ORIGINAL ARTICLE

# Developmental contexts and sporting success: birth date and birthplace effects in national hockey league draftees 2000–2005

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**Objectives:** To examine relative age and birth place effects in hockey players drafted to play in the National Hockey League (NHL) between 2000 and 2005 and determine whether these factors influenced when players were chosen in the draft.
**Methods:** 1013 North American draftees were evaluated from the official NHL website, which provided birthplace, date of birth and selection order in the draft. Population size was collected from Canadian and American census information. Athletes were divided into four quartiles on the basis of selection date to define age cohorts in hockey. Data between the Canadian and American players were also compared to see if the optimal city sizes differed between the two nations.
**Results:** Relative age and birthplace effects were found, although the optimal city size found was dissimilar to that found in previous studies. Further, there were inconsistencies between the Canadian and American data.
**Conclusion:** Contextual factors such as relative age and size of birthplace have a significant effect on likelihood of being selected in the NHL draft.

Researchers examining the development of elite athletes have identified a range of environmental and genetic constraints, which can generally be divided into those having a direct influence on performance (ie, primary factors) and those having an indirect effect (secondary factors).[1] Although a great deal of research has established the significance of primary factors such as training and genes, secondary factors are often overlooked. For instance, access to superior coaching and training facilities can hasten an elite athlete's development, while training in a disadvantaged environment may relegate even athletes with the most promising genotype to suboptimal levels of competition. Researchers are only beginning to understand the role that these contextual factors play in improving or reducing an athlete's chances of attaining elite level performance.

One factor that has a consistent influence on the acquisition of elite performance is the ''relative age effect'' (RAE).[2] In many sports, children are grouped by age to equalise evaluation and competition; however, research indicates that older children in a given age cohort (ie, those that have a higher relative age) are more likely to attain higher levels of proficiency. To date, the RAE has been reported in various educational settings[3] and in sports ranging from professional ice hockey[4] and baseball[5] to junior football[6] and swimming.[7]

Two main explanations have been offered to account for the RAE. The first is that older players appear to be naturally bigger, stronger, faster, and better coordinated than younger players. As a result, they experience more success and rewards leading to greater psychosocial investment and a greater likelihood of remaining involved in the activity. Relatively younger peers, on the other hand, experience failure and frustration and are more likely to withdraw from the sport.[8] A second hypothesis is that relatively older players are more likely to be selected to more competitive teams where they receive improved coaching, facilities and playing time in comparison with their peers. This improved training environment facilitates the involvement in ''deliberate practice'' and thereby increases skill-based differences between relatively younger and older participants.[9] Each of these explanations has clear implications for the development of elite athletes.

In addition to RAEs, researchers have also found that the size of the city where an athlete spends their developmental years can affect their likelihood of attaining elite level performance.[10 11] In a recent examination of birthplace size of professional athletes from baseball, basketball, ice hockey and golf, Côté *et al*[12] found that the optimal city size for athlete development was between 50 000 and 100 000 people. Moreover, there was some evidence that this effect was consistent across both team and individual sports and also across countries, providing strong preliminary support for the concept of a ''birthplace effect''.

Despite the consistency of results in the study of Côté *et al*, the mechanisms for birthplace effects are not known, although it is likely that many factors play a role. For instance, it has been noted that adolescents in rural communities (with populations of under 2500) receive more social support, have higher levels of self-efficacy, and experience fewer conflicts with others than those from larger cities.[13] Furthermore, smaller cities may provide an environment that is more conducive to the development of sports skills by virtue of having more and safer recreational space.[14]

The purpose of this study was to examine relative age and birthplace effects in hockey players drafted to play in the National Hockey League (NHL) between 2000 and 2005. These players represent an important intermediate step in the progression to the professional (ie, expert) level of play in ice hockey. In addition to confirming the birthplace effect in a different population, a primary question of interest in this study was whether relative age and size of birthplace would distinguish players chosen in different rounds of their respective drafts. Given the robustness of the RAE in sport and the apparent strength of the birthplace size effect, our expectation was that relatively older players and players from mid-sized geographical regions would be over-represented

**Abbreviations:** NHL, National Hockey League; RAE, relative age effect

**Table 1** Differences between US and Canadian populations (GenPop) and NHL draftees across regions of different size with odds ratios (ORs) and 95% CI

| | United States | | | Canada | | |
|---|---|---|---|---|---|---|
| **Region size** | **GenPop** | **NHL** | **OR (CI)** | **GenPop** | **NHL** | **OR (CI)** |
| >5 000 000 | 2.9 | 1.8 | 0.58 (0.23 to 1.35) | 0.0 | 0.0 | – |
| 2 500 000–4 999 999 | 2.5 | 2.9 | 1.16 (0.58 to 2.22) | 0.0 | 0.0 | – |
| 1 000 000–2 499 999 | 2.7 | 4.7 | 1.85 (1.08 to 3.16) | 3.9 | 4.6 | 1.18 (0.81 to 1.71) |
| 500 000–999 999 | 4.1 | 9.7 | 2.51 (1.71 to 3.61) | 11.5 | 20.5 | 1.98 (1.63 to 2.40) |
| 250 000–499 999 | 5.9 | 14.4 | 2.68 (1.93 to 3.62) | 10.7 | 9.7 | 0.88 (0.69 to 1.16) |
| 100 000–249 999 | 7.9 | 12.1 | 1.56 (1.11 to 2.19) | 9.9 | 15.6 | 1.68 (1.36 to 2.08) |
| 30 000–99 999 | 17.4 | 29.1 | 1.95 (1.50 to 2.43) | 19.5 | 20.4 | 1.06 (0.87 to 1.28) |
| 10 000–29 999 | 14.3 | 11.8 | 0.80 (0.55 to 1.10) | 13.6 | 11.6 | 0.84 (0.66 to 1.06) |
| 5000–9999 | 6.7 | 7.4 | 1.11 (0.71 to 1.66) | 9.0 | 5.8 | 0.62 (0.45 to 0.87) |
| 2500–4999 | 4.3 | 3.5 | 0.81 (0.43 to 1.45) | 9.4 | 4.9 | 0.60 (0.34 to 0.71) |
| <2500 | 29.6 | 2.6 | 0.06 (0.03 to 0.13) | 12.5 | 7.0 | 0.52 (0.39 to 0.71) |

GenPop, general population; NHL, National Hockey League.

among players drafted in the first round (ie, the most sought after players) and the strength of this over-representation would decline in subsequent rounds.

## METHODS

A total of 1013 male athletes were evaluated and included American (n = 340) and Canadian (n = 673) players drafted between 2000 and 2005 into the NHL. Because census information was not available for countries outside of North America, players from those countries were excluded from further analysis. The time period of 2000–2005 was chosen because these years were the only ones for which draft information was available on the NHL website. Birth dates, birthplace and the order in which the athletes were picked in the draft were collected via the official NHL website (http://www.nhl.com). These data are drawn from the official NHL archive and provided a reliable and complete dataset for examining the research questions.

To investigate the presence of birthplace and RAEs, this study used a similar procedure to Côté *et al*.[12] More specifically, the distribution of the athletes' birthplaces across various city sizes was compared with the distribution of the general population using census statistics. Considering that our examination involved the birthplace of recently drafted players, census statistics from the 1986 census for Canada and the 1990 census for the US were used, as these years more accurately represented the Canadian and American statistics during the players' birth year. The study of Côté *et al* used existing census subdivisions. As a result, comparisons between countries were limited, because the Canadian and US subdivisions were different (eg, the smallest division in the US census was <50 000 whereas in Canada it was <1000). In the present study, standardised subdivisions were created based on a combination of the existing Canadian and American census divisions, which allowed a clearer comparison of the effect in different countries.

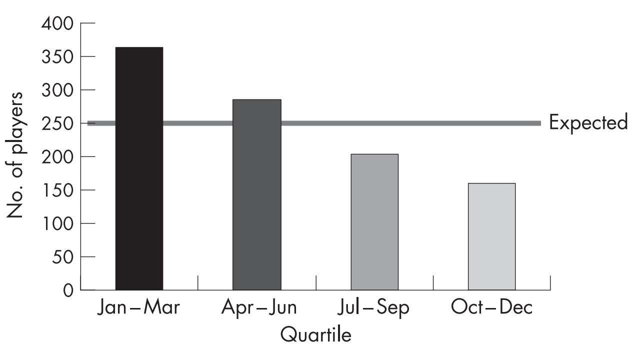


**Figure 1** Distribution of NHL draftees by birth quartile, 2000–2005.

To test the RAE, birthdates for all players were collected from the same website. Each player's birth month was recoded to reflect his birth quartile (Q). The calendar year for US and Canadian hockey is from 1 January to 31 December and, accordingly, Q1 = January, February and March, Q2 = April, May and June, Q3 = July, August and September, and Q4 = October, November and December. As with previous research in this area, comparisons were based on the assumption of equal distribution of births across months of the year.

## RESULTS

Table 1 provides birthplace results for American and Canadian players. Odds ratios for the American data indicate that players from cities of 30 000–2 500 000 were more likely to be drafted into the NHL. In fact, players from cities ranging from 250 000 to 999 999 people were over 2.5 times more likely to be drafted by an NHL team. In addition, players from areas of less than 2500 were significantly disadvantaged.

Data from the Canadian sample suggested that players from cities of less than 10 000 people were at a disadvantage. The Canadian data also indicate that coming from an urban centre with inhabitants ranging from 100 000 to 250 000 and 500 000 to 999 999 was advantageous for NHL draftees. Similar to the US data, players born in cities with 500 000–999 999 people were twice as likely to be drafted.

Figure 1 presents our examination of the birth date data. $\chi^2$ analysis of these data revealed a significant bias for athletes born in the first half of the year ($\chi^2 = 96.3$, $p<0.001$); 64% of athletes drafted into the NHL from 2000 to 2005 were from this group. There were no differences between the RAEs in the Canadian versus the American players.

In addition, Spearman rank-order correlations were used to consider whether birth quartile and size of birthplace were related to how quickly the athletes were picked in the draft (round number). Because of differences in the population distributions between Canadian and American players, each country was examined separately. For the American players, there were no significant correlations among these variables (all $p>0.284$); however, analysis of the Canadian data indicated a significant negative correlation between birth quartile and round number ($r = -0.09$, $p<0.05$). Interestingly, these findings suggest that relatively younger athletes are more likely to be chosen in the earlier rounds of the draft. Further, there was a significant negative correlation between size of birthplace and round number ($r = -0.08$, $p<0.05$), indicating that Canadian players from larger regions are selected in earlier rounds of the

### What is already known on this topic

- For decades, sport scientists have known that the month of birth may affect an athlete's likelihood of reaching elite level because of relative age effects.
- Recent research has also suggested that the size of an athlete's birthplace may also have a large influence.

### What this study adds

- A relative age effect was confirmed for players drafted to play in the NHL, but more research is required to determine the specificity of the birthplace effect.
- Relatively younger players are chosen earlier in the draft, suggesting that these players may show superior performance compared with their relatively older peers.

draft. There was no relationship between size of birthplace and birth quartile ($p = 0.90$).

## DISCUSSION

In general, these results reinforce the conclusion that contextual factors specific to an athlete's developmental environment affect their likelihood of achieving elite level performance. This study provides continued support for the existence of RAEs in professional hockey, but also supports the notion of birthplace effects proposed by Côté *et al*.[12] Côté and colleagues concluded that region sizes that are too small or too large are not conducive to the development of elite athletes because of several environmental factors (eg, amount of available recreational space, safety).

There are some discrepancies between the results of this study and those presented by Côté *et al*, predominantly with respect to the data for Canadian players. Côté and colleagues found that Canadian NHL players were disproportionately over-represented in geographical regions with between 50 000 and 500 000 inhabitants, and under-represented in regions larger than 500 000. In this study, we found that NHL draftees were under-represented in regions with fewer than 30 000 and over-represented in regions with 100 000–250 000 and 500 000–999 999 inhabitants. Like Côté *et al*,[12] we found that there was no benefit from coming from regions of over 1 000 000 people. The lack of consistency across countries was somewhat surprising given the strength of the findings for the RAE and birthplace size effect in previous studies.[2 12]

The discrepancies in results between these two studies may be reconciled in three ways. Firstly, the population subdivisions were different between the studies. The subdivisions in our study allowed comparisons across countries to examine the cultural generality of the birthplace effect. However, use of these subdivisions limits comparisons with studies that did not use similar population partitions. The second concerns limitations of census information, which may have affected the data for the Canadian population because it used census information from 1986 rather than 1976 (as Côté *et al*[12] did). Changes to the manner in which geographical areas are measured, as well as migration to/away from regions of different size, may influence population distribution across a 10-year period, thereby confounding comparisons across different censuses. Finally, our study considered players that had been drafted by NHL teams, which does not automatically ensure that one will play in the NHL. Often, players can spend their entire professional careers playing for development or ''farm'' teams. As a result, our sample may not be the best representation of NHL players. Nevertheless, these discrepancies point to the need for additional research on birthplace effects.

Our hypothesis that relative age and birthplace size effects would be related to the players' selection round was supported for the Canadian players but not for the American players. Interestingly, the Canadian results indicate that relatively younger players were more likely to be chosen in earlier rounds of the draft. To our knowledge, this is a novel finding and suggests an advantage for relatively younger athletes. Regarding birthplace size, correlation analyses indicated that players from larger regions were chosen in earlier draft rounds and players from smaller regions were chosen later. However, both of these correlations were relatively weak. All the same, they suggest that the effects of relative age and birthplace size are more complex than previously considered.

In summary, these results provide additional evidence for the existence of birthplace and birth date effects in professional ice hockey, emphasising the role of environmental and contextual factors in the development of elite athletes. Although the RAE remains robust, additional research is required to confirm the birthplace effect in different sports (as well as other domains) and cultures. Perhaps most important is the need for research to identify the specific mechanisms of these effects. Indeed, knowledge of the specific causes could prove informative for athlete training and development.


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