

Correlates of physical activity among Australian Indigenous and non-Indigenous adolescents

Rona Macniven,¹ Shane Hearn,² Anne Grunseit,¹ Justin Richards,¹ Don Nutbeam,¹ Adrian Bauman¹

The health status and life expectancy of people of Australian Aboriginal and Torres Strait Islander (Indigenous) descent are considerably lower than their non-Indigenous counterparts in Australia.^{1,2} National data also reveal a gap in life expectancy between the highest and lowest socioeconomic groups of four and two years among males and females, respectively, among the general adult population.³ Physical inactivity is an important contributor to the burden of disease, and for Indigenous Australians accounts for 6% of the total burden in 2011.⁴ This is similar to the 5% of the total burden of disease and ill-health attributed to physical inactivity among the overall Australian population.⁵

In Australia and internationally, at least an hour per day of moderate to vigorous physical activity (MVPA) is recommended for young people.⁶ A greater proportion of Indigenous children from non-remote areas aged 5-17 years are achieving these recommendations than non-Indigenous children (48% vs. 35%).⁷ However, at age 18+ years, less than half of Indigenous people (46%) meet the less intensive minimum recommendations for adults of 150 minutes of MVPA per week;⁸ after adjusting for age differences between the two groups, this level was lower than non-Indigenous adults.⁹ Lower levels of physical activity are also evident among low socioeconomic groups within developed countries.¹⁰

Being physically active during adolescence is associated with a number of modifiable and non-modifiable factors. Males are more active than females and the higher activity levels observed among younger children decline during adolescence.¹¹ As well as

Abstract

Objective: Physical inactivity is an important modifiable cause of the excess burden of disease among Indigenous Australians. We describe physical activity patterns and influencing factors, comparing Indigenous and non-Indigenous adolescents.

Methods: Indigenous (n=359) and non-Indigenous (n=637) adolescents aged 13-17 years from disadvantaged New South Wales regions completed a health and lifestyle survey. Socio-demographic, social, psychosocial and health correlates of out of school physical activity (high vs. low) among the whole sample, and stratified by Indigenous status were examined.

Results: Only 21% of Indigenous and 28% of non-Indigenous adolescents achieved higher levels of physical activity. Overall, higher levels were associated with being male; sports team membership; lower levels of TV viewing time and having an employed mother. Indigenous girls were less active than boys (OR=0.36; 95%CI=0.24-0.54), as were those whose mothers were unemployed (OR=0.66; 95%CI=0.40-1.09). Among non-Indigenous adolescents, high levels of physical activity were associated with sports team membership (OR=2.28; 95%CI=1.39-3.74) and community involvement (OR=1.46; 95%CI=1.04-2.06).

Conclusions: Physical activity levels were similarly low among disadvantaged Indigenous and non-Indigenous adolescents. Some influencing factors existed across the whole sample; others in stratification by Indigenous status.

Implications for public health: Early and targeted, supportive approaches are necessary. Some apply to disadvantaged adolescents broadly; others are Indigenous or non-Indigenous specific.

Key words: physical activity, Indigenous, adolescence

these individual correlates, a number of family, socio-demographic and behavioural characteristics including higher affluence and lower levels of TV viewing are associated with higher physical activity.¹² Participation in organised sport is also associated with being more physically active overall.¹³ There are also consistent associations between sport and psychosocial health such as improved self-esteem, social interaction and fewer depressive symptoms.¹⁴ These correlates represent critical targets for initiatives to increase activity yet only a small number of studies have focused on disadvantaged young people and fewer still among Indigenous populations. These are both groups in which both increased rates of risk

factors and low rates of physical activity have been documented.

While physical education in schools is an important contributor to activity levels in school-aged children,¹⁵ participation outside of school hours is vital to achieve optimal levels of physical activity for health benefits.¹⁶ Further, declines in out-of-school physical activity are particularly pronounced during adolescence¹⁷ and into adulthood,¹⁸ identifying a key time period in which to establish patterns and habits that can be continued into adulthood.

This study describes and compares factors associated with physical activity in the out-of-school setting reported among a large community sample of Indigenous and non-

1. Prevention Research Collaboration, Sydney School of Public Health, The University of Sydney, New South Wales

2. Division of the Deputy Vice-Chancellor & Vice-President, The University of Adelaide, South Australia

Correspondence to: Ms Rona Macniven, Prevention Research Collaboration, Sydney School of Public Health, Level 6 – The Hub, The Charles Perkins Centre (D17), The University of Sydney, NSW 2006; e-mail: rona.macniven@sydney.edu.au

Submitted: March 2016; Revision requested: June 2016; Accepted: July 2016

The authors have stated they have no conflict of interest.

[Amended on 14 December 2016, after first online publication: This article has been updated to include a line missing from Table 1 as indicated by the symbol *.]

Aust NZ J Public Health. 2017; 41:187-92; doi: 10.1111/1753-6405.12609

Indigenous Australian adolescents living in disadvantaged areas. It explores associations between demographic, health and lifestyle factors and participation in physical activity, by Indigenous status.

Methods

Population and sampling

Participants were Indigenous and non-Indigenous adolescents aged 13 to 17 years enrolled in the public school system in NSW in 2010. All public high schools in NSW with an Indigenous enrolment greater than 5% were considered for inclusion in the study, as determined by the NSW Department of Education and Training (DET). Due to time and logistical constraints, the sampling frame was narrowed to 23 schools with the highest Indigenous enrolment located within 800 km of Sydney. Initial contact with schools was made via each school's generic email address, followed by a telephone call to the Principal one week later. Thirteen schools agreed to take part. Reasons for non-participation included a lack of time and a perceived burden from participating in research. Once participation of a school was confirmed, a date and time were scheduled to administer the surveys and a package sent to the principal in advance containing information for participants and consent forms. School staff were provided with an outline of the study and collected consent forms from students. An Indigenous researcher (SH) travelled to each school to administer surveys either in a classroom or in a common area such as a school hall. All adolescents aged 13–17 years at each participating school were invited to complete the survey. Information on student absenteeism on the day of data collection was sought from each school.

Survey instrument

A 54-item questionnaire, the Health and Lifestyle of NSW School Students Survey was developed primarily to measure resilience and lifestyle behaviours among adolescents and piloted with 28 subjects aged 13–17 years (25 of Indigenous descent). Test-retest reliability over a 10 day period was acceptable with Spearman rank order coefficients showing most test-retest correlations >0.6.¹⁹ Pilot study participants also attended a focus group and provided feedback and suggestions to improve the face validity and readability of the questionnaire.

The questionnaire covered a range of established socio-demographic factors, physical health behaviours and mental health measures from various population studies conducted previously with diverse populations of adolescents.^{20–22} Physical activity was of interest, given known declines during adolescence¹⁸ and the relationships between physical activity and both chronic disease²³ and mental health in this age group.²⁴

Measures

MVPA was measured according to reported frequency and duration. The frequency question asked "Outside school hours: How often do you usually exercise in your free time, so much that you get out of breath or sweat?" with response categories: every day; 4–6 times a week; 2–3 times a week; once a week; once a month or less. The duration question asked "Outside school hours: How many hours do you usually exercise in your free time, so much that you get out of breath or sweat?" with response categories: 7 or more hours a week; about 4–6 hours a week; about 2–3 hours a week; about 1 hour a week; about ½ hour a week; none. These questions have been used previously with diverse and disadvantaged adolescent health surveys and have acceptable measurement properties.²⁵ Consistent with the methods established by the validation study, the response categories 'every day' or '4–6 times a week' were recoded as 'highly active by frequency' and '7 or more hours a week' and 'about 4–6 hours a week' were recoded as 'highly active by duration'. Responses were further categorised by whether or not respondents were both highly active by frequency *and* duration, "higher levels of physical activity" representing a level most closely approximating meeting recommendations of at least 60 minutes MVPA per day.⁶

Socio-demographic variables were dichotomised as self-reported Indigenous status (Indigenous vs. non Indigenous), gender (male vs. female), region (urban vs. rural) and age based on the known timing of declines in physical activity (13–14yrs vs. 15–17yrs).²⁶ Social indicators were dual parent household (yes vs. no), has sibling (yes vs. no), father and mother employment, respectively (yes; no; unknown), been bullied this term (yes vs. no), bullied others this term (yes vs. no) and community involvement (strongly & moderately involved vs. a little & not involved). Psychosocial variables were also dichotomised based on distribution such

that each category contained approximately equal numbers. Categories were: feeling happy/ok (happy & ok vs. not very & not at all happy); feeling lonely (very often & rather often vs. sometimes & never); feeling confident (always, often, sometimes vs. rarely & never); and feeling depressed in the last six months (not depressed vs. depressed in any setting). Health behaviours included were: ever smoked (yes vs. no); and ever been drunk (yes vs. no); sports team membership (yes vs. no); TV viewing time, dichotomised to approximate current sedentary behaviour recommendations (>3hrs/day vs. <3hrs/day).²⁷

Statistical analyses

Pearson's chi-square tests assessed bivariate relationships between demographic and behavioural variables with achieving high (versus low) levels of physical activity in the whole sample and stratified by Indigenous status. Subsequently, three (whole sample, Indigenous only, non-Indigenous only) multivariate logistic regression models were run to calculate the odds of achieving higher levels of physical activity, with age, gender and variables which were significant ($p \leq 0.05$) in the bivariate analyses as the independent variables. Data analyses were carried out using SPSS version 17.0 and Stata version 11.1 and all inferential tests were adjusted for clustering within school using Stata's *svy* commands (StataCorp, College Station, Texas, US).

Ethics

Ethical clearance was obtained from the researchers' University Ethics Committee and a Government Department.

Results

In six of the 13 schools, absenteeism rates on the day of the survey ranged from 6.5% to 22.2%. The proportion of absentees in these schools did not differ by Indigenous status (17.4% vs. 13.9%; 95%CI=−0.1–7.2).¹⁹ Survey completion response rates were 50% and 46% among Indigenous and non-Indigenous students, respectively, based on school enrolment numbers. In the remaining schools, corresponding response rates were also similar for Indigenous and non-Indigenous students. Each of the 13 participating schools were in areas in the lowest two quintiles, and half were in the most disadvantaged decile, of Census data on Socio-Economic Indexes for Areas (SEIFA) and the Index of Relative

Social Disadvantage (IRSD).²⁸ A total of 996 adolescents completed the questionnaire (60% response rate among students at school on the survey day), 359 (36%) of whom reported they were of Indigenous descent. Respondents were aged between 13 and 17 years, with almost half aged 14 years (47.3%). Fifty-one percent of respondents were male but Indigenous males were underrepresented at 46.5% of the total male sample whereas Indigenous females represented a high proportion of total female respondents at 53.5%. Rates of single parent families were higher in the Indigenous compared to non-Indigenous adolescents (32.7% vs. 26%, $p < .001$).¹⁹ Only just over a quarter (26%) of the total sample achieved higher levels of physical activity. The proportion of adolescents achieving this level in relation to demographic, social, psychosocial and health variables in the whole sample, and stratified by Indigenous status are presented in Table 1.

Whether a respondent achieved higher levels of physical activity varied significantly by Indigenous status; 21% (95%CI=17-25%) of Indigenous adolescents met the recommendations, compared with 28% (95%CI=25-31%) of non-Indigenous adolescents ($p=0.01$ in unadjusted analyses). Across all three groups, higher levels of physical activity were observed for girls aged 13-14 years compared to those aged 15-17 years (21.3% vs. 18.4% for the total sample; data not shown), whereas physical activity levels were higher among boys in the older versus younger age group.

In terms of other correlates, among the whole sample, eight variables were significantly associated with achieving higher levels of physical activity in the bivariate analyses. Being male, maternal employment, involvement in community, sometimes/never feeling lonely, feeling confident, ever having been drunk, sports team membership and watching less than three hours of TV daily were associated with being more physically active. Five variables were significantly associated with higher levels of physical activity among the Indigenous sub-sample: being male; maternal employment; paternal employment often/always feeling confident; and community involvement. For non-Indigenous respondents, sports team membership, lower TV viewing time per day, feeling confident and community involvement were significantly associated with higher levels of physical activity.

Table 1: Percentages achieving high levels of physical activity^{d,e} and bivariate relationships across demographic variables in whole sample, Indigenous and non-Indigenous adolescents.^{a,c}

| Variable ^b | N | Total sample (n=996) | | Indigenous (n=359) | | Non-Indigenous (n=637) | | |
|----------------------------------|----------------------------|----------------------|---------|--------------------|---------|------------------------|---------|---------|
| | | % | p value | % | p value | % | p value | |
| Socio-demographic factors | | | | | | | | |
| Age | 13-14 years | 652 | 24.4 | 0.183 | 21.0 | 0.763 | 26.5 | 0.264 |
| | 15-17 years | 337 | 28.7 | | 22.1 | | 31.8 | |
| Gender | Male | 512 | 31.0 | 0.001 | 29.6 | <0.001 | 31.2 | 0.113 |
| | Female | 419 | 20.5 | | 14.3 | | 24.8 | |
| Region | Urban | 415 | 26.3 | 0.811 | 21.4 | 0.996 | 28.8 | 0.790 |
| | Rural | 588 | 25.5 | | 21.4 | | 27.8 | |
| Social influences | | | | | | | | |
| Dual parent household | Yes | 653 | 26.3 | 0.710 | 20.1 | 0.389 | 29.0 | 0.745 |
| | No | 339 | 24.9 | | 22.7 | | 27.0 | |
| Has sibling | Yes | 810 | 25.8 | 0.872 | 20.1 | 0.628 | 29.0 | 0.524 |
| | No | 125 | 25.0 | | 23.8 | | 25.6 | |
| Father employed ^f | Yes | 725 | 27.6 | 0.073 | 25.5 | 0.014 | 28.3 | 0.967 |
| | No | 118 | 18.8 | | 13.2 | | 28.3 | |
| | Unknown | 160 | 22.5 | | 16.5 | | 27.8 | |
| Mother employed ^f | Yes | 624 | 29.9 | 0.015 | 26.9 | 0.041 | 30.9 | 0.229 |
| | No | 275 | 18.6 | | 14.0 | | 22.4 | |
| | Unknown | 104 | 19.2 | | 17.1 | | 20.6 | |
| Been bullied this term | Yes | 426 | 25.3 | 0.685 | 18.9 | 0.321 | 27.9 | 0.808 |
| | No | 562 | 26.3 | | 22.9 | | 28.6 | |
| Bullied others this term | Yes | 477 | 26.0 | 0.963 | 21.4 | 0.968 | 28.9 | 0.738 |
| | No | 499 | 25.8 | | 21.6 | | 27.6 | |
| Involvement in community | Yes | 303 | 33.3 | <0.001 | 26.3 | 0.040 | 37.7 | <0.001 |
| | No | 656 | 22.6 | | 19.0 | | 24.3 | |
| Psychosocial influences | | | | | | | | |
| Feeling happy/ok | Happy/ok | 880 | 26.4 | 0.128 | 21.9 | 0.251 | 28.8 | 0.335 |
| | Not very/not at all happy | 113 | 20.4 | | 16.7 | | 23.2 | |
| Feeling lonely | Never | 854 | 29.8 | 0.040 | 24.1 | 0.085 | 33.3 | 0.095 |
| | Sometimes/often/very often | 141 | 23.3 | | 19.2 | | 25.3 | |
| Feeling confident | Rarely/never | 106 | 20.0 | 0.010 | 14.4 | 0.017 | 23.7 | 0.036 * |
| | Always/often/sometimes | 883 | 29.7 | | 26.1 | | 31.3 | |
| Feeling depressed | Depressed in any setting | 721 | 25.9 | 0.994 | 20.2 | 0.070 | 28.7 | 0.588 |
| | Not depressed | 273 | 25.9 | | 24.6 | | 27.2 | |
| Health risk factors | | | | | | | | |
| Ever smoked | Yes | 354 | 25.9 | 0.998 | 22.4 | 0.784 | 29.0 | 0.825 |
| | No | 644 | 25.9 | | 20.7 | | 28.0 | |
| Ever been drunk | Yes | 425 | 28.6 | 0.019 | 23.9 | 0.379 | 32.1 | 0.069 |
| | No | 437 | 24.0 | | 19.5 | | 25.4 | |
| Sport team member | Yes | 489 | 33.7 | <0.001 | 26.9 | 0.067 | 37.3 | <0.001 |
| | No | 502 | 18.4 | | 16.4 | | 19.4 | |
| TV viewing time | >3hrs/day | 763 | 24.1 | 0.026 | 20.6 | 0.585 | 25.7 | 0.002 |
| | <3hrs/day | 233 | 31.6 | | 23.7 | | 37.9 | |

a: Indigenous status was unknown for two respondents (missing data).

b: Participants who did not respond to a specific question were excluded from the analysis for that question.

c: P value refers to tests of bivariate associations for whole sample and stratified by Indigenous status.

d: Achieving high levels of physical activity was defined as participation of a frequency of 'every day' or '4-6 times a week' and '7 or more hours a week' and 'about 4-6 hours a week'.

e: % achieving high levels of physical activity was adjusted for clustering at the school level.

f: A category for where parental unemployment was unknown was included, as a high proportion (16% for father's employment, 10% for mother's) of the sample had missing data for this variable. It is likely that a majority of these missing data were due to respondents coming from single parent families (only 27% and 39% of those with missing data for father's and mother's employment respectively were from dual parent households compared with around two-thirds among those without missing data).

The results of the analyses adjusting for age, sex and the variables significant in the bivariate analyses described above are shown in Table 2. Among the whole sample, achieving higher levels of physical

activity did not differ by Indigenous status (OR=0.75, 95% CI 0.51-1.11) once adjusted for other covariates. However, gender, sports team membership, maternal employment and involvement in community remained

significant correlates of higher physical activity levels.

Among Indigenous students, the odds of achieving higher levels of physical activity were significantly lower for females compared with males, and for those whose mothers were unemployed compared with those whose mother was employed. The odds of achieving higher levels of physical activity were significantly higher among Indigenous students who felt confident 'always, often or sometimes' compared with those who 'rarely or never' felt confident. Among the non-Indigenous sample, sports team membership and 'involvement in community' remained significant independent correlates of achieving higher levels of physical activity.

Discussion

Our findings indicate that less than a quarter of this sample of adolescents achieved higher levels of physical activity in the out-of-school setting. The proportion achieving this level was significantly lower among Indigenous adolescents, but this difference became non-significant after adjusting for other variables.

These low rates of physical activity in both Indigenous and non-Indigenous groups may largely relate to the sampling frame used to recruit high numbers of Indigenous adolescents that resulted in the selection

of schools within areas of overall levels of disadvantage. While individual-level measures of SES were not obtained from our questionnaire, social disadvantage was further manifest in the students' survey responses through higher reported rates of paternal unemployment and single parent status in both Indigenous and non-Indigenous groups, compared to the NSW average according to Census data.²⁹ Relative to those from more advantaged areas, young people experiencing social disadvantage are less active³⁰ and report more sedentary behaviour.^{31,32} This may be due to a combination of complex factors including reduced opportunities and expectations to be active, less supportive families and social networks, poorer access to facilities and neighbourhood safety concerns.³³

Physical activity levels in both Indigenous and non-Indigenous adolescents in our sample were considerably lower compared with ABS data of 48% and 35% meeting national recommendations, respectively.⁷ This is likely due at least in part to the older group sampled for the current study (13–17 years compared with that underlying the ABS data, 5–17 years), reflecting the age-related decline in physical activity described earlier. Additionally, while the ABS data measured total activity, the HBSC measures only activity which occurred outside of school hours,

which meant we did not capture all of our respondents' time spent being physically active. However, validation of the HBSC with objective fitness testing allows for comparability across measures and domains of physical activity,²⁵ giving legitimacy to the data from this sample.

Consistent with previous research, male gender³⁴ and sports team membership³⁵ were associated with higher levels of physical activity in this sample, as well as maternal employment and community involvement which are less well established correlates. However, it is evident that the relative importance of some factors and their association with physical activity may differ between Indigenous (gender, maternal employment, confidence) and non-Indigenous (sports team membership, community involvement) adolescents. These findings call for early and targeted, supportive approaches to promote regular physical activity. Some interventions may apply to disadvantaged adolescents broadly, while others may be specifically relevant to Indigenous or non-Indigenous adolescents. There is some demonstrated effectiveness of programs to improve lifestyle behaviours among Indigenous and disadvantaged students within the school setting,³⁶ however few have focussed on promoting physical activity among Indigenous young people or been rigorously evaluated. Involvement of local Aboriginal organisations can be critical to the delivery and success of sport and lifestyle programs³⁷ and such partnership approaches are suggested in future policy responses.

Our findings reinforce other research findings that Australian girls are less active than boys.³⁸ It appears that gender differences begin to emerge during early adolescence³⁹ and increase year-on-year. Importantly, our data found a stronger gender difference in the Indigenous sample compared to the non-Indigenous participants. This may be due in part to cultural factors relating to gender in Indigenous communities, which may require culture-specific solutions⁴⁰ such as initiatives targeted to Indigenous girls. Family support and facility access have been found to be a pathway for associations between sports club participation and socioeconomic status among female adolescents⁴¹ and represent important future avenues for enhancing participation rates.

An important contributor to physical activity in young people is participation in organised

Table 2: Adjusted odds ratios (OR) with 95% confidence intervals (CI) for respondents achieving high levels of physical activity in relation to demographic variables among the whole sample and stratified by Indigenous status.

| Variable (reference category) | Whole sample ^a OR (CI) | Indigenous ^b OR (CI) | Non-Indigenous ^b OR (CI) |
|--|--------------------------------------|------------------------------------|--|
| Socio-demographic factors | | | |
| Indigenous (Non-indigenous) | 0.75 (0.51-1.11) | | |
| Age 13–14 years (15–17 years) | 0.90 (0.57-1.43) | 1.15 (0.72-1.85) | 0.80 (0.48-1.36) |
| Gender (Male) | 0.67 (0.46-0.98) | 0.36 (0.24-0.54) | 0.77 (0.47-1.26) |
| Social influences | | | |
| Father unemployed (employed) | | 0.75 (0.38-1.50) | |
| Unknown (employed) | | 0.57 (0.31-1.05) | |
| Mother unemployed (employed) | 0.66 (0.40-1.09) | 0.47 (0.24-0.92) | |
| Unknown (employed) | 0.52 (0.35-0.79) | 0.78 (0.40-1.52) | |
| Sports team member (No) | 2.13 (1.35-3.38) | | 2.28 (1.39-3.74) |
| Involved in community (No) | 1.30 (1.00-1.68) | 1.40 (0.87-2.24) | 1.46 (1.04-2.06) |
| Psychosocial influences | | | |
| Feeling lonely: Always/often/Sometimes (Rarely/never) | 0.82 (0.57-1.18) | | |
| Feeling confident: Always/often/Sometimes (Rarely/never) | 1.05 (0.68-1.64) | 1.93 (1.05-3.57) | 1.05 (0.70-1.59) |
| Health risk factors | | | |
| Ever been drunk (No) | 1.30 (0.96-1.75) | | |
| TV viewing time >3 hours (<3 hours) | 0.67 (0.45-1.00) | | 0.59 (0.40-1.59) |

All models adjusted for age and gender and those variables significant in the bivariate analyses:

a: Whole sample model: adjusted for age; gender; sports team member; TV viewing time; mother employed; ever been drunk; feeling lonely; involved in community;

b: Indigenous model: adjusted for age; gender; mother employed; feeling confident; involved in community; Non-Indigenous model: adjusted for age; gender; sport team member; TV viewing time; feeling confident; involved in community.

sport.⁴² We found sports team membership was associated with higher levels of physical activity in both the total and the stratified non-Indigenous sample, but not among the Indigenous respondents. The lack of association found in this Indigenous sample may reflect cultural preferences towards unstructured physical activity such as Caring for Country programs.⁴³ Despite experiences of racial stereotyping in sport,⁴⁴ there are claims that sport strengthens pride and identity among Indigenous populations in Australia⁴⁵ and long standing program practice exist.⁴⁶ However, estimations of the positive effects of Indigenous sport programs and their association with health outcomes may be overstated.⁴⁷

Higher levels of feeling confident were found to be associated with higher physical activity among the Indigenous participants only. There is evidence of a relationship between physical activity participation and self-efficacy, the belief in oneself to achieve goals.^{48,49} However, previous studies have not examined this association in Indigenous youth. While our findings may provide emerging evidence of a similar relationship, cross-sectional data does not allow for inference of whether this finding can be directly attributed to physical activity.

Our finding that community involvement was significantly positively correlated with higher levels of physical activity in non-Indigenous adolescents may partly relate to higher rates of sports team membership being synonymous with overall community club involvement. This may further reflect the semi-rural nature of this sample; rural adolescents have demonstrated higher fitness levels than their urban counterparts⁵⁰ again reflecting higher participation in community based physical activity. While previous research has found lower rates of involvement in organised sport in low SES neighbourhoods,^{41,51} such evidence was derived from studies in urban environments. However, physical activity relating to community involvement cannot be tied to sport alone. There is evidence of an association between both neighbourhood and social connections and physical activity among Indigenous and non-Indigenous adults.⁵² Identifying the influence of these environments on physical activity levels in adolescents may help identify the specific mechanisms which lead to increased physical activity, which could be targeted in future behavioural interventions.

After adjusting for age, gender and other significant factors in the bivariate analyses, the association between physical activity and TV viewing time in the whole sample was only marginally significant. Previous studies have indicated that TV viewing time is associated with decreased fitness⁵³ and lower levels of physical activity, yet complex associations between these two behaviours exist.⁵⁴

It is widely accepted that in order to improve rates of adoption of healthy behaviours such as physical activity among adolescents, a broad population approach that targets the fundamental determinants of health, including education, access to facilities and health literacy is important.⁵⁵ Improving equity in opportunities for physical activity among all disadvantaged populations, including and especially those with high proportions of Indigenous Australians is necessary. Using approaches which focus on the social determinants of health could translate to culturally appropriate and role modelling initiatives focussed around sport or wellbeing more broadly, together with educational outcomes. Such initiatives show promise.^{46,56} Our results also suggest more targeted approaches would be beneficial to increasing physical activity, with specific emphases on the effects of social disadvantage and gender differences, especially among Indigenous adolescents. Further investigation of culturally-based physical activity preferences and their relationship with levels of participation is required. A number of community-based initiatives for young people exist but program evaluation is limited⁵⁷ and should be a priority to inform resource allocation. Finally, the emerging evidence of a positive association between feeling confident and being physically active among our sample should be explored longitudinally in future studies of mental health and physical activity, particularly among Indigenous populations.

Strengths and limitations

A strength of this study was that it included a large sample of young Indigenous Australians, which is rare in research and government data. Whilst the sample was not population representative and may be subject to recruitment bias, the large absolute number of Indigenous adolescents makes these findings indicative and strengthens the evidence base around physical activity behaviour of

Indigenous adolescents. It also allows for the identification of some similarities in the issues faced by those of both Indigenous and non-Indigenous background residing in areas of socioeconomic disadvantage. Our measurement tool was based on existing established measures,²⁰ was reliable and valid and allowed for the examination of a comprehensive range of correlates of physical activity. Although objective measures are generally considered more robust than self-reporting, only one previous study has established the measurement properties of objective physical activity measures among both Indigenous and non-Indigenous young people.⁵⁸

Limitations include the self-reporting measures used and some non-responses arising from school absenteeism and sampling factors. Response rates were however similar among both Indigenous and non-Indigenous adolescents. The cross-sectional nature of the data also limits the causal inferences from this study. Nonetheless, these data provide initial insights into physical activity levels and its correlates in well powered study of a population group where there is little existing information. Comprehensive, regular measurement of physical activity in populations of young people, particularly among those experiencing disadvantage warrants further effort in order to capture trends and monitor progress in policies and initiatives. Such measurement could be strengthened through more detailed examination of temporal and seasonal patterns of physical activity. Longitudinal designs would also facilitate the elucidation of causal mechanisms on the determinants of physical activity among disadvantaged youth.

Conclusion

Physical activity levels in Indigenous and non-Indigenous adolescents in the out-of-school setting were similarly low in this large disadvantaged adolescent sample. Indigenous girls, those from fragmented families, or those feeling disengaged from their community had particularly low activity levels. Improving opportunities for physical activity among disadvantaged populations, including those with high proportions of Indigenous Australians is necessary. These findings can guide future research examining physical activity correlates in priority population groups and provide directions for targeted, supportive approaches within

schools and the wider community. Further investigation of culturally based physical activity preferences and their relationship with levels of participation is required.

References

- Australian Institute of Health and Welfare. *The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples*. Canberra (AUST): AIHW; 2008.
- Steering Committee for the Review of Government Service Provision. *Overcoming Indigenous Disadvantage: Key Indicators 2011*. Canberra (AUST): Productivity Commission; 2011.
- Australian Bureau of Statistics. *1370.0 – Measures of Australia's Progress, 2010*. Canberra (AUST): ABS; 2010.
- Australian Institute of Health and Welfare (AIHW) (2016) *Australian Burden of Disease Study: impact and causes of illness and death in Aboriginal and Torres Strait Islander people 2011*. Australian Burden of Disease Study series no. 3. Cat. no. BOD 4. Canberra: AIHW.
- Australian Institute of Health and Welfare (AIHW) (2016) *Australian Burden of Disease Study: impact and causes of illness and death in Australia 2011*. Australian Burden of Disease Study series no. 3. Cat. no. BOD 4. Canberra: AIHW.
- Department of Health. *Australia's Physical Activity and Sedentary Behaviour Guidelines for Young People (13–17 years)* [Internet]. Canberra (AUST): Government of Australia; 2013 [cited 2014 Sep 23]. Available from: <http://www.health.gov.au/internet/main/publishing.nsf/content/health-phubhlth-strateg-phys-act-guidelines#apa1317>
- Australian Bureau of Statistics. *Australian Aboriginal and Torres Strait Islander Health Survey: Physical activity, 2012–13*. Canberra (AUST): ABS; 2014.
- Australian Bureau of Statistics. *4364.0.55.004 – Australian Health Survey: Physical Activity, 2011–12*. Canberra (AUST): ABS; 2013.
- Australian Bureau of Statistics. *Australian Aboriginal and Torres Strait Islander Health Survey: First Results, Australia, 2012–13*. Canberra (AUST): ABS; 2014.
- Kavanagh AM, Goller JL, King T, Jolley D, Crawford D, Turrell G. Urban area disadvantage and physical activity: A multilevel study in Melbourne, Australia. *J Epidemiol Community Health*. 2005;59(11):934–40.
- Corder K, Sharp SJ, Atkin AJ, Griffin SJ, Jones AP, Ekelund U, et al. Change in objectively measured physical activity during the transition to adolescence. *Br J Sports Med*. 2015;49(11):730–6.
- Stanley RM, Ridley K, Dollman J. Correlates of children's time-specific physical activity: A review of the literature. *Int J Behav Nutr Phys Act*. 2012;9:50.
- Telford RM, Telford RD, Cochrane T, Cunningham RB, Olive LS, Davey R. The influence of sport club participation on physical activity, fitness and body fat during childhood and adolescence: The LOOK Longitudinal Study. *J Sci Med Sport*. 2016;19(5):400–6.
- Eime RM, Young JA, Harvey JT, Charity MJ, Payne WR. A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model of health through sport. *Int J Behav Nutr Phys Act*. 2013;10:98.
- Dobbins M, De Corby K, Robeson P, Husson H, Tirilis D. School-based Physical Activity Programs for Promoting Physical Activity and Fitness in Children and Adolescents Aged 6–18 (Cochrane Review). In: *The Cochrane Database of Systematic Reviews*; 1, 2009. Chichester (UK): John Wiley; 2009.
- Schranz N, Olds T, Cliff D, Davern M, Engelen L, Giles-Corti B, et al. Results from Australia's 2014 Report Card on Physical Activity for Children and Youth. *J Phys Act Health*. 2014;11 Suppl 1:21–5.
- Brooke HL, Atkin AJ, Corder K, Ekelund U, van Sluijs EMF. Changes in time-segment specific physical activity between ages 10 and 14 years: A longitudinal observational study. *J Sci Med Sport*. 2016;19(1):29–34.
- Sallis JF. Age-related decline in physical activity: a synthesis of human and animal studies. *Med Sci Sports Exerc*. 2000;32(9):1598–600.
- Hearn S. *Adolescent Health in an Indigenous Context – The Potential Role for Resilience*. Sydney (AUST): University of Sydney; 2010.
- Aarö L, Wold B, Kannas L, Rimpelä M. Health behaviour in schoolchildren A WHO cross-national survey. *Health Promot Int*. 1986;1(1):17–33.
- Honkala S. World Health Organization approaches for surveys of health behaviour among schoolchildren and for health-promoting schools. *Med Princ Pract*. 2014;23 Suppl 1:24–31.
- Phongsavan P, Olatunbosun-Alakija A, Havea D, Bauman A, Smith BJ, Galea G, et al. Health behaviour and lifestyle of Pacific youth surveys: a resource for capacity building. *Health Promot Int*. 2005;20(3):238–48.
- World Health Organization. *Preventing Chronic Disease – A Vital Investment*. Geneva (CHE): WHO; 2009.
- Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: A review of reviews. *Br J Sports Med*. 2011;45(11):886–95.
- Booth ML, Okely AD, Chey T, Bauman A. The reliability and validity of the physical activity questions in the WHO health behaviour in schoolchildren (HBSC) survey: A population study. *Br J Sports Med*. 2001;35(4):263–7.
- Australian Bureau of Statistics. *2008 National Aboriginal and Torres Strait Islander Social Survey (NATSISS)*. Canberra (AUST): ABS; 2008.
- Department of Health and Ageing. *Australia's Physical Activity Recommendations for Children and Young People 2005* [Internet]. Canberra (AUST): Government of Australia; 2005 [cited 2012 Jun 13]. Available from: http://www.health.gov.au/internet/main/publishing.nsf/content/9D7D393564FA0C42CA256F970014A5D4/5File/kids_phys.pdf
- Australian Bureau of Statistics. *Socio-Economic Indexes for Areas (SEIFA) 2011* [Internet]. Canberra (AUST): ABS; 2013 [cited 2016 Nov 8]. p. 54–8. Available from: <http://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa>
- Australian Bureau of Statistics. *Census Quick Stats* [Internet]. Canberra (AUST): ABS; 2016 [cited 2016 Nov 8]. Available from: <http://www.abs.gov.au/census>
- Finger JD, Mensink GB, Banzer W, Lampert T, Tyllskar T. Physical activity, aerobic fitness and parental socio-economic position among adolescents: The German Health Interview and Examination Survey for Children and Adolescents 2003–2006 (KiGGS). *Int J Behav Nutr Phys Act*. 2014;11(1):43.
- Coombs N, Shelton N, Rowlands A, Stamatakis E. Children's and adolescents' sedentary behaviour in relation to socioeconomic position. *J Epidemiol Community Health*. 2013;67(10):868–74.
- Pulsford RM, Griew P, Page AS, Cooper AR, Hillsdon MM. Socioeconomic position and childhood sedentary time: Evidence from the PEACH project. *Int J Behav Nutr Phys Act*. 2013;10:105.
- Wilson DK, Lawman HG, Segal M, Chappell S. Neighborhood and parental supports for physical activity in minority adolescents. *Am J Prev Med*. 2011;41(4):399–406.
- Trost S, Pate RR, Sallis JF, Freedson PS, Taylor WC, Dowda M, Sirard J. Age and gender differences in objectively measured physical activity in youth. *Med Sci Sports Exerc*. 2002;34(2):350–5.
- Eime RM, Harvey JT, Charity MJ, Casey MM, van Uffelen J, Payne WR. The contribution of sport participation to overall health enhancing physical activity levels in Australia: A population-based study. *BMC Public Health*. 2015;15(1):806.
- Gwynn J, Blunden S, Turner N, Flood V, Attia J, Smith W, et al. *Many Rivers Diabetes Prevention Project 2007–2012: Final Report*. Sydney (AUST): New South Wales Ministry of Health; 2014.
- Peralta LR, Cinelli RL. An evaluation of an Australian Aboriginal controlled-community organization's remote sports-based programme: A qualitative investigation. *Sport Sci*. 2015:1–17.
- Hardy L, King L, Espinel P, Cosgrove C, Bauman A. *NSW Schools Physical Activity and Nutrition Survey (SPANS) 2010: Full Report*. Sydney (AUST): New South Wales Ministry of Health; 2010.
- Dumith SC, Gigante DP, Domingues MR, Kohl HW 3rd. Physical activity change during adolescence: A systematic review and a pooled analysis. *Int J Epidemiol*. 2011;40(3):685–98.
- Macdonald D, Abbott R, Jenkins D. Physical Activity of Remote Indigenous Australian Women: A Postcolonial Analysis of Lifestyle. *Leis Sci*. 2012;34(1):39–54.
- Eime RM, Harvey JT, Craike MJ, Symons CM, Payne WR. Family support and ease of access link socio-economic status and sports club membership in adolescent girls: A mediation study. *Int J Behav Nutr Phys Act*. 2013;10:50.
- Cadogan SL, Keane E, Kearney PM. The effects of individual, family and environmental factors on physical activity levels in children: A cross-sectional study. *BMC Pediatr*. 2014;14:107.
- Burgess CP, Johnston FH, Bowman DMJS, Whitehead PJ. Healthy Country: Healthy People? Exploring the health benefits of Indigenous natural resource management. *Aust N Z J Public Health*. 2005;29(2):117–22.
- Hallinan CJ, Bruce T, Coram S. UP FRONT AND BEYOND THE CENTRE LINE: Australian Aborigines in elite Australian Rules Football. *Int Rev Social Sport*. 1999;34(4):369–83.
- Bamblett L. Straight-line stories: Representations and Indigenous Australian identities in sports discourses. *Aust Aboriginal Stud*. 2011;2:5–20.
- Neesham G, Garnham AP. Success story: Clontarf Foundation promotes education, life-skills and employment prospects through Australian Rules Football. *Br J Sports Med*. 2012;46(13):898–9.
- Evans JR, Wilson R, Dalton B, Georgakis S. Indigenous Participation in Australian Sport: The Perils of the 'Panacea' Proposition. 2015. *Cosmopolitan Civil Societies*. 2015;7(1):25.
- Neissar I, Raudsepp L. Changes in physical activity, self-efficacy and depressive symptoms in adolescent girls. *Pediatr Exerc Sci*. 2011;23(3):331–43.
- Ryan GJ, Dziewaltowski DA. Comparing the relationships between different types of self-efficacy and physical activity in youth. *Health Educ Behav*. 2002;29(4):491–504.
- Machado-Rodrigues AM, Coelho-E-Silva MJ, Mota J, Padez C, Martins RA, Cumming SP, et al. Urban-rural contrasts in fitness, physical activity, and sedentary behaviour in adolescents. *Health Promot Int*. 2014;29(1):118–29.
- Seabra AF, Mendonça DM, Thomis MA, Peters TJ, Maia JA. Associations between sport participation, demographic and socio-cultural factors in Portuguese children and adolescents. *Eur J Public Health*. 2008;18(1):25–30.
- Macniven R, Richards J, Gubhaju L, Joshy G, Bauman A, Banks E, et al. Physical activity, healthy lifestyle behaviors, neighborhood environment characteristics and social support among Australian Aboriginal and non-Aboriginal adults. *Prev Med*. 2016;3:203–10.
- Tremblay MS, LeBlanc AG, Kho ME, Saunders TJ, Larouche R, Colley RC, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *Int J Behav Nutr Phys Act*. 2011;8:98.
- Marshall SJ, Biddle SJ, Gorely T, Cameron N, Murdey I. Relationships between media use, body fatness and physical activity in children and youth: A meta-analysis. *Int J Obes Relat Metab Disord*. 2004;28(10):1238–46.
- Friel S, Marmot MG. Action on the social determinants of health and health inequities goes global. *Annu Rev Public Health*. 2011;32(1):225–36.
- Cinelli RL, Peralta LR. 'Achievement, pride and inspiration': Outcomes for volunteer role models in a community outreach program in remote Aboriginal communities. *Rural Remote Health*. 2015;15(4):3482.
- Clifford A, Pulver LJ, Richmond R, Shakeshaft A, Ivers R. Smoking, nutrition, alcohol and physical activity interventions targeting Indigenous Australians: Rigorous evaluations and new directions needed. *Aust N Z J Public Health*. 2011;35(1):38–46.
- Trost SG, Marshall AL, Miller R, Hurley JT, Hunt JA. Validation of a 24-h physical activity recall in indigenous and non-indigenous Australian adolescents. *J Sci Med Sport*. 2007;10(6):428–35.