The relationship of sport participation to provision of sports facilities and socioeconomic status: a geographical analysis

The relationship of sport participation to provision of sports facilities and socioeconomic status: a geographical analysis

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Abstract

Objective: Ecological models have been applied to investigate multiple domains influencing physical activity behaviour, including individual, social, organisational, community, environmental and policy factors. With regard to the built environment, research to date has been limited to small geographical areas and/or small samples of participants. This study examined the geographical association between provision of sport facilities and participation in sport across an entire Australian state, using objective total enumerations of both, for a group of sports, with adjustment for the effect of socioeconomic status (SES).

Methods: De-identified membership registration data were obtained from state sport governing bodies of four popular team sports. Associations between participation rate, facility provision rate and SES were investigated using correlation and regression methods.

Results: Participation rate was positively associated with provision of facilities, although this was complicated by SES and region effects. The non-metropolitan region generally had higher participation rates and better provision of facilities than the metropolitan region.

Conclusions: Better provision of sports facilities is generally associated with increased sport participation, but SES and region are also contributing factors.

Implications for public health: Community-level analysis of the population, sport participation and provision of facilities should be used to inform decisions of investments in sports facilities.

Key words: sport, facility, participation, socioeconomic status, community

It is widely acknowledged that to achieve substantive health benefits, physical activity should be of at least moderate intensity, and vigorous intensity activities provide even greater health benefits'[1] However, global trends show that a third of adults and four-fifths of children are not achieving the levels of physical activity recommended in public health guidelines.[2] Physical inactivity has been identified as a public health pandemic and is consistently associated with global increases in the prevalence of obesity.[3]

Researchers have used ecological models to investigate multiple domains of influence on behaviour, from individual and social factors to organisational, community, built environment and policy factors.[4] A key principle of the ecological approach is that behaviour change is most effective when multiple factors are addressed. Making changes to the built environment and to policies that support physical activity is expected to have a long-term impact on most or all individuals within a community.[5]

Research exploring the influence of the environment on physical activity has emerged in the past decade.[6-10] Environmental factors explored include: the built environment, such as proximity to parks, playgrounds and sports facilities; access characteristics, such as transport, footpaths, traffic lights and crossings; the natural environment such as climate and weather; and perceptions of safety.[6,7] A review of environmental characteristics relevant to young people's use of sports facilities found consistent and positive associations between physical activity and the presence of sport facilities, open parks and play-recreational facilities.[6] However, these findings were often limited to individuals' perceptions of the environment, with few studies using objective measures.[8-10]

More recently, researchers have used objective measures to examine the association between sports participation and the availability of sports facilities. These studies have reported mixed results, with no association being reported in some studies from the Netherlands,[11] while other studies from Europe,[12] the United States[13] and Hong Kong[14] found positive relationships. However, these studies did not differentiate between different types of sports facilities, which may have influenced the findings, as some types of sports facilities may affect sports participation more than others.[15] For instance, a study in Germany found that the distance from home to the nearest tennis court and indoor pool was not significantly related to participation rates in the respective sports (i.e. tennis, swimming or water polo) for girls or boys.[15] However, girls from rural areas with access to better indoor fitness centres were more likely to participate in leisure-indoor sports activities such as dance, volleyball and gymnastics than those from rural areas with poorer gym availability.[15] Another German study found that swimming pools were

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important for sport participation in general, while sport fields were important only for participation within sporting clubs.[16]

There is growing evidence that there are differences in physical activity and sport participation patterns according to residential location.[17] Analysis of data from an Australian population survey of recreational physical activity revealed that while the prevalence of participation in any specific physical activity and regular physical activity generally both decreased as remoteness increased, participation in some popular team sports actually increased with increased remoteness.[17] Furthermore, it is well established that socioeconomic status (SES) is a critical factor in participation in recreational physical activity in general and sport in particular, and health more broadly.[17,18]

Sport has been particularly targeted in attempts to increase overall physical activity levels. There is recent evidence that participation in sport is associated with better psychosocial health than individual physical activities due to the social nature of participation.[19,20] Several countries, including the UK and Australia, have sought to increase mass participation in sport to achieve various population health objectives,[21,22] and policies have been established promoting the development of sport infrastructure to achieve this goal.[23] Gaining a clear understanding of the relationship between proximity to specific sports facilities and participation is essential for evidence-based strategic facility planning and development.[24,25]

This study is the first to examine the geographical association between participation of a large cohort of participants in a defined group of sports and provision of facilities for those sports across a large geographic region (an Australian state) using objective total enumerations of both. We posed the following research questions:

- How variable are the levels of sport participation and provision of sport facilities across Victorian communities, represented by local government areas (LGAs)?
- Is the level of participation in each sport in each community related to the level of provision of facilities?
- Is the level of participation and the level of provision of facilities for each sport related to the SES of the community?
- Does any relationship between the level of participation and the level of provision of facilities persist after adjustment for the effects of SES?
- Do any of these relationships differ between metropolitan and non-metropolitan regions?

Methods

We investigated the associations between sport participation and facility provision in each of the 79 LGAs in the state of Victoria, Australia, while controlling for the effects of SES and differences between two regions (metropolitan Melbourne and the non-metropolitan remainder of the state). In community sport in Australia, the vast majority of registered members are active participants (players) so registered membership provides an excellent proxy for active participation, and has previously been used for this purpose.[17] De-identified data on membership registrations in four popular team sports were obtained from state sport governing bodies, generically referred to as state sporting associations (SSAs). The four sports were ranked within the top 10 in Australia for participation by both children aged 5-14 years[26] and persons aged 15 years and over.[27] A condition of provision of these data was that the particular sports would not be identified in publicly available research outputs. The participant numbers for these sports for the year 2012 ranged from 78,656 to 198,255 with a total sample size of 488,693. Data regarding facilities and playing fields/courts for each of the four sports were obtained from Sport and Recreation Victoria, Department of Transport, Planning and Local Infrastructure. The area and population data of each LGA were obtained from the Australian Bureau of Statistics (ABS).

For this study, the key aspects of the participant data were year of registration and residential postcode of each participant. Of the four sports, three registered participants for a calendar year and the fourth for a financial year. We included 2012 registrations for three sports and 2012-13 registrations for one sport. Although postcode areas are not precisely geographically specified, ABS defines approximations to postcode areas entitled postal areas.[28] ABS also produces a postal area-to-LGA correspondence table, containing population-weighted allocations of postal areas to LGAs,[29] which enabled estimated numbers of participant registrations in each LGA to be calculated.

We calculated participation rates as the number of registered members per 1,000 residents in the LGA aged four years or more (the designated lower age limit for SSA membership), using ABS estimated resident population (ERP) data for each LGA as at 30 June 2012.[30]

The four sports all required specific playing fields or courts. Data on public facilities pertaining to each of the four sports were collected in a facilities audit undertaken during 2011-12 by Sport and Recreation Victoria (SRV), in consultation with LGAs. A facility used by more than one sport (such as a playing field used for Australian Rules football in winter and cricket in summer) was counted once for each sport. A facility may also incorporate multiple playing fields or courts for one particular sport (such as tennis or basketball). In this study, the definition of facility provision was the playing infrastructure measured by the number of fields/courts. Facility locations were geocoded (latitude, longitude) and assigned to LGAs using geographic information system (GIS) software. Counts of playing fields/courts associated with each of the four sports were calculated for each LGA. These counts were combined with LGA ERPs to produce rates of facility provision, calculated as the number of fields/courts per 1,000 residents in the population.

Location was characterised as two Victorian regions: metropolitan (31 LGAs) and non-metropolitan (48 LGAs).[31] The total population of Victoria was 5,628,348, within a land area of 237,629 km^2, with 4,185,982 in metropolitan and 1,442,366 in non-metropolitan regions.[32]

Socioeconomic status was represented by the value of the 2011 Socioeconomic Indices for Areas (SEIFA) Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD) assigned to each LGA by the Australian Bureau of Statistics (ABS)[33]. SEIFA IRSAD scores are centred on 1,000, and ranged from 888 to 1,114 for the 79 Victorian LGAs, with higher/lower scores representing comparative socioeconomic advantage/disadvantage, respectively.

Ethics approval was granted by a university Human Research Ethics Committee for secondary analysis of the de-identified membership data without explicit consent of the participants or their parents/caregivers.

Statistical analysis

Because of substantial differences in the patterns of facility provision for the four

Table 1: Facility provision rate, participation rate and socioeconomic status of LGAs: by sport and region.

Indicator	Measure	State of Victoria (n=79)			Metropolitan (n=31)			Non-metropolitan (n=48)		
		Mean	Standard Deviation	Range	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Sport A										
Participation rate	Players per 1,000 residents	16.7	6.9	6.5–38.8	12.7	3.7	6.6–19.5	19.3	7.2	6.5–38.8
Facility provision rate	Fields/courts per 1,000 residents	0.60	0.40	0.12–2.13	0.29	0.09	0.12–0.56	0.80	0.40	0.28–2.13
Sport B										
Participation rate	Players per 1,000 residents	49.5	22.3	10.1–105.8	29.0	9.9	10.1–50.4	62.7	17.5	38.9–105.8
Facility provision rate	Fields/courts per 1,000 residents	0.41	0.34	0.07–1.69	0.16	0.05	0.07–0.25	0.57	0.35	0.2–1.69
Sport C										
Participation rate	Players per 1,000 residents	22.3	13.0	3.4–94.5	19.3	16.1	5.0–94.5	24.3	10.1	3.4–53.3
Facility provision rate	Fields/courts per 1,000 residents	2.31	2.32	0.21–12.26	0.63	0.28	0.21–1.36	3.39	2.41	0.64–12.26
Sport D										
Participation rate	Players per 1,000 residents	28.3	15.3	3.8–66.7	13.5	6.0	3.8–23.3	37.8	11.4	17.2–66.7
Facility provision rate	Fields/courts per 1,000 residents	0.67	0.60	0.03–2.36	0.15	0.10	0.03–0.46	1.00	0.55	0.23–2.36
Socioeconomic status	SEIFA IRSAD[a]	989	50	888–1,114	1,026	50	905–1,114	965	33	888–1,060

a: Socio-economic Indexes for Areas – Index of Relative Socio-economic Advantage and Disadvantage

sports, data for each sport were analysed separately. In each case, tabular summaries of rates of participation and facility provision, together with SEIFA IRSAD values, were produced for the State overall and for each region. Accompanying graphs were produced for selected variables. Pearson correlation coefficients and associated scatterplots were used to examine the relationships between participation rates, facility provision and SES, for the state overall and separately for each region. General linear models (GLM) were used to predict participation rate from facility provision rate, while controlling for the effects of region and SES.

Results

Table 1 shows summary statistics for the three measures for each sport, for the state overall and for each region. As might be expected, there were marked differences between sports in the overall rates of participation, as indicated by the mean participation rates (players per 1,000 residents: Sport A: 16.7; Sport B: 49.5; Sport C: 16.4; Sport D 28.3). However, consistently across all four sports, the participation rates were higher in the non-metropolitan region than in the metropolitan region (Sport A: 19.3 and 12.7; Sport B: 62.7 and 29.0; Sport C: 18.1 and 13.9; Sport D 37.8 and 13.5).

Similarly, considering the differences in the types of playing fields/courts and the modes of play of different sports, it is not surprising that there were marked differences between sports in the overall level of facility provision, as indicated by the mean number of fields/courts per 1,000 residents (Sport A: 0.60; Sport B: 0.41; Sport C: 2.31; Sport D 0.67. However, once again, it was consistently the case across all sports that the non-metropolitan region was better provided with facilities than the metropolitan region (Sport A: 0.80 and 0.29 fields/courts per 1,000 residents; Sport B: 0.57 and 0.16; Sport C 3.39 and 0.63; Sport D: 1.00 and 0.15).

Table 2 shows for each sport the correlations between the participation rate, the rate of facility provision and the SES measure (SEIFA IRSAD), for the state overall and separately for each region.

There was a consistent pattern of positive associations between the participation rate and the rate of facility provision for all four sports, for the state overall and for both metropolitan and non-metropolitan regions. The correlations ranged from 0.29 to 0.87, with 10 of the 12 being in the 'moderate range' (0.47-0.77), and 11 of the 12 being statistically significant at the 0.01 level. In general, higher/lower levels of facility provision in an LGA were associated with higher/lower levels of sport club participation among residents in that LGA.

With regard to the potential confounder SES, the picture was more complex. The pattern of associations was very different in metropolitan and non-metropolitan regions, making it pointless to attempt to interpret correlations calculated for the state as a whole. In the metropolitan region, there were strong positive correlations between participation rate and SES for all four sports. The correlations between facility provision and SES were positive for two sports (but not as strong as for participation rates) and close to zero for the other two sports. In the non-metropolitan region, the correlations

Table 2: Correlations between participation rate, facility provision rate and socioeconomic status of LGAs: by sport and region.

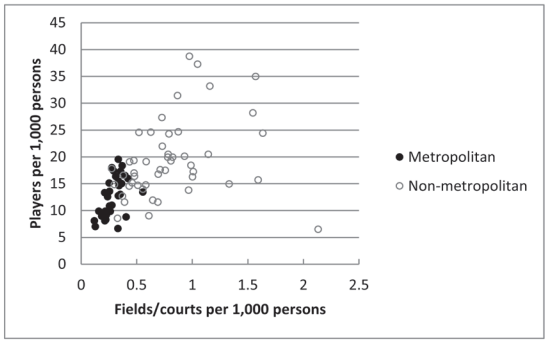
	State of Victoria (n=79)		Metropolitan (n=31)		Non-metropolitan (n=48)	
	Facilities	SES	Facilities	SES	Facilities	SES
Sport A						
Participation	0.499**	-0.179	0.515**	0.505**	0.285*	-0.002
Facilities		-0.447**		0.234		-0.242
Sport B						
Participation	0.765**	-0.427**	0.517**	0.373*	0.642**	-0.152
Facilities		-0.459**		-0.035		-0.258
Sport C						
Participation	0.400**	0.104	0.639**	0.548**	0.513**	-0.140
Facilities		-0.453**		0.440*		-0.299*
Sport D						
Participation	0.865**	-0.460**	0.510**	0.424*	0.756**	-0.202
Facilities		-0.541**		0.012		-0.351*

Measures: Facilities – fields/courts per 1,000 residents; participation – Participants per 1,000 residents; SES – SIEFA IRSAD

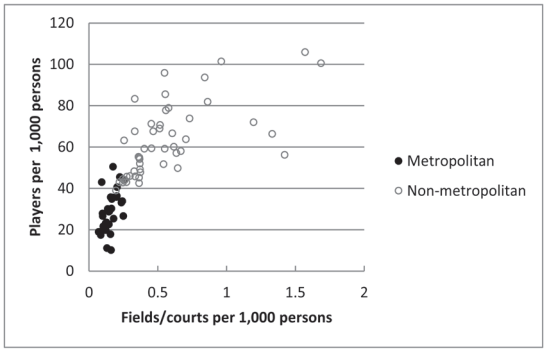
**Correlation is significant at the 0.05 level*

***Correlation is significant at the 0.01 level*

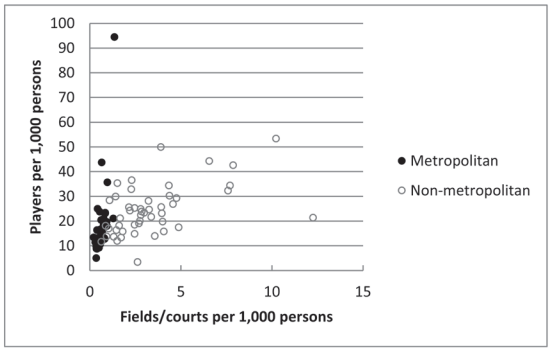
Figure 1: Scatterplots of participation rate v facility provision rate and SEIFA IRSAD score: by sport and region.



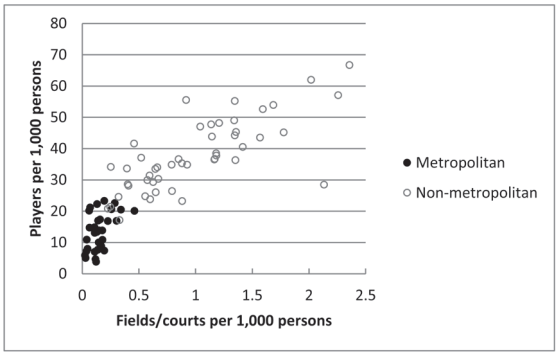
a. Sport A



b. Sport B

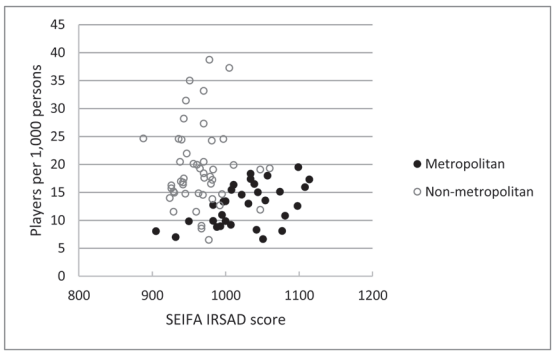


c. Sport C

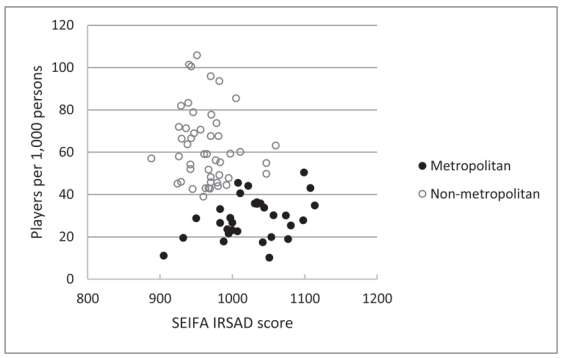


d. Sport D

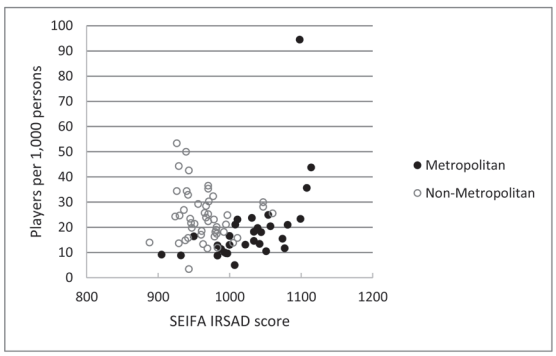
I. Participation rate v Facility provision rate



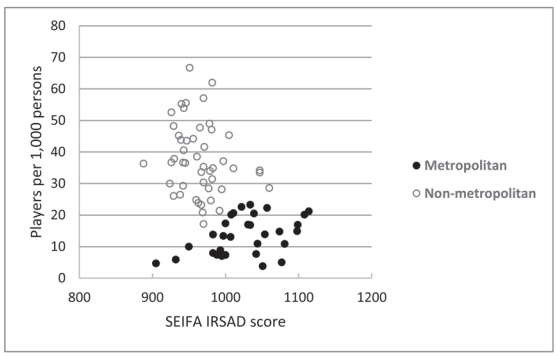
a. Sport A



b. Sport B



c. Sport C



d. Sport D

II. Participation rate v SEIFA IRSAD score

between SES and both participation and facility provision rates were weakly negative for each of the four sports, with only two of the eight correlations being statistically significant.

These varying patterns of correlation can be explained with reference to Figure 1. Figure 1.1 shows for each sport a plot of the participation rate against the facility provision rate. Figure 1.2 shows for each sport a plot of the participation rate against the SES indicator (SEIFA IRSAD).

A characteristic common to all four Figure 1.1 graphs is the tendency for metropolitan LGAs to have lower values for both variables than non-metropolitan LGAs. Notwithstanding this, the relationships are all positive, albeit with varying strengths of correlation, and with the presence of a few extreme outliers that influence/distort some of the calculated correlations. Considering Figure 1.2, it is apparent that the different patterns of correlation within the two regions, compounded by the difference in the magnitude of the variables within the two regions, make it meaningless to talk about an overall state-wide correlation. The positive trends in the metropolitan area are apparent for all four sports, while the non-metropolitan area exhibits weaker negative relationships for sports C and D, and negligible correlation for sports A and B.

The relationship between participation rate and facility provision for each sport within each region was further investigated with adjustment for the effects of SES (SEIFA IRSAD) in a series of multiple linear regression analyses (Table 3).

All statistically significant predictors had positive regression coefficients, indicating that the LGA participation rate tended to increase with increases in SES and/or rate of facility provision. The R^2 values show that across the eight sport-region combinations, the levels of SES and facility provision together accounted for between 9% and 58% of the variation in participation rates between LGAs. As well as this wide variation in overall predictive power, the individual contributions of SES and facility provision varied markedly between sports and regions, with instances of significant contributions from SES alone, facility provision alone, both SES and facility provision, and neither SES nor facility provision.

Focusing on the relationship between the participation rate and the facility provision rate, Table 3 shows that after adjustment for the effects of SES the relationship was statistically significant ($p<0.001$) in the non-metropolitan area for three sports (B, C and D) and statistically significant ($p<0.01$) in the metropolitan area for three sports (A, B and D).

Table 3 also shows that for each sport, the magnitude of the regression coefficient for facility provision was larger for the metropolitan region than for the non-metropolitan region, by factors of around 3:1 for sports A and B, 4:1 for sport C and 2:1 for sport D. These differences in the relative magnitudes of the rates of participation and resource provision in the two regions reflect the higher intensity of usage of facilities in the more densely populated metropolitan region.

Discussion

This study draws on comprehensive data for a large sub-national region regarding participation in four popular sports and associated sports facilities, to investigate the geographical variations in both participation and facility provision, and the association between participation and facility provision, after adjustment for the effects of SES. The study identified differences in the levels of both participation and facility provision between sports, between regions, and between LGAs within each region. This provides a model for the production of critical information for the management of sport through the provision of sports facilities. First, this study quantifies the levels of both participation and facility provision throughout a state for four major sports. Second, it demonstrates that associations exist between participation and facility provision, although some of these associations do not persist after adjustment for the effects of SES. Third, it provides a comparative analysis of LGAs with regard to the level of facility provision. This provides objective information to support an evidence-based approach to decisions about sport facility investment. Investments can be made in areas of clear need based on statistics regarding sports facility provision, population and participation, in order to improve participation and population health.

There were considerable differences between sports, which are to be expected. Previous research has reported large discrepancies among different types of sports and the provision of facilities relative to the size of the residential population.[34] Such variation reflects differences in the general level of popularity of the sports, together with differences in infrastructure required to play each of the sports, and in addition to obvious differences in the levels of infrastructure investment in different geographical locations. While it was outside the scope of this study, we acknowledge that the playing space for each field/court and the number of people per playing field/court for a game varies considerably from sport to sport, from two to four players for tennis to a team

Table 3: Results of the regression of participation rate on facility provision rate and SES: by sport and region.

Sport & region	R2	Predictor	Coefficient	95% CI	*p*-value
Sport A					
Metropolitan	0.42	Facility rate	16.8	(0.47–29.0)	0.008**
		SES	0.030	0.010–0.050	0.010*
Non-metropolitan	0.09	Facility rate	5.4	0.1–10.8	0.045*
		SES	0.020	-0.050–0.080	0.628
Sport B					
Metropolitan	0.42	Facility rate	103.2	45.8–160.6 .	0.001**
		SES	0.080	0.020–0.140	0.011*
Non-metropolitan	0.41	Facility rate	32.0	20.2–43.9	<0.001***
		SES	0.010	-0.120–0.130	0.900
Sport C					
Metropolitan[a]	0.51	Facility rate	9.9	0.0–19.7	0.050
		SES	0.090	-0.040–0.110	0.001**
Non-metropolitan	0.26	Facility rate	2.2	1.0–3.3	<0.001***
		SES	0.004	-0.080–0.090	0.917
Sport D					
Metropolitan	0.44	Facility rate	30.7	13.1–48.4	0.001**
		SES	0.050	0.020–0.090	0.006**
Non-metropolitan	0.58	Facility rate	16.3	11.9–20.6	<0.001***
		SES	0.020	-0.050–0.100	0.492

a: One unexplained influential outlier in the metropolitan data for Sport C was excluded from this analysis.

** p< 0.05 **p< 0.01 ***p<0.001*

of around 22 for Australian Rules football. Therefore, the contribution of each field/court to participation of community players is quite different for each sport. In addition, non-registered players may use community facilities; however, there is currently no available data on these participants.

With regard to inter-regional differences, we acknowledge that the division of LGAs into metropolitan and non-metropolitan is a coarse categorisation. Within each region, there are many differences between LGAs. LGAs in regional cities have more in common with metropolitan LGAs than they do with rural LGAs. LGAs on the metropolitan fringe may be more similar geographically and demographically to LGAs based in regional towns, than to more centrally located metropolitan LGAs. Consequently, the population-standardised level of facility provision varies widely between LGAs within each region, with some degree of overlap between the regions.

Nevertheless, the differences between the metropolitan and non-metropolitan regions reflect broad differences in physical and human geography, demography, culture and opportunities between the two regions. In the non-metropolitan region, the population is concentrated in a few large regional cities and many smaller regional towns and townships, interspersed by extensive rural areas with varying levels and concentrations of agricultural and pastoral activity. Population density in this region is much lower than in the metropolitan region, and much more spatially heterogeneous. Sport looms large in the culture of these communities, and most towns or rural population concentrations of even moderate size are likely to have a facility for one or more of the four sports examined.[17] In many cases, our investigations using GIS satellite imagery show that these facilities provide only the most basic essential features, and many of them are under-utilised, being used by the relatively small populations immediately surrounding each facility. As a result, the population-standardised level of facility provision is relatively high. In the metropolitan region, by contrast, population densities are generally higher, and spatially more homogeneous. Facilities are generally more developed and more intensively utilised. Space for expansion of facilities or development of new facilities is also more limited in metropolitan areas. As a result, the population-standardised level of facility provision is relatively low. While there is no extensive research on provision of facilities by location there is evidence that as remoteness increases, participation in many team sports actually increases.[17] A recent longitudinal study also found that living in a rural neighbourhood predicted maintenance of participation in both organised and unorganised physical activity.[35]

This study has shown that in general, for all four sports and in both regions, there is a positive relationship between the level of population-standardised facility provision in an LGA and the level of sport club participation among residents in that LGA. We acknowledge that, in general, a cross-sectional study cannot conclusively establish the direction of the 'arrow of causation'. We also acknowledge the complexity of the structural relationships between behaviours and environmental factors[36] and specifically that the level of demand for existing facilities may be an input to decisions about new facility development. Nevertheless, we contend that, since one cannot play sport without an appropriate facility, provision of facilities is a fundamental prerequisite of sport participation, rather than the reverse. This builds on other recent literature which has shown that intention to participate in sport is stronger when more sports facilities are available.[37] Several studies have found an association between access to swimming pools and participation.[38,16] In one of these studies access to facilities was not related to the practice of other sports[38] yet in the other it was.[16] The common finding of an association between provision of swimming pools and participation could be due to swimming pools being less densely available at a community level than other sports facilities.

Studies that have focused on the relationship between sport facility availability and adolescent sport participation have reported mixed findings. Sport participation among adolescents was not associated with availability of sports facilities in several studies.[11,37] However, more recently, a positive association was reported for adolescent girls between proximity of residence to a gym and participation in gym-based activities, but not for tennis courts or indoor pools.[15]

In contrast to the findings of studies that focused on adolescents, studies that focused on adults reported more consistent results. For example, Roux (2007) reported that for adult residents there was a significant direct relationship between the density of sports facilities and participation in the activities offered by these facilities.[39] For recreation more generally, multiple studies have shown a positive association between the availability and proximity to facilities and physical activity participation.[5]

In short, our findings, based on a large cohort and a large geographical area are aligned with the majority of the findings of other researchers using more limited samples and areas. We have shown that there is a positive ecological association at the level of LGAs between participation and facility provision. Moreover, we have shown that for some sports in one or other of metropolitan or non-metropolitan contexts, the association between participation and facility provision is confounded with the effects of SES, while in other cases the association between participation and facility provision persists after adjustment for the effects of SES.

With regard to the effects of SES in the two regions, in the metropolitan region higher levels of participation were associated with higher SES, however, the opposite was true for the non-metropolitan region. This is consistent with another recent Australian study that reported while non-metropolitan areas tended to have lower SES, participation in many team sports was higher in these areas, and there were very few sports or types of physical activity for which the rate of participation increased as SES increased.[17]

The present study found that within the metropolitan regions higher facility provision was related to higher SES for two sports, however, in non-metropolitan regions higher facility provision was related to lower SES for all sports. This finding for the non-metropolitan region is consistent with the results of a recent German study that found no support for the 'deprivation amplification' hypothesis, which states that individuals who are already socially disadvantaged experience further contextual disadvantage relating to access to relevant health facilities.[40] Similarly, a French study found mixed results. There was an increased availability of some sports facilities in higher SES areas, however, decreased availability of other types of facilities.[41] In another study, areas of lower SES were related to higher availability of physical activity facilities for children and adolescents.[40] A study of the association of sports facilities (pools and gyms) and socioeconomic status with participation in jogging, swimming and gym use in Spain found that the number of sports facilities was

not related with either swimming or gym use, and SES was not associated with swimming for either sex or with gym use for males.[42]

It is worth noting also that provision of sports facilities offers much more than opportunities for participation and the physical health benefits of participation. Sports facilities play a role in being the social anchor within communities and increase social capital.[43] This is especially true for rural towns where sport is seen as a vehicle for the development of social capital.[44] This is aligned to findings that participation in club sport is associated with greater psychological and social health benefits than participation in individual-based activities.[19,20]

This study also found evidence of differences in the relative magnitudes of the rates of participation and resource provision in the two regions, reflecting higher intensity of usage of facilities in the metropolitan region. This may be regarded as an 'economy of scale' effect, with usage of facilities near or at full capacity in metropolitan LGAs, where population densities are generally relatively high and spatially homogeneous, and utilisation of available facilities is high. This is less likely to be the case in non-metropolitan LGAs, where population densities are generally relatively low and spatially heterogeneous. The facilities provided in many regional and rural towns are regarded as culturally and communally valuable, even necessary, but are not necessarily fully utilised.

Very few studies have examined sport facility usage. A Norwegian study of facility usage found that sports facilities were less used by girls, adolescents and the least active than by boys, children and the most active.[6] They also found that the least active used multifunctional facilities to a greater extent than specialised facilities. Future research is needed to explore the complexities of facility utilisation and the effect on participation levels. For instance, anecdotally, some fully utilised facilities schedule games late into the evening to accommodate participants; however, some scheduled game times may not be convenient for all.

Mobility, whereby participants travel from one LGA to another to play sport, also reduces the strength of the relationships reported in the current study. This is likely to be more prevalent in the metropolitan area, where the distances involved are less and the provision of facilities may be more stratified and concentrated in particular LGAs. Other research suggests that there is a window (8 kilometres) that is critical in the association of travel distance with participation in physical activity.[39] However, a more recent study found that proximity to facilities was not related to maintenance of participation in organised physical activity among adolescents, and the authors suggest that this may have been because during adolescence it is the choice of their specialised activity that determines participation rather than close proximity to infrastructure.[35] In more general terms, access to facilities encompassing both knowledge of the types of facilities available locally and perceptions of ability to get there, either by themselves or with an adult's assistance, has been shown to be significantly associated with sport participation among adolescent girls.[18] Similarly, increasing awareness has been suggested as a strategy for increasing sport and PA involvement for adolescents, in addition to building more facilities.[14]

We acknowledge some limitations and sources of potential inaccuracy in this study. The study was based on data from several sources: facility data were collected during 2011-2012 by Sport and Recreation Victoria, Department of Transport, Planning and Local Infrastructure, and validated by local government authorities; 2012 membership registration data were provided by four state sporting associations (SSAs) and allocated from postal areas to LGAs using an ABS correspondence table; and 2012 estimated resident populations were published by ABS. Data screening checks resulted in some anomalies being identified in the membership registration and facility data, and to the extent that it was possible these were resolved after consultation with the four SSAs and independent checks of facilities by the researchers using Google Maps; however, some anomalies could not be resolved. The most extreme values in Table 1 and the correlations in Table 2 may have been marginally affected by small membership counts in some postal areas and limitations in the process of allocating postal area counts to LGAs in some non-metropolitan areas with low population densities. Another limitation is that we controlled only for the effects of SES and broad geographical region, which are well-known to influence sport participation, and readily measured/assigned; other confounders may exist among the many characteristics of LGAs. Finally, we used the whole participation age range as the reference population for calculating participation rates. Because the population age profiles varies between LGAs, the results may be different if a sub-population (such as 4-10 years, 11-17 years, 18+ years) were used as the reference population.

Conclusion

We concluded:

- There was great variation in the level of sport participation and the level of provision of sport facilities across Victorian LGAs, both within and between both sports and regions; we conjecture that the regional difference is due to differences in patterns of population density, land availability and facility capacity and utilisation.
- There were statistically significant positive relationships between the level of participation and the level of provision of sport facilities in each LGA; this was true for all four sports and for both metropolitan and non-metropolitan regions.
- There were statistically significant positive relationships between the level of participation and the level of SES for all sports, but only in the metropolitan region; there were no statistically significant relationships between the level of participation and the level of SES for any sport in the non-metropolitan region.
- Positive relationships between the level of participation and the level of provision of facilities persisted after adjustment for the effects of SES in the metropolitan area for all sports, and in the non-metropolitan area for three of the four sports.

Broadly, we can conclude that the level of sport participation is related to the level of facilities provided, and that while the level of SES is a contributing factor to participation in metropolitan regions, the relationship between participation and facility provision persists after adjustment for the effects of SES. The direction of the arrow of causation cannot be determined on the basis of this cross-sectional study (does facility provision enable increased participation or does participant demand lead to facility development, or both?) but, regardless, when levels of both participation and facility provision are so variable across a jurisdiction, this relationship should be borne in mind by decision makers when planning the location of new facilities. Detailed local community-

level measures such as the LGA-based measures summarised and analysed in this paper can provide invaluable geographical comparisons and insights to inform decisions about where future investment in sports facilities should be allocated to best foster increased participation and ultimately result in improved population health.

Practical implications

- Community-level analysis of the population, participation in sport and provision of facilities should be used to inform decisions of future investments in sports facilities.
- Future research could utilise projections of future population to investigate the implications of population changes for the provision of facilities.
- It is recommended that facility capacity and intensity of facility usage be investigated in order to develop more refined measures of facility provision.

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