jordi Arboix-Alió; Methodology Guillem Trabal, Jordi Arboix-Alió & Javier Peña.; Software Guillem Trabal; Validation Vasco Vaz & Hugo Sarmento; Formal Analysis Guillem Trabal & Javier Peña; Investigation Guillem Trabal & Jordi Arboix-Alió; Resources Guillem Trabal & Dani Moreno; Data Curation Javier Peña & Hugo Sarmento; Writing – Original Draft Guillem Trabal & Jordi Arboix-Alió; Writing – Review & Editing Hugo Sarmento, Vasco Vaz & Javier Peña; Visualization Dani Moreno & Guillem Trabal.; Supervision Hugo Sarmento & Guillem Trabal.; Project Administration Guillem Trabal. All authors have read and agree with the published version of the manuscript.

## Data Availability Statement

The data that support the findings of this study are available on request from the corresponding autor (guillem.trabal@uvic.cat).

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