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THE IMPACTS OF TRANSPORT ACCESSIBILITY AND REMOTENESS ON ELITE SPORTS TALENT DEVELOPMENT

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ABSTRACT

How does transport availability and access to training, coaching and competition influence the propensity for towns and regions to produce elite sports athletes? This paper provides the first multivariate spatial analysis exploring the influence of transport accessibility and remoteness from major centres, where higher-order junior coaching and competition is available, on the propensity of towns and regions to produce elite professional sports players. Our approach is to geo-code the place of junior development for a large population of elite athletes, match it with socio-demographic data for the populations in those areas, and with measures of transport accessibility and remoteness, to identify possible correlates. The authors develop a unique approach, the Talent Tracker, that identifies, tabulates and maps the junior town/region of origin for the 1,290 players who were drafted and played at least one game in the senior professional Australian Football League (AFL), Australia's most popular football code by participation, in the period 1997-2010. Junior AFL participation data for the same period is used to determine spatial measures of each AFL region's annual average 'talent yield' (elite players produced per junior participant). The results are matched with Accessibility/Remoteness Index of Australia (ARIA) data, which provides a measure of spatial accessibility via the road network to key centres and services, and with Australian Bureau of Statistics Socio-Economic Indexes for Areas (SEIFA) data, aggregated to the level of AFL regions. Bi-variate and multivariate analyses are conducted using SPSS software. The bivariate results suggest that as transport accessibility decreases, talent yield also decreases (Pearson correlation statistic -0.242; p=0.02) but the relationship is weaker than first expected. Locations are identified that fit the trend, to provide further insight. Locations that deviate from the trend, over-producing talent are also identified. However, multivariate analysis highlights that if one controls for whether the region is predominantly AFL or rugby dominated (in Australia's parochial sports landscape), and for socio-economic status, the influence of transport accessibility becomes significantly less strong. The hypothesis that transport accessibility and remoteness affects sports talent development for sports with wide national coverage in rural areas has minimal support. Many of the AFL regions with low transport accessibility scores but high talent yields have well designed coaching and competition structures, suggesting the organisation of sports landscapes may help overcome tyrannies of distance. Opportunities for further research include detailed examination of transport factors at the micro-scale within such locations, to assist sports administrators and to give greater opportunity to youth in more remote peri-urban and regional locations.

Keywords: sports geography, talent development, transport accessibility, remoteness

INTRODUCTION

Is sports player talent development influenced by transport accessibility? Given the WCTR2013 conference is being held in the future Olympic and World Cup city of Rio de Janeiro, it is timely to consider how transport accessibility influences this aspect of sports geography. Sports administrations have become much more sophisticated in understanding athletic variation and the multitude of factors that influence talent identification and player development in recent years. The theoretical and conceptual frameworks commonly used identify a set of integrating factors thought to most influence in sports talent development. Bailey et al. (2010, p. 6) have suggested a biopsychosocial model of talent development that focuses on 'the biological domain, the psychological domain and the social domain'. Socio-spatial factors are central to the social domain, and research in this area has focused on geographical locations for recruiting and birthplace effects. Transport accessibility to junior coaching and playing opportunities, which one would assume may influence sports talent production, has not been generally been considered as a factor in player development in previous empirical research. This paper seeks to fill that research gap.

Access to coaching, to training, and to playing opportunities is highly varied across cities and regions. This accessibility may be problematic in many landscapes, such as the rural and regional areas of Australia, where distances between towns are vast. Understanding how strong the effect of accessibility and remoteness may be is important for improving sports talent identification and development, and could lead to changes in the management and organisation of junior sports activities, and the spatial arrangements of junior competitions, coaching and training. The aim of this research was to analyse the role of transport accessibility, amongst many other factors, as part of a broader project evaluating Australian approaches to talent identification. It was hypothesised that reduced transport access and increased remoteness would be associated with lower rates of junior sports talent production, even in sports with wide spatial coverage and healthy rural and regional participation rates. But we did not know if this effect would be found only for the most remote parts of Australia, or whether it would also be associated with larger regional towns and cities and with locations closer to major cities. To find out required the preparation of the first major dataset of professional football players by their place of junior development and the development of spatial measures of regional performance in producing talented footballers. This data could then be correlated with both accessibility and socio-economic datasets available for Australia, to identify any possible relationship.

The paper is organised into a background section providing key concepts, an outline of the project and the measures developed. The Australian case study is introduced and the methods involving the player, accessibility and socio-economic datasets are laid out. The results of one-way and then multivariate spatial regression are provided. And these outcomes are discussed in terms of their implications for accessibility studies, sports geography, sports administrations and future research.

BACKGROUND

Desires to improve national performance at Olympic games and events such as football's World Cup has stimulated much research and development in sports talent identification and development. In addition to government sports bodies, professional clubs also spend significant sums trying to source young talent for competitive advantage. Sports administrators are keenly interested in locations that over-produce talent and the factors behind that difference in regional performance. Researchers have started using modern spatial analysis to try to identify possible spatial factors for this spatial variation. The key finding thus far is that smaller cities of less than 500,000 persons yet more than 10,000 are over-represented in being the birthplaces of elite sports players (Abernethy & Farrow, 2005; Côté, Macdonald, Baker, & Abernethy, 2006). It has been suggested such birthplace effects may be due to 'differential opportunities' in larger and smaller cities and towns (MacDonald, Cheung, Côté, & Abernethy, 2009, p. 85). But there are problems in considering regional variation in talent development as a function of an athlete's birthplace as opposed to the place where a junior athlete was coached and competed and where their skill was actually developed. This is especially so in nations with high residential mobility, such as Australia, where almost 2 million people moved regions between 2001 and 2006 (Australian Bureau of Statistics, 2009). And it may not just be town size that matters, but rather differential access to coaching and playing opportunities, for which town size is likely a proxy.

Transport accessibility has rarely been applied to questions of sports geography. A few studies have assessed stadium accessibility to urban populations (i.e. Berry, Carson, & Smyth, 2007; Burke & Woolcock, 2009) and other authors have looked at how transport technology and access influenced the development of sporting competitions (R. Hess, 1998). But little attempt has been made at exploring access to playing and coaching thus far. Advances in geographic information systems (GIS), the growing professionalism and the collection of spatial data by sports agencies makes such analysis possible. Accessibility analysis has proven valuable in exploring spatial variation in transport access and its impacts on urban populations, particularly in terms of access to transit, employment, and social services (Dodson, Burke, Evans, & Sipe, 2011; Geurs, Zondag, de Jong, & de Bok, 2010; Horner, 2004; Liu & Zhu, 2004). Conceptually, exploring accessibility to sports playing and coaching opportunities should not be dissimilar to those studies that have explored access to other goods and services, whether that be single-destinations such as schools (Talen, 2001) or a broader range of urban services (Tsou, Hung, & Chang, 2005). One just needs the right datasets and an appropriate set of accessibility measures.

Our approach was to develop a dataset of elite athletes by their place of junior development, geo-coded to specific regions, and matched with previously developed spatial measures of transport accessibility and remoteness, for a sport with wide spatial coverage in Australia. The place of junior development was defined as the club or school where young athletes were registered whilst playing when young teenagers, an age when families of talented young athletes are less likely to have moved to locations with better training and competition opportunities, as occurs commonly in later years. This dataset was geo-coded and aggregated to specific regions and matched to junior participation data to generate a measure of 'talent yield' based on participation. The measure was then spatially matched to Accessibility/Remoteness Index of Australia (ARIA) data for all of Australia, along with a key spatial socio-economic dataset, to allow for one-way relationship testing and for spatial regression analysis. The intent was to test whether talent yield was related to accessibility, even when controlling for other factors.

METHODS

Developing Talent Tracker

This approach was applied to the elite Australian Football League (AFL) in Australia, the country's premier national football competition. AFL participation, especially at junior level, is widespread in Australia and the AFL Commission and the top clubs have done much to extend and improve junior coaching, competition and recruiting structures across regional and remote Australia, in part seeking to overcome what Australian's often term the 'tyrrany of distance' (Blainey, 1966). We sought to determine if accessibility and remoteness could still have a significant influence on sports talent production, even in a sport with such coverage in regional and remote areas. We have labeled our approach *Talent Tracker*, the full methods for which are provided in Woolcock and Burke (Forthcoming) and we provide a summary here only due to space limitations.

Talent was defined as the number of AFL players who were either drafted through the main national draft or played at least one game of senior AFL football in the period 1997-2010 who developed in a specific Australian region (i.e. a small number of Irish players who swapped from Gaelic football to AFL were excluded). Each player's place of junior development was identified via an exhaustive process. The place of junior development was defined as the club or school where each player was registered as playing AFL from the age of late primary/early high school (11 to 15 years of age). Information was gleaned from through national AFL Draft records, published secondary sources and information provided by key informants. This was geo-coded and matched to the 94 AFL regions, for which boundaries were supplied by the AFL Commission, and which cover almost all of Australia excepting the remotest desert lands of the state of South Australia, where few people live. The principle performance measure is a region's 'talent yield' defined as the ratio of talent to participation in each of the regions, expressed as talent produced vs. average participation per year. Participation was defined as the number of 13-18 year old males registered for either club and/or school football in each AFL region derived from AFL census data. The spatial variation in talent yield per 1,000 junior participants for all AFL regions is provided in Figure 1.

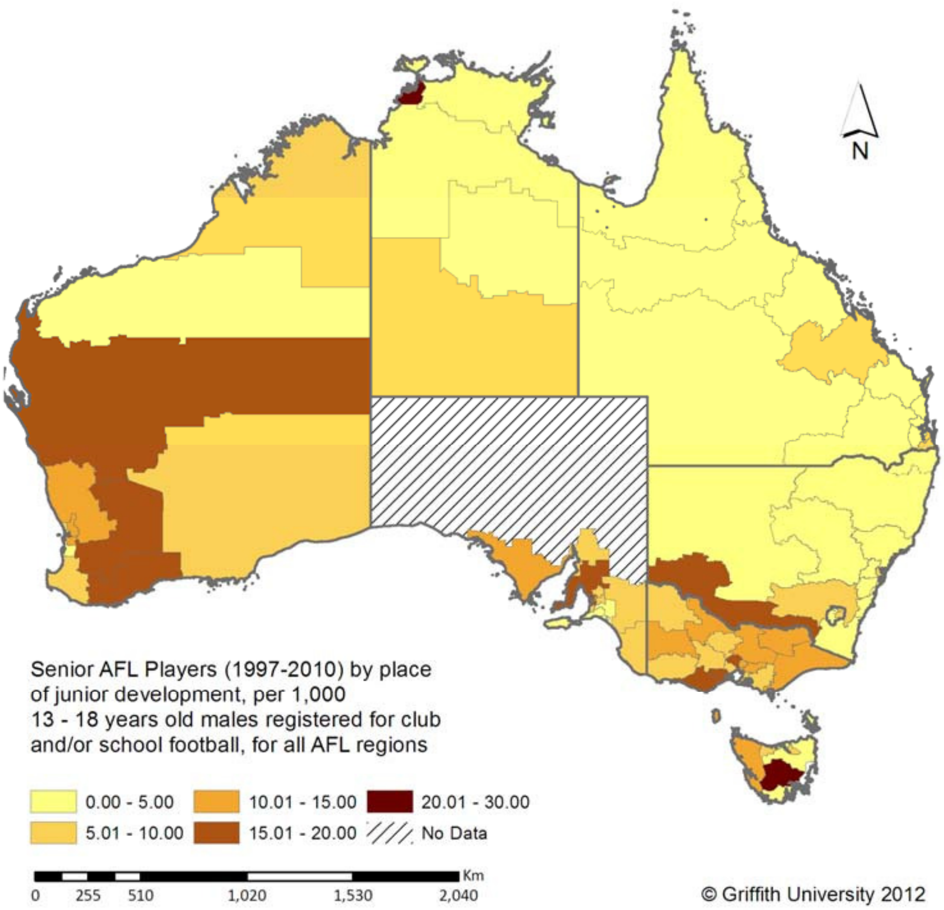

Figure 1 – AFL Talent Yield (1997-2010) by AFL Region

ARIA

Accessibility/Remoteness Index of Australia (ARIA) data is provided by the Commonwealth Department of Health and Ageing and used widely in Australia to define remote and inaccessible locations to assist in targeting welfare and service delivery to the regions. ARIA is a uses measures of road network accessibility to services, to develop a standard classification and an index of accessibility/remoteness. It uses GIS to calculate distances from 11,340 localities to 201 service centres on available road networks. Population size is used as a proxy for the services available in particular locations. ARIA defines accessibility and remoteness solely in terms of geography, and does not incorporate other socio-economic or rural/urban effects, and only describes spatial (not socio-economic) disadvantage (Commonwealth Department of Health and Aged Care, 2001, p. 3). As the most robust measure of transport accessibility to major centres across Australia, ARIA has been used to explore relationships with health (Eckert, Taylor, & Wilkinson, 2004; Murray et al., 2004; Rajkumar & Hoolahan, 2004) food (Harrison et al., 2007) and even attitudes towards sex (Rissel, Richters, Grulich, de Visser, & Smith, 2003).

Conceptually, the transport accessibility to centres that ARIA describes is likely to relate to a junior athlete's access to quality training, coaching and competition. In general, within the remote regions of central Australia a junior may be lucky to access a single dirt oval and some rudimentary coaching. Competition may require significant long-distance travel including an overnight stay. A major metropolitan centre will instead provide residents with much higher-order skill training, specialist junior development programs, and a range of club and school competitions within a short travel distance. One limitation is that ARIA is a measure of road transport access only, and does not incorporate non-car transportation. However, public buses and light rail services mostly use roads in Australia and the car dominates Australian leisure and sports-related travel behaviour other than spectator travel to the largest stadiums (Burke & Evans, 2010).

ARIA data for 2001 Statistical Local Areas (SLAs) is freely available and was spatially matched to the 94 AFL Regions. Each AFL region contained on average around ten SLAs. Using *ArcInfo* GIS software, the AFL regions were first snapped to the 2006 ABS census collection district boundaries, the smallest level of disaggregation in the 2006 census. The surface area of each 2006 SLA was then calculated and the 2001 and 2006 SLA regions intersected so as to attribute 2001 ARIA scores to all parts of the 2006 SLAs. These 2006 SLA regions were then ascribed their respective 2001 ARIA score. By adding population data from the ABS 2006 census, it was then possible to match this to the AFL region boundaries and calculate a population-weighted ARIA score (PWIARIA) for each AFL region using the following formula:

$$PWIARIA_{AFLreg} = \frac{\sum_{1}^{n}(ARIA_{CCD_n} * Pop_{CCD_n})}{\sum_{1}^{n} Pop_{CCD_n}}$$

where:

$PWIARIA_{AFLreg}$ = Population Weighted Index of ARIA for an AFL region
$ARIA_{CCD}$ = ARIA score for a CCD
POP_{CCD} = Usual Resident Population for a CCD
n = number of Collection Districts

As a measure of transport accessibility and remoteness, the spatial variation in the population-weighted index of ARIA scores for all AFL regions is provided in Figure 2. It shows that the densely populated Eastern coastline, Tasmania, and the regions surrounding the population centres of Adelaide and Perth are the places offering the highest transport access to goods and services.

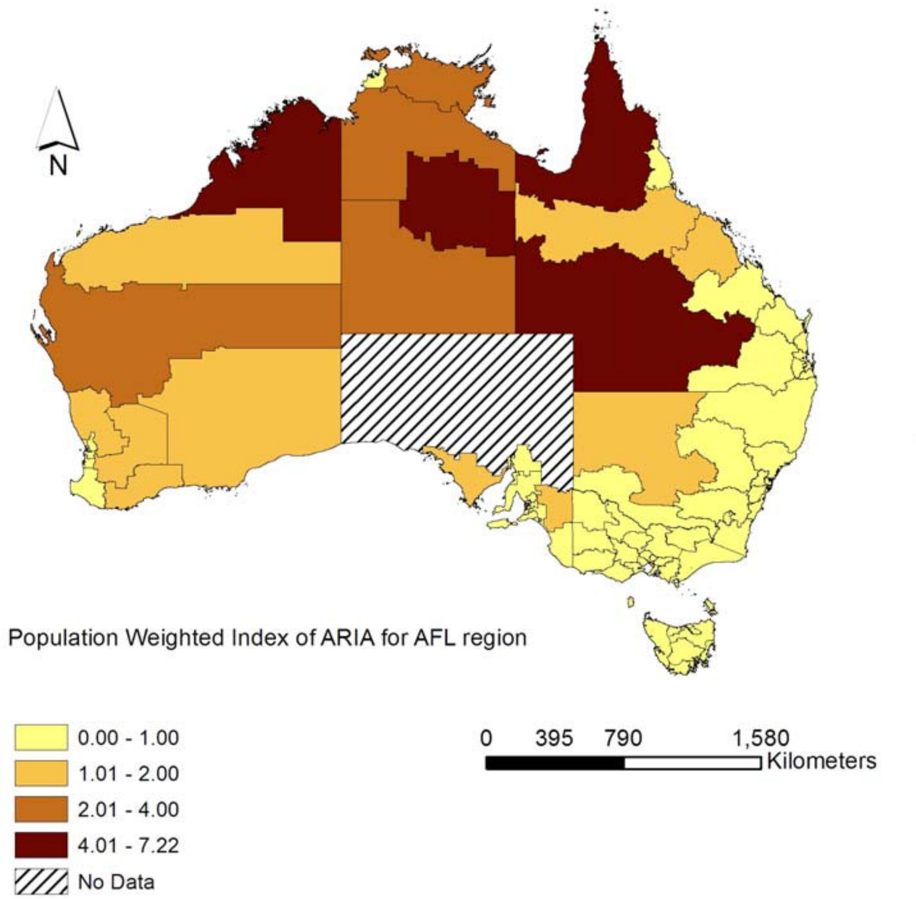

Figure 2 – Population-weighted index of ARIA scores by AFL region

SEIFA

To control for socio-economic disadvantage, use was made of Socio-Economic Indexes for Areas (SEIFA) data for 2006, as provided by the Australian Bureau of Statistics. SEIFA is a generalised measure of relative socio-economic disadvantage calculated using Principal Components Analysis from household census data. Though Australia is a wealthy nation, some regions perform more poorly than others in terms of relative disadvantage. Though this spatial dataset contains a number of separate indices we used the SEIFA Index of Relative Socio-economic Disadvantage (IRSD) which uses variables such as income, educational attainment, unemployment and dwellings without motor vehicles each of which represents a dimension of disadvantage in the Australian setting. As an aggregated measure, two regions may have a similar IRSD score but for different reasons. See Pink (2008) for more information on SEIFA and its indices. The IRSD data for all 2006 SLA regions was spatially mapped to the AFL regions using almost identical processes as that applied to the ARIA data. A population-weighted IRSD score (PWIRSD) for each AFL region was calculated, using the same equation as that provided earlier for ARIA. The spatial variation for this measure is provided in Figure 3, with higher scores suggesting less disadvantage. The map shows that regions with higher levels of relative socio-economic disadvantage mostly lie outside the major metropolitan centers.

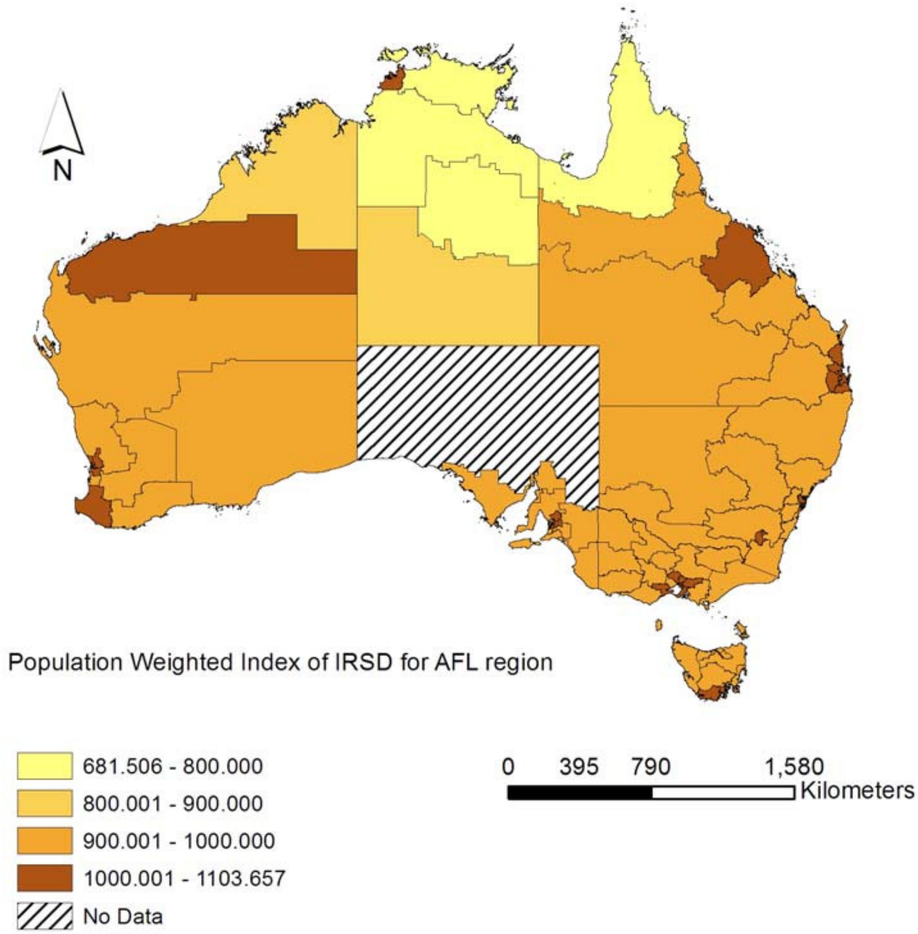

Figure 3 – Population-weighted index of IRSD scores by AFL region

Non-traditional AFL regions

A dummy variable was also included to represent the AFL regions without a long history of widespread AFL programs and competitions. The non-traditional AFL regions are in the two Australian states of New South Wales and Queensland, which were not traditional AFL states and in which the rugby codes have dominated, despite strong incursions by the AFL in recent decades. The two exceptions were the most southern New South Wales regions of Albury Murray and the Riverina, which have a much longer tradition of AFL participation due in part to their proximity to the birthplace of the code in Melbourne (see Rob Hess, 2008 for further information). A total of 16 AFL regions were therefore assigned as 'non-traditional AFL regions'. This variable was included to control for any effects the different historical development of AFL clubs and culture in these states may have on sport talent production.

Conceptually these regions may have greater competition in the sports marketplace for young sporting talent and have less coverage in their junior programs than in comparable regions with a longer AFL history.

Limitations

It is important to note some key limitations with this method. The sources used to allocate players to specific AFL regions introduce some potential for errors. A small set of players who did not start playing the football code until over 15 years of age in Australia were omitted. A few of the AFL regions had produced nil or very few players who met the definition of 'talent'. The nature of the regression means we have not included every conceivable predictor variable and conceivably there may be things we have not included that may be an important influence or moderator of any effects. And there were problems of areal aggregation common to much spatial analytical research in preparing the final Talent Tracker, ARIA and SEIFA data layers for all AFL regions.

Analysis

The analysis was conducted using *SPSS* software commencing with descriptive statistical analysis for the variables, as provided in Table 1.

Table I – Descriptive statistics for Talent Yield, PWIARIA and PWIIRSD for all 94 AFL regions

	Minimum	**Maximum**	**Mean**	**Std. Deviation**
AFL Talent Yield (1997-2010)	0	31.85	8.84	6.72
Population Weighted Index of ARIA Score	0	7.22	0.79	1.30
Population Weighted Index of IRSD Score	681.5	1,103.7	979.6	68.2

A set of one-way relationships between AFL talent yield and the other variables was then conducted, prior to application of a multivariate regression model. The one-way tests used were primarily standard bivariate Pearson correlations; the regression a standard linear model.

RESULTS

Outputs of the one-way tests correlating ARIA with talent yield are provided in Table 2.

Table 2 – Pearson Correlation Results, AFL Talent Yield (1997-2010) vs. other variables by AFL Region

	Pearson R Value	**Asymp. Std. Error[a]**	**Approx. T[b]**	**Approx. Sig. [c]**
AFL Talent Yield vs. Population Weighted Index of ARIA Score	-0.242	.081	-2.39	0.02
AFL Talent Yield vs. Population Weighted Index of IRSD Score	0.245	.084	2.42	0.02
AFL Talent Yield vs. Non-traditional AFL regions	-0.294	.068	-2.95	0.01
No. of valid cases	94			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

The one-way results suggest that all the variables included have some statistically significant association with AFL talent yield. As expected, accessibility and remoteness, as measured by the population weighted index of ARIA score, appears to be negatively correlated with AFL talent yield at the 95% confidence level (Pearson R = -0.242; p = 0.02). Being in a non-traditional region is also negatively associated with AFL talent yield. The population weighted index of IRSD score, is positively associated with AFL talent yield (Pearson R = 0245; p = 0.02) suggesting that more disadvantaged regions are associated with lower AFL talent yields.

Visual analysis suggests transport accessibility is having an influence in specific parts of Australia, at least at the sub-regional level. For instance Darwin, in the north of Australia, has relatively good transport accessibility to services, and has one of the highest AFL talent yields. Yet it's two neighbouring regions, Katherine and Barkly, with very high indices for accessibility/remoteness, did not produce one player in the elite AFL competition for the years 1997-2010.

To control for the effects of the three predictor variables upon one another requires multivariate analysis, such as regression. A simultaneous linear regression model was applied using *SPSS.* The outputs of the regression analysis are provided in Tables 3-5.

Table 3 – Model Summary

R	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
.391[a]	.153	.125	6.290

[a] Dependent variable: AFL Talent Yield (1997-2010); Predictors: (Constant), Non-traditional AFL regions, Population Weighted Index of IRSD Score, Population Weighted Index of ARIA Score

Table 4 – ANOVA

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	643.107	3	214.369	5.418	.002
Residual	3560.848	90	39.565		
Total	4203.955	93			

Table 5 – Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	-7.299	14.528		-.502	.617
Population Weighted Index of ARIA Score	-.488	.758	-.094	-.644	.521
Population Weighted Index of IRSD Score	.018	.014	.180	1.236	.220
Non-traditional AFL regions	-5.212	1.734	-.293	-3.006	.003

The regression results are revealing. Firstly, using the simultaneous method a significant model emerged (F=5.418; $p < 0.01$; Adjusted $R^2 = 0.125$). However, not all of the predictor variables were significantly associated with spatial variation in AFL talent yield when controlling for other factors. By far the strongest influence was whether a region was in a traditional or non-traditional AFL region (Beta = -0.293, $p < 0.01$). Contrary to all expectations, there was negligible association of AFL talent yield with either the population weighted index of ARIA score (Beta = -0.94, p = 0.521) or the population weighted index of IRSD score (Beta = 0.180, p = 0.220). Various sensitivity tests were conducted to scrutinise this finding, but similar results were obtained in each case.

DISCUSSION

The one-way results suggest a clear association between AFL talent yield and accessibility and remoteness. But when controlling for other factors, by far the major predictor of spatial variation in AFL talent yield was simply if a region was either a traditional or non-traditional AFL region, defined as being in New South Wales or Queensland (and excluding the Albury Murray and Riverina regions). This explained most of the variance in spatial variation. Surprisingly, when controlling for other factors, accessibility and remoteness did not appear to play much of a role by comparison, nor did socio-economic disadvantage.

This finding was not expected and is obviously unique to the AFL code in the Australian setting. AFL is one of the most well organised, widespread codes of football in Australia and its junior programs reach into many distant corners of the nation. The AFL Commission has done much to disseminate improved junior coaching and training programs across the nation. Further, both the Commission and the top clubs have well-developed recruiting networks that span right across the country. Strong recruitment of indigenous Australians into the elite clubs is reflective of this. Accessibility and remoteness may have some effect still, but the results obtained seem to bare out that the efforts of the AFL community and the pathways available are helping players from most regions, whether spatially or socially disadvantaged, to overcome the 'tyrrany of distance' and of disadvantage that exists in Australia and to enter the premier national competition. Whilst other researchers have found that birthplace effects and town size are associated with sporting talent production (Abernethy and Farrow 2005; Côté, Ericsson and Law 2005; MacDonald et al. 2009) the results obtained here suggest that for codes with strong programs and with wide spatial coverage of junior coaching and playing opportunities, there may be less influence of place on sports talent production except where there are gaps in that coverage, such as in parts of New South Wales and Queensland in the AFL case.

The approach and methods provided by Talent Tracker open significant opportunities for comparative research on the questions of transport accessibility and sports talent production across codes. We maintain that similar results would certainly not be expected for sporting codes with lower participation and coverage in regional and remote areas such as archery, gymnastics, fencing or volleyball. Such comparative research may help determine what any sport needs to do to overcome or at least mitigate against any transport accessibility and remoteness effects. What is it about sports such as AFL that they are having success in regions such as Western Australia's Wheatbelt region, where there is significant talent being produced, to overcome these transport access limitations? What is happening at the micro-scale in such places that if applied elsewhere may give greater sporting opportunity to youth in remote peri-urban and regional locations. The broader study of which this paper is a part seeks to answer such questions, using more in-depth examinations of community well-being, development and training, talent identification processes and recruitment, social and organisational factors, psychological profiling of athletes, and the influence of external factors on psychological connection to sport.

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