Influence of population size, density, and proximity to talent clubs on the likelihood of becoming elite youth athlete

Rossing, Niels Nygaard; Stentoft, Diana; Flattum, Alexander ; Côté, Jean ; Karbing, Dan Stieper

Published in:
Scandinavian Journal of Medicine & Science in Sports

DOI (link to publication from Publisher):
10.1111/sms.13009

Publication date:
2018

Document Version
Accepted author manuscript, peer reviewed version

Citation for published version (APA):
Rossing, N. N., Stentoft, D., Flattum, A., Côté, J., & Karbing, D. S. (2018). Influence of population size, density, and proximity to talent clubs on the likelihood of becoming elite youth athlete. *Scandinavian Journal of Medicine & Science in Sports*, *28*(3), 1304–1313. https://doi.org/10.1111/sms.13009

MR NIELS NYGAARD ROSSING (Orcid ID : 0000-0003-0271-0682)

Article type : Original Article

Title: Influence of population size, density, and proximity to talent clubs on the likelihood of becoming elite youth athlete.

Running head: Role of community in development to expertise

Authors

Niels N. Rossing[1], Diana Stentoft[1], Alexander Flattum[2], Jean Côté[3], Dan S. Karbing[1]

[1] Department of Health Science and Technology, Aalborg University, Aalborg

[2] Department of Public Health, Aarhus University, Aarhus, Denmark

[3] School of Kinesiology and Health studies, Queens University, Kingston, Canada

Corresponding Author:

Niels Nygaard Rossing

Department of Health Science and Technology, Aalborg University, Aalborg, Fredrik Bajers vej 7 E2, 9220 Aalborg, Denmark. Tel.: + 45 99407603, E-mail: nnr@hst.aau.dk

Acknowledgement:

We would like to thank Centre for Youth Sport, CEBU, for the cooperation and endless support.

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/sms.13009

Abstract

Previous studies have found significant differences in the likelihood of becoming an elite athlete depending on community population sizes and densities, an effect known as the place of early development, or birthplace effect. However, the results have not been consistent between sports or European countries. Since both professional and voluntary clubs are vital to the talent development systems in Europe, the proximity of an athlete's place of early development to the location of talent clubs may be an important predictor of the likelihood of becoming an elite athlete. Therefore, the primary purpose of this study was to investigate the place of early development effect and the effect of proximity to talent clubs. The samples included elite youth league athletes (579 football and 311 handball) and national youth athletes (85 football and 80 handball) and a comparison group of 147,221 football and 26,290 handball youth athletes. Odds ratios showed variations in the optimal community size and density across sports. Geospatial analyses of proximity to talent clubs highlighted a trend indicating that most national and elite youth league athletes in both sports had their place of early development in their sport near a talent club. The results suggest that proximity is an important a predictor in the development of expertise across sports, but future studies need to clarify if proximity is important in other countries and sports.

Keywords

Athlete development, community size, community density, birthplace effect

Introduction

For decades, a growing body of literature has sought to understand how an individual's early environment contributes to the development of expertise in sport. Several studies have shown that the population size of a birthplace community influences the likelihood of achieving elite status [1,2].

Birthplace also seems to influence both youth athlete participation [3,4] and long-term adherence to the sport [5]. However, community size has been a less consistent predictor in European [3,6,7] and Israeli [8,9] birthplace studies. This inconsistency has led researchers to conclude that future studies should examine other variables that could indicate an ideal setting for talent development in sport [2,6].

Recently, the birthplace effect was renamed the "place of early development effect" [3], since the term should accurately highlight the critical role that the "location in which children spent their developmental years" [1(p1067)] has on athletic development [10] and early sport participation[4]. Nearly all studies conducted so far have used the population size of the athlete's birthplace community as a proxy for the early environment of the athlete [7].

Community size

The studies on community size, primarily from North America and Australia, have shown that relatively smaller cities or communities (i.e., those with populations between 1,000 and 500,000) have fostered proportionally more elite athletes than cities with fewer than 1,000 or more than 500,000 inhabitants [1,11–14] . However, there is emerging evidence that the consistencies of these effects are not stable in North American samples, as they first appeared to be [15]. Furthermore, studies within Israel [8] and European countries, such as Germany [6], Denmark [3], Sweden and Finland [2], have shown inconsistent results in the optimal community size. Therefore, the idea of an optimal community size as predictor for the development to sport expertise cannot be established and generalized to countries of different sizes and culture. Researchers have explained the conflicting results between Anglo-American and mostly European countries with three primary reasons: 1) there is a significantly higher population density in Europe than in Anglo-American countries, which may weaken the importance of community size in Europe [6], 2) there is a shorter distance between cities in smaller European countries compared to cities in Canada, the USA, and Australia [9], and 3) there are differences in athlete performance levels and the cultures of sport and athlete development between geographical regions [2,3]. Since there are multiple geographical and cultural differences between countries and continents, community density was proposed by Baker[6] as a more accurate variable.

Community density

Baker and colleagues [6] compared the population density in North American and European countries and revealed that Europe is a far more populated area per square meter of land, which probably affects its opportunities for athlete development. Population density may also better reflect the internal structure of a community since it comprises two dimensions; namely, the total population and the inhabitants per unit area. Previous studies highlight that a low-density community is a strong predictor of higher levels of childhood obesity in Sweden [16] and higher physical activity levels, but also a greater weight, in US adolescents [17]. Low-density communities were also likely to have more green spaces, which promote more leisure walking activities [18] and stronger social interactions and social networks [19,20]. It is likely that these characteristics have an impact on youth athletes in terms of their opportunities to enroll in sport and their athletic development.

A limited number of studies have examined the influence of community density on expertise development in sport. Community density has only been examined in a Danish [3] and a Portuguese context [7]. The Danish study found that communities with high density had proportionally more elite football athletes, while mid-density communities had a higher proportion of elite handball athletes. Conversely, the study on Portuguese volleyball athletes showed that less densely populated districts had higher proportions of elite male athletes; however, there was no apparent relationship between density and the distribution of elite female athletes. In both papers, the authors [3,7] hypothesized that the inconsistent results may be due to shared pride in communities with dominant clubs in a club-based sport system. As such, the population density of the place of early development by itself may not be an accurate predictor of development into sport expertise. Lidor and colleagues [8,9] have called for a more culture-specific approach to place of early development studies that includes other variables that can affect how children develop in sport. One such variable could be the proximity between talent clubs and where young athletes reside.

Proximity to talent clubs

From studies in physical activity, we know that proximity to open play spaces and recreational facilities are important determinants of the level of physical activity and sport participation [21,22]. In

1982, Bloom [23] revealed, from his well-known interview study, that almost all Olympic swimmers were characterized by being very much at ease in the water as early as age 3 to 4 years old. Bloom rationalized that close proximity to water, particularly in warmer climate, could function as a catalyst to the early stimulation to feeling at ease. Consequently, the swimmers could develop a special "feel" for the water at an early stage[24(p.514)] , which seemed crucial in the development of their swimming talent. Recent studies have shown that athletes' proximity to talent clubs or elite centers in their early development seem important in athlete development. For example, Rossing et al. [3] showed an association between Danish handball and football elite athletes' place of early development and the location of talent clubs. Moreover, Finnegan and colleagues [24] concluded that Irish youth football athletes developed in counties with a national center of excellence were 50 % more likely to gain selection than those developed in counties without a center. Furthermore, Hancock and colleagues[7] suggested community pride could explain the varied results in Portuguese elite volleyball. One could argue that communities in proximity to talent or high-performance clubs are more likely to inherit a community sport pride, since it has been shown to nurture athlete development [25]. Once they reach the age of specialization, youth athletes will often be required to leave their local club in favor of a high-performance club where they can access better coaching and resources. Athletes growing up far from a talent club may face additional challenges, for example as longer distances require additional resources for transportation to and from the new club. The results from recent studies [3,24] suggest that proximity to central key factors such as clubs or talent centers in talent development should be an important consideration when analyzing place of early development in expertise research. However, no studies have yet investigated proximity to talent clubs as a predictor for attaining sports expertise.

The purpose of this study was to examine proximity to talent clubs as well as community size and density as predictors of development of expertise in sport. The study included two samples of talented Danish handball and football youth athletes. The specific objectives were to investigate: 1) the relation between the probability of becoming an elite youth football or handball player and the population size and density of the player's place of early development, and 2) the relation between the proximity of an athlete's place of early development to a talent club and the likelihood of reaching elite youth level.

Methods

Danish Talent Development Structure

The Danish sport structure attempts to balance mass participation and elite sport development [26]. Sport is traditionally a voluntary activity with a so-called heterarchical organizational structure that includes several key factors such as local clubs, professional clubs, and volunteers [27]. Volunteerism and non-trained coaches and managers often characterize local sports clubs. Every small or large community in Denmark has both a sports hall and a football field, which is a strong indication that handball and football are among some of the most popular and successful sports in Denmark in terms of youth athlete sport participation and media coverage. Consequently, all Danish children have access to sport participation in both handball and football. Nevertheless, there are noteworthy differences in the talent development structure between Danish handball and football, and data on both sports have therefore been included in the present study to allow for a comparison between sports.

Overall study design

The study was separated into two sports, one on youth football and one on youth handball. The design and methods were similar between the two sports. The methods are presented below, followed by a presentation of the specific samples and analyses on football and handball along with their respective results.

Samples

Three samples representing different competitive levels were included in both the study in youth football and handball. Sample 1, representing the lowest competitive level, was comprised of registered youth athletes under 12 years of age who were registered (2003) as athletes in a club. Sample 1 was obtained from the Danish football federation (DBU) and the Danish handball federation

(DHF). The youth athletes under 12 years of age were selected because they represented a broad sample of competitive and recreational athletes, as talent clubs mostly recruit athletes who are 12 years old or older. We selected to collect sample from the year 2003, since the competitive youth athletes in samples 2 and 3 most likely have been a part of the recreational youth player population in this year. The data for sample 2 were collected in 2015, meaning the elite youth league athletes' age band in 2003 was 3-7 years. We collected the data for sample 3 in 2013, meaning the national youth athletes' age band in 2003 was 5-12 years. Most Danish athletes in handball and football are introduced to the sports in 5-6 years of age and will formally be selected at the age of 12. As such recreational youth player populations from 2003 provide us with an appropriate comparison sample for samples 2 and 3. Sample 2 included Danish male youth from the highest youth leagues in 2015. Each team received a demographic questionnaire by mail that asked the athletes to fill in their primary city of residence from birth to the 12th year of age. The inclusion criteria for athletes were (1) born in Denmark; (2) lived in Denmark for the first 12 years of their life; (3) on the first team roster, regardless of the number of games they had played in the season. The club response rate was 100% for both football (30 teams) and handball (24 teams). A small subset of youth athletes in both handball (n=4) and football (n=19) failed one or more inclusion criteria and was excluded. Sample 3 represented the highest competitive levels during 2013 included national male youth athletes who all had been selected for one of the Danish national youth teams. The sample data were obtained by email contact with either the secretary or coach of each national youth team. All national youth teams (8) in both sports participated in the study.

Data analysis

Odds ratio (OR) analysis was performed to investigate community size and density as predictors for expertise. OR were calculated relating odds for being a youth elite league player (sample 2) to being a youth player (sample 1), and odds for being a national youth player (sample 3) to being a youth player. In doing so, we assumed that only youth athletes in each sport are eligible for the youth elite league level, as was also assumed in previous studies[3,28], and that selection of national youth team athletes is nationally concerned and not limited to the elite youth league per se.

Communities were divided into five sub-divisions by population size (<10,000; 10,000– 30,000; 30,000– 50,000; 50,000– 100,000; >100,000). Similar to a previous study [3], communities were also divided into six sub-divisions by density (population per km^2). The division was based on sub-divisions of density in European countries from the Nordregio analysis institute [29]. Statistical analyses were performed using Microsoft Excel version 2010.

Geospatial analysis was applied to analyse proximity to talent clubs as a predictor for development to expertise. This analysis was carried out in four steps. First, we calculated the odds ratio for being a youth elite league or national youth player compared to being a youth player in each community. Second, we linked our statistical data with geo-coded data on Danish communities within a geographical information system (GIS) called QGIS. GIS allows statistical geo-coded data to be symbolized on maps [30], and it can include additional information, such as the locations of the talent clubs. Third, we used the Jenks method (also called natural breaks) to categorize the communities into five categories based on their OR. This method is aligned with the methodological proposal from Hancock and colleagues [7], since it ensures stronger within-category consistency. This means that the units on the geographical map that share the same color are statistically more similar to each other than to other units with alternative colors [30]. Finally, we specified the geographical location of the talent clubs on the maps.

Football

Danish talent development structure in football

In football, clubs can apply for a license from the national federation to be identified as a "talent club." Licenses are divided into three hierarchical categories, A- (12 clubs) and B- (14 clubs) and T-license (13 clubs), with the A-license representing the highest ranked level. The national federation has licensing requirements for both material and human resources, such as the quality of the club's sport facilities and the number of educated coaches. The clubs with A-license approval, or the talent clubs, receive extra economic resources, and their U-17 and U-19 teams are admitted to the highest youth leagues. Eleven of the twelve investigated talent clubs were also participating in the Danish Senior Premier League during data collection.

Sample

Sample 1 consisted of 147,221 registered male youth football athletes. Sample 2 included Danish male youth athletes (n=589) from the highest youth leagues U17 and U19, with a mean age of 17.3 years. Sample 3 included 85 (football) national male youth athletes who all had been selected for one of the Danish national youth teams on the U16, U17, U18, U19 or U21 football teams. The national football athletes ranged from 15-21 years of age (mean age=17.8 years).

Results

Table 1 shows the distribution of youth football athletes in each category of community density and size in comparison to the proportion of youth elite league and national youth athletes in football. The OR and CI indicate whether the communities have an over- or an under-representation of elite league or national youth athletes.

The results show that most urban communities of population size (>30,000) and density (>250 pop./km^2) have developed proportionally more youth elite league football athletes, while there is an underrepresentation of youth elite league athletes in the most rural communities of size (< 30,000) and density (< 100 pop./km^2). The results also show that urban communities of size (<50,000) and density (>1000 pop./km^2) have proportionally more national youth football athletes, while rural communities of size (<10,000) and density (<100 pop./km^2) have proportionally fewer. Overall, the results show that rural youth athletes are underrepresented at the elite youth league level, and even more so at the national youth level, while urban youth athletes are overrepresented at the elite youth league level, especially at the national youth level.

Figures 1 and 2 illustrate the distribution of elite youth league and national youth football athletes' place of early development in comparison to the distribution of youth athletes in each community. Both figure 1 and 2 show that communities located at or close to a talent club have higher proportions of elite youth league and national youth football athletes than communities located farther away from talent clubs. This tendency, however, seem more marked at national youth than elite youth league level.

Handball

Danish talent development structure in handball

In handball, a national federation ensures that there are regional competition leagues at earlier developmental levels and a national competitive league at under 16 (U16) and under 18 (U18) age groups. Each local sport club and youth team is, in principle, able to qualify for the highest U16 and U18 leagues through an annual series of matches in the pre-season. Local sport clubs primarily select athletes from their local area and ensure their own economic resources via sponsors and voluntary work. Eight out of the fourteen clubs investigated in the present study were situated in a community that participated in the elite youth league and the Danish Senior Premier League at the time of data collection.

Sample:

Sample 1 consisted of 26,290 registered male youth handball athletes. Sample 2 included Danish male youth athletes (n=311) from the highest youth leagues, U16 and U18, with a mean age of 17.6 years. Sample 3 included 80 male youth athletes who all had been selected for one of the Danish national youth teams on the U18, U20 or U21 handball teams. The national youth athletes ranged from 15-21 years of age (mean age=18.6 years).

Results

Table 2 shows the distribution of youth handball athletes for each category of community density and size in comparison to the proportion of youth elite league and national youth athletes in handball. OR with CI indicate whether youth elite league athletes and national youth athletes are over- or under-represented compared to the proportion of registered youth athletes.

The results in handball show that there is an overrepresentation of elite league youth athletes from mid-urban communities of size (30,000 to <100,000) and density (250 to <1000 pop./km^2), while rural youth athletes are underrepresented in communities of size (<30,000) and density (<100 pop./km^2). The results at the national youth level demonstrate that there is an overrepresentation of national youth athletes in communities with a population size ranging 30,000 to <50,000, while there is an underrepresentation of national youth athletes in the more rural communities of size (10,000 to < 30,000) and density (50 to <100 pop./km^2). It is noteworthy and surprising that the least dense communities (<50 pop./km^2) seem to have a smaller but insignificant underrepresentation of national youth athletes. Consistent with football, rural youth handball athletes were underrepresented at the elite youth league level, although the results varied at the national youth level. Furthermore, there was no consistent, significant overrepresentation of elite youth athletes at the elite youth level or the national youth level. As in football, the findings indicate that rural youth handball athletes have more difficulty reaching the elite and national youth competitive levels than those in other areas, although there are some exceptions.

Figures 3 and 4 show the proportion of elite youth league and national youth handball athletes' place of early development in comparison to the proportion of youth athletes in each community. The figure highlights a trend that communities located at or close to a talent club are more likely to have developed elite youth league or national youth handball athletes than communities located farther away from talent clubs. One noteworthy exception to the trend was found in figure 4, where national youth athletes also seem to come from communities with an elite handball club located in the area (marked with the letter a).

Discussion

There are two main findings from the study. First, we observed variations in the optimal community size and density for athletes at the elite youth league and national youth levels for handball and football. Second, there was a general trend that both elite youth league and national youth handball and football athletes mostly come from communities near talent clubs.

Community size and density

The results showed variations in the optimal community size or density between sports. However, athletes from rural communities of various densities and sizes were proportionally underrepresented in both sports, while mid-sized communities in handball and the densest communities in football had proportionally more athletes at the elite youth league and national youth levels. The inconsistency of the results across sports in this study and in previous studies in Europe and Israel [6,7,9,31,32] suggest that it is difficult to establish an optimal community size or density in countries that have smaller distance between cities and high-performance centers. It indicates, that other variables ought to be considered to study how the characteristics of an early place of development promote superior athlete development at community level.

Proximity to talent clubs

A novelty of this study was its exploration of the athletes' proximity to talent clubs as a predictor of sport expertise. The consistent results in the effect of proximity to talent clubs across sports and samples indicate that proximity to talent clubs has an important influence on the development to expertise, at least in the Danish talent development system. Until now, most studies in spatial talent development have only considered athletes' place of early development as the precursor for differences in their results. However, as talent identification and development occur in a reciprocal relationship [33], we cannot rule out that the effect of proximity may influence athlete development in three developmental stages; namely in its early stages (at local club level), in the talent identification stage (from local club to talent club) and the specialisation stage in the talent club.

Firstly, it seems surprising that the effect of proximity to talent clubs was more marked at national youth level in football and handball than at elite youth league. Especially national youth athletes should be irrespective to proximity to talent clubs, as these represent the highest national youth competitive level. Therefore, the results suggest that there are early advantages for young athletes to spend the childhood years near talent clubs, which somehow have a long-term impact in the development of expertise. The close proximity to talent clubs for young athletes may create better opportunities for them to adopt local role models and owning a sense of community pride, since the talent clubs are viewed as central actors in the local sport system. Previous studies have indicated that both role models and community pride are crucial in athlete development [25,34]. Communities situated near talent clubs most often receive additional financial ressources which may influence the quality of coaching with these communities [35]. Therefore communities near talent clubs may be characterized with features that promote athlete development such as interest, motivation, skill building, and support for efficacy and positive social norms [36,37]. Given the fact that an area with elite clubs also had proportionally more national youth athletes in handball, the effect of proximity might not only be influenced by current talent clubs, but durable privileged clubs such as elite clubs. Consequently, the structure in Danish youth and senior handball, with more diverse talent and elite clubs, may allow more youth players to be able to pursue development to expertise. Secondly, we cannot rule out that youth athletes from communities near talent clubs also may be favored in the talent identification process. Professional coaches have been shown to view talent based on their own cultural background and experiences [38]. Therefore, youth athletes may have an advantage in the talent identification process, creating a “proximity” bias in the selection process. Thirdly, living near a talent club in the specialization stage may provide athletes and their families with better conditions in their everyday life. For instance, athletes and their families who live remotely from talent clubs may experience transportation to and from the local club as a barrier for participation in the talent development.

In Denmark, talent development has been centralised to elite sport schools within larger cities in conjunction with already established talent clubs and elite clubs [39]. The results from this study could be a result of the centralisation of talent development; since the centralisation may generate a proximity effect favouring the athletes growing up close to the centrally located talent development institutions as an unintended consequence. Therefore, it seems that Danish handball and football talent development system appear to lack both *resource* and *pipeline fairness*, because the results show that not “every person have an equal opportunity to… develop one’s talent to play sport” [40(p14)]. Moreover, similar to the predominant selection of athletes born early in the year, also called the relative age effect [41], the predominant selection of athletes living close to a talent club suggests a *waste* of potential talented youth athletes. As national conditions and talent development systems probably can influence the importance of proximity to talent clubs it remains to be investigated how our results on proximity can be generalized to other countries and sports.

Since the composition of handball clubs in the Danish youth elite leagues varies each year, the location of these talent clubs (as shown in the figures) is a more temporary representation than it is for football. Spatial data analysis has highlighted a broad proximity trend across the country, but it cannot give a more detailed account of the specific influence of the proximity effect, which would be worth pursuing.

Perspective

This study complements previous research [6,72,6] by adding to the notion that there is no optimal community population size or density for developing talented athletes in a small country like Denmark. This study also extends previous work by proposing proximity to talent clubs as another spatial predictor of sport expertise. Population size, density, and proximity are environmental indicators of a sport system that affects primary factors such as access to a sport and coaching. Moving forward, countries of different sizes, population, and density should consider proximity as an important determinant of sport participation and performance.

Several studies have now documented the influence of athletes' place of early development. The results from these analyses have shown that there are certain types of communities that have been more inclined to produce elite athletes than others. However, these analyses do not reveal the underlying mechanisms that promote athlete development. This is needed if sport organizations and clubs are to move forward with adjusting their policies and practices. Future studies should either use more sophisticated methods to explore the effect of proximity or use qualitative methods to understand why some communities succeed in talent development while others do not.

References

1. Côté J, Macdonald DJ, Baker J, Abernethy B. When 'where' is more important than 'when': Birthplace and birthdate effects on the achievement of sporting expertise. *J Sports Sci*. 2006;24(10):1065-1073.

2. Bruner MW, Macdonald DJ, Pickett W, Côté J. Examination of birthplace and birthdate in world junior ice hockey players. *J Sports Sci*. 2011;29(12):1337-1344.

3. Rossing NN, Nielsen AB, Elbe A-M, Karbing DS. The role of community in the development of elite handball and football players in Denmark. *Eur J Sport Sci*. 2016;16(2):237-245. doi:10.1080/17461391.2015.1009492.

4. Turnnidge J, Hancock DJ, Côté J. The influence of birth date and place of development on youth sport participation. *Scand J Med Sci Sports*. 2014.

5. Imtiaz F, Hancock DJ, Vierimaa M, Côté J. Place of development and dropout in youth ice hockey. *Int J Sport Exerc Psychol*. 2014;12(3):234-244. doi:10.1080/1612197X.2014.880262.

6. Baker J, Schorer J, Cobley S, Schimmer G, Wattie N. Circumstantial development and athletic excellence: The role of date of birth and birthplace. *Eur J Sport Sci*. 2009;9(6):329-339.

7. Hancock DJ, Coutinho P, Côté J, Mesquita I. Influences of population size and density on birthplace effects. *J Sports Sci*. 2017;414(January):1-6. doi:10.1080/02640414.2016.1276614.

8. Lidor R, Côté J, Arnon M, Zeev A, Cohen-Maoz S. Relative age and birthplace effects in division 1 players–Do they exist in a small country. *Talent Dev Excell*. 2010;2(2):181-192.

9. Lidor R, Arnon M, Maayan Z, Gershon T, Côté J. Relative age effect and birthplace effect in Division 1 female ballgame players—the relevance of sport-specific factors. *Int J Sport Exerc Psychol*. 2014;12(1):19-33. doi:10.1080/1612197X.2012.756232.

10. Baker J, Logan AJ. Developmental contexts and sporting success: birth date and birthplace effects in national hockey league draftees 2000-2005. *Br J Sports Med*. 2007;41(8):515-517. doi:bjsm.2006.033977 [pii].

11. Bruner MW, Munroe-Chandler KJ, Spink KS. Entry into elite sport: A preliminary investigation into the transition experiences of rookie athletes. *J Appl Sport Psychol*. 2008;20(2):236-252.

12. Baker J, Shuiskiy K, Schorer JJ. Does size of one's community affect likelihood of being drafted into the NHL? Analysis of 25 years of data. *J Sports Sci*. 2014;32(16):1570-1575. doi:10.1080/02640414.2014.908319.

13. Abernethy, B., & Farrow D. Contextual factors influencing the development of expertise in Australian Athletes. In: T. Morris, P. C. Terry, S. Gordon, S. Hanrahan, L. Levleva, G. Kolt & PT, ed. *Proceedings of the 11th ISSP World Congress of Sport Psychology. Psychology*. Sydney: International Society of Sport; 2005.

14. Cobley S, Hanratty M, O'Connor D, Cotton W. First Club Location and Relative Age as Influences on Being a Professional Australian Rugby League Player. *Int J Sport Sci Coach*.

2014;9(2):335-346. doi:10.1260/1747-9541.9.2.335.

15. Wattie N, Schorer J, Baker J. Seeing the forest but not the trees: Heterogeneity in community size effects in Canadian ice hockey players. *J Sports Sci*. 2017;0(0):1-9. doi:10.1080/02640414.2017.1313444.

16. Moraeus L, Lissner L, Yngve A, Poortvliet E, Al-Ansari U, Sjoberg A. Multi-level influences on childhood obesity in Sweden: societal factors, parental determinants and child/'s lifestyle. *Int J Obes*. 2012;36(7):969-976. doi:10.1038/ijo.2012.79.

17. Joens- Matre RR, Welk GJ, Calabro MA, Russell DW, Nicklay E, Hensley LD. Rural–urban differences in physical activity, physical fitness, and overweight prevalence of children. *J Rural Heal*. 2008;24(1):49-54.

18. Forsyth A, Oakes JM, Schmitz KH, Hearst M. Does Residential Density Increase Walking and Other Physical Activity? *Urban Stud*. 2007;44(4):679-697. doi:10.1080/00420980601184729.

19. Raman S. Designing a liveable compact city physical forms of city and social life in urban neighbourhoods. *Built Environ*. 2010;36(1):63-80. doi:10.2148/benv.36.1.63.

20. Dempsey N, Brown C, Bramley G. The key to sustainable urban development in UK cities? The influence of density on social sustainability. *Prog Plann*. 2012;77(3):89-141. doi:10.1016/j.progress.2012.01.001.

21. Cicchetti CJ. Some economic issues in planning urban recreational facilities. *L Econ*. 47:14–23.

22. Sallis, J. F., Nader, P. R., Broyles, S. L., Berry, C. C., Elder, J. P., McKenzie, T. L., & Nelson JA. Correlates of physical activity at home in Mexican-American and Anglo-American preschool children. *Heal Psychol*. 1993;12:390–398.

23. Bloom BS. The Role of Gifts and Markers in the Development of Talent. 1982;48(6):510-522.

24. Finnegan L, Richardson D, Littlewood M, et al. The influence of date and place of birth on youth player selection to a National Football Association elite development programme The influence of date and place of birth on youth player selection to a National. *Sci Med Footb*. 2017;1(1):30-39. doi:10.1080/02640414.2016.1254807.

25. Balish S, Côté J. The influence of community on athletic development: an integrated case study. *Qual Res Sport Exerc Heal*. 2014;6(1):98-120. doi:10.1080/2159676X.2013.766815.

26. Ibsen B, Seippel Ø. Voluntary organized sport in Denmark and Norway. *Sport Soc*. 2010;13(4):593-608.

27. Bjørndal CT, Ronglan LT, Andersen SS. Talent development as an ecology of games: a case study of Norwegian handball. *Sport Educ Soc*. 2015;3322(March):1-14. doi:10.1080/13573322.2015.1087398.

28. Woolcock G, Burke M. Measuring Spatial Variations in Sports Talent Development: the approach, methods and measures of 'Talent Tracker'. *Aust Geogr*. 2013;44(1):23-39. doi:10.1080/00049182.2013.765346.

29. Hansen K, Rasmussen RO, Roto J. *Demography in the Nordic Countries – A Synthesis Report*. Vol 978-91-893. Stockholm: Nordregio; 2011. doi:http://www.nordregio.se/Publications/Publications-2011/Demography-in-the-Nordic-countries---A-synthesis-report1/.

30. Brewer CA. Basic mapping principles for visualizing cancer data using geographic information systems (GIS). *Am J Prev Med*. 2006;30(2 SUPPL.):25-36. doi:10.1016/j.amepre.2005.09.007.

31. Schorer J, Baker J, Lotz S, Büsch D. Influence of early environmental constraints on achievement motivation in talented young handball players. *Int J Sport Psychol*. 2010;41(1):42-57.

32. Lidor R, Arnon M, Maayan Z, Gershon T, Côté J. Relative age effect and birthplace effect in Division 1 female ballgame players—the relevance of sport-specific factors. *Int J Sport Exerc Psychol*. 2013;(ahead-of-print):1-15.

33. Abbott A, Button C, Pepping GJ, Collinds D. Unnatural selection: Talent identification and development in sport. *Nonlinear Dyn Psychol Life Sci*. 2005;9(1):61-88.

34. Henriksen K, Stambulova N, Roessler KK. Successful talent development in track and field: considering the role of environment. *Scand J Med Sci Sports*. 2010;20(s2):122-132.

35. Chase M a., DiSanti JS. Talent development recommendations for coaches to consider. *J Sport Psychol Action*. 2016;0(0):1-11. doi:10.1080/21520704.2016.1205696.

36. MacDonald DJ, King J, Côté J, Abernethy B. Birthplace effects on the development of female athletic talent. *J Sci Med Sport*. 2009;12(1):234-237.

37. National Research Council and Institute of Medicine. *Community Programs to Promote Youth Development*. Washington, DC: National Academies Press; 2002. doi:10.17226/10022.

38. Christensen MK. An Eye for Talent: Talent Identification and Practical Sense of Top-level Soccer Coaches. *Sociol Sport J*. 2009;26:365-382. doi:10.1111/1365-2664.12319.

39. Skrubbeltrang LS, Olesen JS, Nielsen JC. How to stay becoming – living up to the code of conduct in a sports class. *Ethnogr Educ*. 2016;7823(December):1-17. doi:10.1080/17457823.2015.1109467.

40. Karen, D. & Washington RE. *Sociological Perspectives on Sport: The Games Outside the Games*. (Karen, D. & Washington RE, ed.). New York: Taylor & Francis; 2015.

41. Jiménez IP, Pain MTG. Relative age effect in Spanish association football: Its extent and implications for wasted potential. *J Sports Sci*. 2008;26(10):995-1003.

Table 1. Odds ratios (OR) and confidence intervals (CI) for being Danish elite U17-19 players and national youth players in football in comparison with registered youth players across community population sizes and densities.

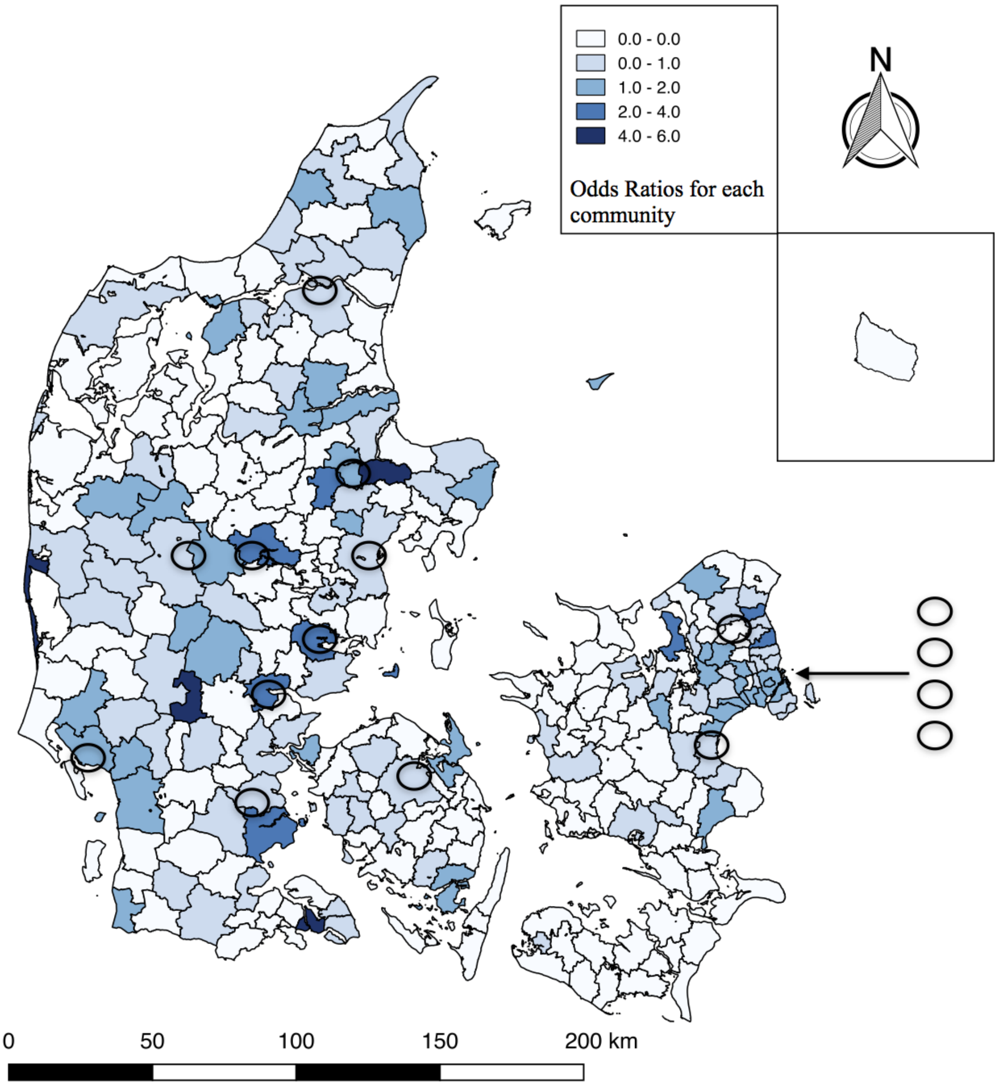
	Youth players		Elite U17-U19 players				National youth players			
	No.	%	No.	%	OR	95 % CI	No.	%	OR	95 % CI
Community size*										
≥ 100	20878	14.4	120	20.4	1.53	1.25 to 1.87	22	25.9	2.08	1.34 to 3.23
50 to < 100	20281	14.0	145	24.7	2.02	1.67 to 2.44	22	25.9	2.15	1.38 to 3.34
30 to < 50	22960	15.8	121	20.6	1.38	1.13 to 1.69	15	17.6	1.14	0.67 to 1.93
10 to < 30	48898	33.7	142	24.2	0.63	0.52 to 0.76	23	27.1	0.73	0.47 to 1.12
< 10	32004	22.1	59	10.1	0.39	0.24 to 0.65	3	3.5	0.13	0.04 to 0.40
Community density (pop. /km^2)										
≥ 1000	17319	16.2	103	17.5	1.57	1.27 to 1.94	24	28.2	2.90	1.90 to 4.44
500 to < 1000	20950	16.1	116	19.8	1.46	1.19 to 1.79	17	20.0	1.48	0.90 to 2.43
250 to < 500	20461	15.3	119	20.3	1.55	1.27 to 1.89	17	20.0	1.52	0.93 to 2.50
100 to < 250	29509	19.2	121	20.6	1.02	0.83 to 1.24	15	17.6	0.84	0.50 to 1.42
50 to < 100	32568	20.7	83	14.1	0.57	0.45 to 0.72	9	10.6	0.41	0.21 to 0.80
< 50	24214	12.4	45	7.7	0.41	0.31 to 0.56	3	3.5	0.18	0.06 to 0.57

*: Numbers are in 1000s.

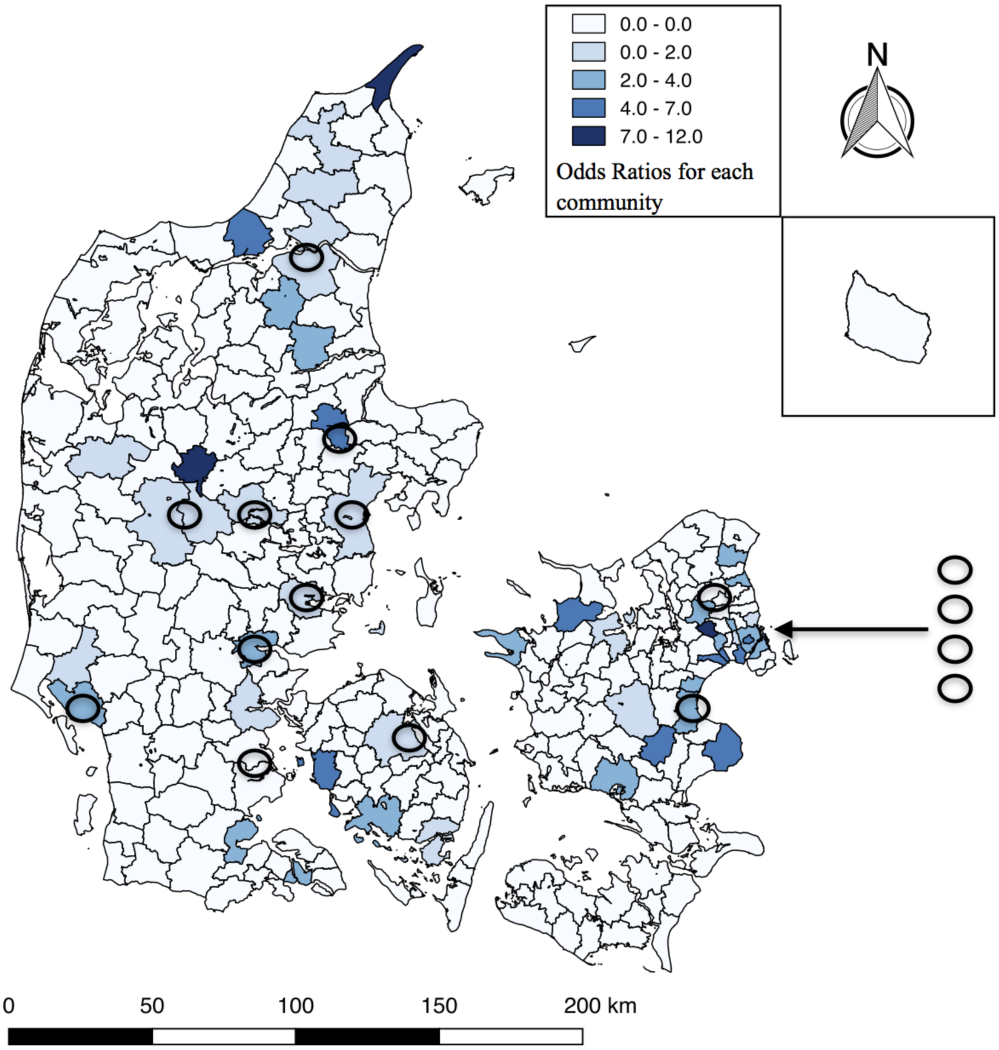
Table 2. Odds ratios (OR) with confidence intervals (CI) for being Danish elite U16-18 players and national youth players in handball in comparison with registered youth players across community sizes and densities.

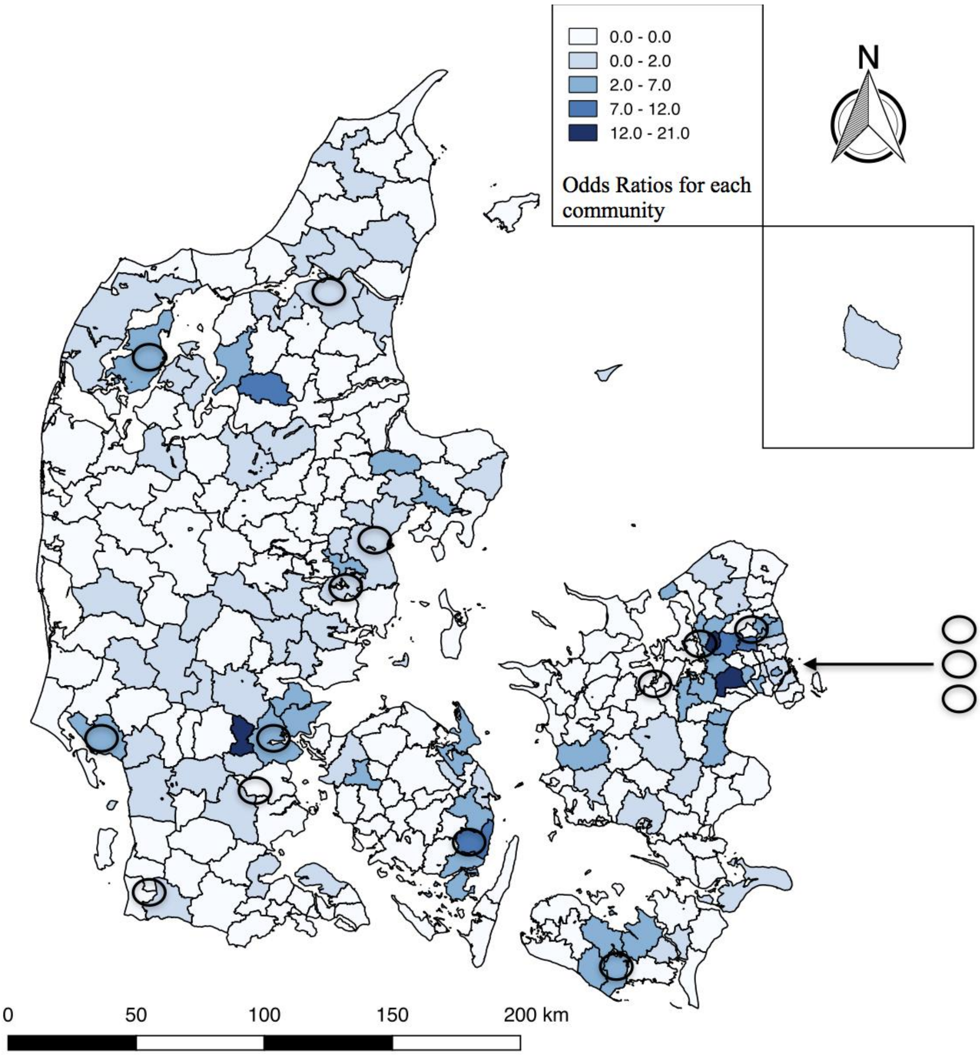
	Youth players		Elite U16-U18 players				National youth players			
	No.	%	No.	%	OR	95 % CI	No.	%	OR	95 % CI
Community size*										
≥ 100	4639	12.9	38	12.1	0.93	0.66 to 1.31	12	15.0	1.19	0.64 to 2.20
50 to < 100	3890	10.8	63	20.1	2.07	1.57 to 2.73	14	17.5	1.75	0.98 to 3.11
30 to < 50	4125	11.5	52	16.6	1.53	1.14 to 2.07	18	22.5	2.24	1.32 to 3.79
10 to < 30	14145	39.3	102	32.5	0.74	0.59 to 0.94	19	23.8	0.48	0.29 to 0.80
< 10	9149	25.5	59	18.8	0.68	0.51 to 0.90	17	21.3	0.79	0.46 to 1.35
Community density (pop. /km²)										
≥ 1000	3056	8.5	28	8.9	1.05	0.71 to 1.56	9	8.4	1.36	0.68 to 2.73
500 to < 1000	3097	8.6	64	20.4	2.72	2.06 to 3.58	10	14.3	1.52	0.78 to 2.94
250 to < 500	3956	11.0	56	17.8	1.76	1.31 to 2.35	10	9.1	1.16	0.60 to 2.24
100 to < 250	7409	20.6	56	17.8	0.84	0.63 to 1.12	23	29.9	1.55	0.96 to 2.52
50 to < 100	10963	30.5	78	24.8	0.75	0.58 to 0.97	13	23.4	0.44	0.24 to 0.80
< 50	7467	20.8	32	10.2	0.43	0.30 to 0.62	15	14.9	0.88	0.50 to 1.54

*: Numbers are in 1000s.

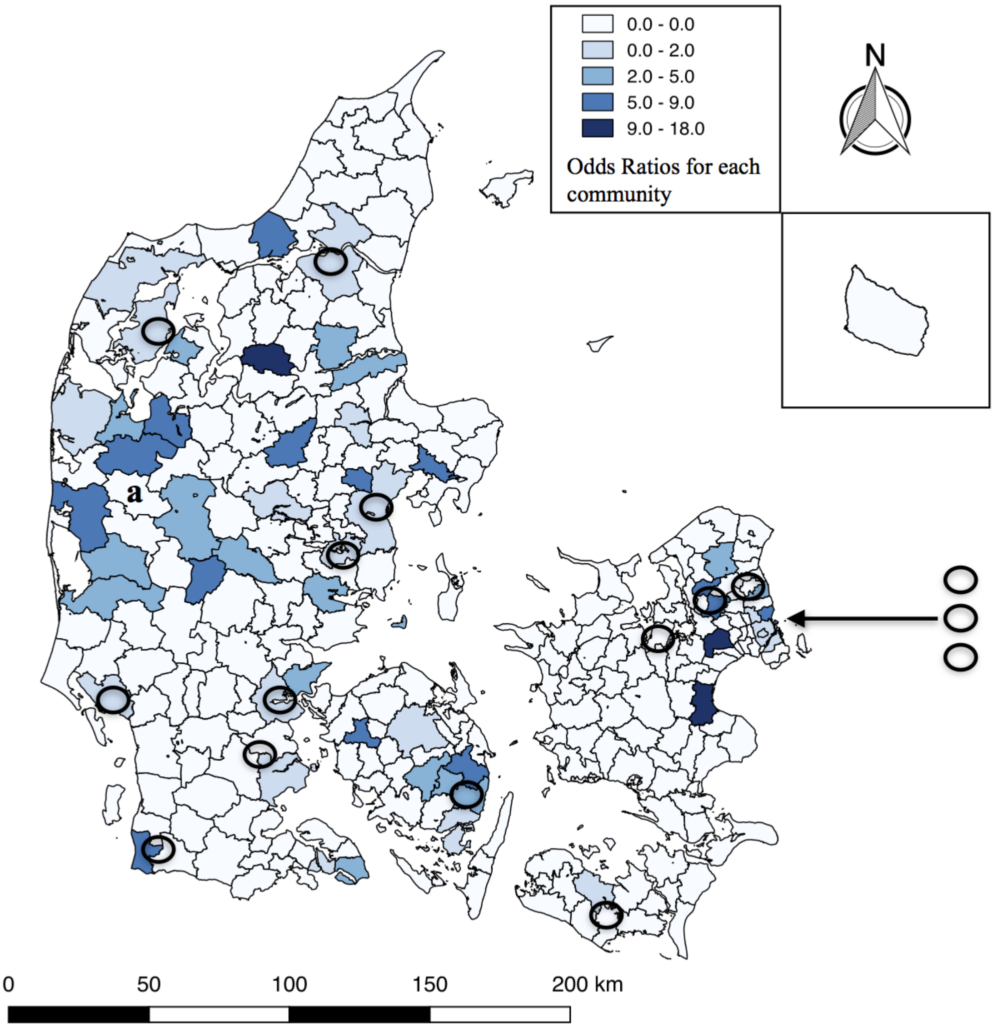


0.0 - 0.0
0.0 - 1.0
1.0 - 2.0
2.0 - 4.0
4.0 - 6.0
Odds Ratios for each community
N
0
50
100
150
200 km


0.0 - 0.0
0.0 - 2.0
2.0 - 4.0
4.0 - 7.0
7.0 - 12.0
Odds Ratios for each community
N
0
50
100
150
200 km



0.0 - 0.0
0.0 - 2.0
2.0 - 7.0
7.0 - 12.0
12.0 - 21.0
Odds Ratios for each community
N
0
50
100
150
200 km


0.0 - 0.0
0.0 - 2.0
2.0 - 5.0
5.0 - 9.0
9.0 - 18.0
Odds Ratios for each community
N
a
0
50
100
150
200 km