

# The relationship between community physical activity settings and race, ethnicity and socioeconomic status

Lisa M Powell,<sup>1,2</sup> Sandy Slater,<sup>1</sup> Frank J Chaloupka<sup>1,2</sup>

<sup>1</sup>Health Research and Policy Centers, <sup>2</sup>Department of Economics; University of Illinois at Chicago, Chicago, IL, USA

**Abstract:** This study provides evidence on the association between the availability of community-level physical activity-related settings and race, ethnicity and socioeconomic status (SES). We draw on outdoor observational data on community-level physical activity-related settings (such as sports areas, parks and green space, public pools and beaches, and bike paths/lanes) from the ImpacTeen Project and Census Bureau data. The results show that the availability of environmental factors that are conducive to physical activity such as sports areas, parks and green spaces, public pools and beaches, and the presence of bike paths/lanes is significantly associated with racial, ethnic and SES factors. We find that higher median household income and lower poverty rates are associated with increasing levels of available physical activity-related settings. Communities with higher proportions of minority races such as African American and the race category 'other' are associated with fewer physical activity settings. The results highlight the importance of targeting interventions in low SES areas and communities with minority populations where the associated barriers are relatively high and the levels of physical activity are known to be relatively low.

**Keywords:** physical activity, obesity, community, race, socioeconomic status

## Introduction

The public health challenge that stems from physical inactivity and obesity has been well documented. For instance, the health risks associated with obesity are numerous, including premature death, type 2 diabetes, heart disease, stroke, hypertension, gallbladder disease, osteoarthritis, sleep apnoea, asthma, breathing problems, cancer, high blood cholesterol, complications of pregnancy, menstrual irregularities, hirsutism, stress incontinence and depression (USDHHS 2001). Also, research shows that regular physical activity is associated with reduced mortality due to many of these and other chronic diseases. In particular, regular physical activity has been found to reduce the risk of coronary heart disease, diabetes, colon cancer, hip fractures, high blood pressure and obesity (USDHHS 1996, 2002).

In addition to its relationship to physical health, physical activity has been shown to yield positive benefits related to adult mental health. Higher levels of physical activity have also been positively associated with young people's mental health by increasing self-esteem levels and reducing stress (USDHHS 1996). Limited evidence reveals that they may even lead to improved academic performance (Sallis et al 1999). Higher levels of physical activity among youths have

also been associated with reduced risky behaviours such as smoking and drug use (Escobedo et al 1993; Kulig et al 2003).

Despite the evidence on the health benefits associated with regular physical activity and the maintenance of moderate weight levels, physical inactivity rates remain high, and obesity rates have reached record levels in the United States among both adults and youths. Overweight and obesity statistics reveal a current epidemic among the US population.<sup>1</sup> Recent data from the National Health and Nutrition Examination Survey (NHANES) 1999–2000 found that 64.5% of the US adult population is overweight and almost one in three is obese (30.5%) (Flegal et al 2002). Data on the prevalence of overweight (age- and gender-specific body mass index (BMI) greater than or equal to the 95th percentile) among children is also staggering. Data from NHANES II, III and 1999–2000 show a tripling in the prevalence of overweight among children aged 6–11 and 12–19 years over the last few decades. From the mid-1960s through to 1980 the overweight prevalence rates remained

Correspondence: Lisa M Powell, Health Research and Policy Centers, University of Illinois at Chicago, 1747 W Roosevelt Road, Room 558, M/C 275, Chicago, IL 60608, USA; tel +1 312 413 8468; fax +1 312 355 2801; email [powell@uic.edu](mailto:powell@uic.edu)

relatively stable, increasing from 4% to 7% among 6–11-year-olds and remaining constant at 5% for youth aged 12–19 years. However, by 1999–2000 the overweight prevalence among both age groups reached 15%.<sup>2</sup>

Almost three-quarters of adults do not get enough physical activity to meet public health recommendations.<sup>3</sup> Based on data from the Behavioral Risk Factor Surveillance System, 24.4% of adults reported no leisure-time physical activity in 2002.<sup>4</sup> Furthermore, data reveal that physical activity patterns differ by race, ethnicity and socioeconomic status (SES). Both the Healthy People 2010 report and the Physical Activity and Health: a Report of the Surgeon General report that populations most at risk for inactivity include people with low income, members of some ethnic minority groups and those with disabilities (USDHHS 1996, 2000).

Examining physical inactivity among racial and ethnic minorities, Crespo et al (2000) found that ethnic differences still exist, accounting for differences in social class. The authors also found significantly higher levels of age-adjusted leisure-time inactivity among those with lower education levels, lower income levels and those living below the poverty line in all racial and ethnic groups. The authors highlight the importance of examining other constructs of social class such as environmental barriers in order to promote successful interventions to increase physical activity within these populations.

With respect to physical activity patterns among adolescents, the Centers for Disease Control and Prevention (CDC) found that in 2002, based on the Youth Media Campaign Longitudinal Survey, among children aged 9–13 years 38.5% participated in organised sports and 77.4% participated in free-time physical activity. Substantial differences by race and parental income and education levels were found in the participation in organised sports (CDC 2003). Data on trends in vigorous exercise (jogging, swimming, callisthenics or any other active sports) among adolescents based on the Monitoring the Future survey show that while there has been no decline since 1991 among children in middle school level (8th grade), with nearly every day or more rates of vigorous exercise of 61% for boys and 50% for girls in 2002, the corresponding rates among 10th and 12th graders have declined over time and reveal a greater gender gap. Lower than the rates for the 10th graders, the nearly every day or more vigorous exercise rates for 12th-grade boys and girls were reported to be 42% and 26%, respectively, in 2002, down from 50.0% and 32.8%, respectively, in 1979 (Johnston and O'Malley 2003). Drawing on the National Longitudinal Study of Adolescent

Health, Gordon-Larsen et al (1999) found that physical activity and inactivity patterns vary significantly by ethnicity for youths in grades 7–12.

Overweight and obesity rates are also shown to vary by race, ethnicity and SES. On the basis of the 1994–1996 Continuing Survey of Food Intake by Individuals, Paeratakul et al (2002) found significant differences in obesity rates among individuals aged 18 years and older by race, income and education levels. The prevalence of obesity was found to be significantly higher among African American and Hispanic populations than among their white counterparts, higher among low- versus high-income groups (defined with an income cutoff of 130% of the poverty level) and higher among low- versus high-education groups (defined by high school diploma).

The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity also documents clear differences in the prevalence of overweight and obesity based on SES. For all racial and ethnic groups, women of lower SES (income less than or equal to 130% of the poverty threshold) are about 50% more likely to be obese than those with higher SES (income greater than 130% of the poverty threshold). Obesity was also found to be higher among women of racial and ethnic minorities. Male obesity rates do not differ much by SES; however, Hispanic men have higher overweight and obesity prevalence rates than their non-Hispanic counterparts. Racial, ethnic and income disparities in overweight (although weaker than those in adults) were also found to exist for children and adolescents (USDHHS 2001).

In addressing the importance of communities in their support of physical activity and healthy food choices, the Surgeon General's 2001 Report (USDHHS 2001, p 18) proposes a call for research to 'determine the root causes, behaviors, and social and ecological factors leading to obesity and how such forces vary by race and ethnicity, gender, and socioeconomic status'.

Indeed, underscoring the public health challenge related to physical inactivity and obesity, an increasing body of research has emerged finding important associations between SES, physical activity, obesity and health outcomes. The importance of the community environment as a determinant of physical activity has recently received significant attention by researchers, as is discussed in greater detail in the next section. However, limited empirical evidence exists on the associations between race, ethnicity and SES and the availability of community-level environmental physical activity supports.

The lack of community-level settings (such as parks, sidewalks, bike paths) conducive to physical activity can represent a significant barrier to an active lifestyle for residents. Barriers to physical activity, in part, may underpin some of the documented differences in physical activity levels and obesity rates found to exist by race, ethnicity and SES.

Self-reported data do, in fact, suggest that environmental barriers to physical activity vary significantly by race and SES. On the basis of the Youth Media Campaign Longitudinal Survey, parents were asked about their perceptions of potential barriers to their children's participation in physical activities. Parents of non-Hispanic African American children and parents with lower income and education levels perceived significantly higher barriers that included transportation problems, lack of opportunities to participate in physical activity in their area, expense and concerns about neighbourhood safety. Parents' lack of time was not found to differ significantly by race or SES characteristics (CDC 2003).

A national survey in the United States demonstrated that perceived environmental barriers to physical activity are strongly related to income. Twice as many low-income (31%) as moderate-income (15%) respondents worried about safety in their neighbourhoods as an obstacle. Low-income respondents were also likely to identify lack of sidewalks as an obstacle to physical activity (17% versus 11%). Affordability of recreational facilities was cited as an important obstacle by 50% of low-income respondents (Moore et al 1996).

The research reported here examines the associations between the availability of community-level physical activity-related settings and race, ethnicity and SES. The study draws on outdoor observational data on community-level physical activity-related settings from the ImpacTeen Project and Census Bureau data. Specifically, we examine observational data on the availability of sports areas, parks and green space, public pools and beaches, and bike paths/lanes. The findings provide evidence on the extent to which racial, ethnic and SES groups face differential barriers to supportive community-level physical activity settings. This evidence highlights the potential importance of targeted community supports to reduce barriers to physical activity among individuals most at risk of inactivity and obesity.

## **Environmental factors and ecological models of physical activity**

The importance of environmental policy interventions based on ecological models to promote physical activity has been

clearly articulated in several studies (King et al 1995; Sallis et al 1998). Sallis et al (1998) discuss the importance of physical environmental factors as essential elements of an ecological model of physical activity. Underlying this is the premise that physical activities take place in specific physical environments (behaviour settings) that are likely to influence the amount and type of activity. Behaviour settings are defined by Sallis et al (1998) as the physical and social contexts in which behaviours occur (ie designed for physical activity such as sports fields, gyms, health clubs and bicycle trails).

Extensive reviews of studies that support the ecological hypothesis that environmental variables and physical activity are correlated are provided by Humpel et al (2002), Sallis et al (1998) and King et al (1995). Positive associations between physical environments and levels of physical activity have been found for children, adolescents and adults.

Recent work by Duncan et al (2002) that examines the association between perceived neighbourhood physical activity opportunities and SES in 56 neighbourhoods of a metropolitan city in the Pacific Northwest is the most comparable study within the literature to the work proposed in this paper. In their paper, variables related to neighbourhood physical activity opportunities included playgrounds, parks or gyms close to home, and difficulty for walking or jogging in neighbourhood because of traffic, no sidewalks, dogs, gangs etc. The authors found that residential members' perceptions of neighbourhood physical activity opportunity were higher in neighbourhoods with less poverty. Controlling for the effects of neighbourhood race and poverty, the study also provided between-level neighbourhood correlation estimates that showed that higher levels of perceived neighbourhood physical activity opportunities were significantly related to physical activity levels.

Understanding the influence of participation behaviour settings on physical activity provides evidence on the importance of interventions in those settings, since related to these environments are regulations and policies that may create opportunities or restrictions for physically active behaviour. It is also important to understand the extent to which the availability of such settings varies across different communities. While most studies examine direct associations between environmental factors and levels of physical activity, very few studies assess the extent to which the availability of physical activity settings is associated with community demographic and SES characteristics. Understanding the extent to which environmental attributes related to physical

activity are associated with race, ethnicity and SES can help inform policymakers on the importance of targeting policy interventions to help increase the activity levels of the groups most at risk of inactivity.

## Methods

This study uses outdoor observational data on community-level physical activity-related settings from the ImpacTeen Project<sup>5</sup> – A Policy Research Partnership to Reduce Youth Substance Use (supported by the Robert Wood Johnson Foundation) and Census Bureau data. This data is used to examine the associations between race, ethnicity and SES and the availability of sports areas, parks and green space, public pools and beaches, and bike paths/lanes. We examine both a dichotomous prevalence indicator of the availability of our physical activity-related settings and ordered levels of availability that include the following four categories: none, 1 or 2, some, and many.

### Sample selection

Data were collected in 2002 and 2003 as part of the ImpacTeen Project. The original purpose of the project was to examine the effects of policies and other environmental factors on youth substance use and related outcomes. Recently the project has been expanded to include the development and analysis of measures of environmental and policy influences on physical activity.

The selection of communities was determined by the location of separate nationally representative school-based, cross-sectional samples of 8th-, 10th- and 12th-grade students in the coterminous United States. A multistage random sampling procedure was used at each of the three grade levels, with the first stage being the selection of particular geographic areas and the second the selection of one or more schools in each area, with probability proportionate to the estimated school size.<sup>6</sup> For each school in the final sample, a catchment area, or community, was defined, reflecting the area from which the school drew the majority of its students. Our sample size for this study consisted of 209 communities in 2002 and 200 communities in 2003. Maps of the catchment area were then generated to ensure the information recorded on site was accurately reflective of our defined neighbourhood for the students.

### Data collection

Observations were conducted from 12 February to 2 June in 2002, and from 19 February to 1 June in 2003. The data used in this study represent one component of the larger

project and come from the ImpacTeen site summary form. This information is collected in conjunction with tobacco and alcohol marketing information in retail establishments and substance use-related local ordinances.

Using the maps of the catchment areas as a guide, trained field staff teams composed of a lead and an assistant observer were instructed to drive/walk around and record general impressions of advertising, recreational space, social interactions, public events/signage, safety and the general upkeep of the catchment area. The purpose of this data collection, known as the ‘day in the life’ component of the project, was to identify the availability of public spaces such as parks, public pools, playgrounds and sports areas used in this study.

Training methods vary across the two years of data. In 2002, field staff were instructed to record information on the site summary form while they collected data for the other project components. Field staff were instructed to visit the index school, collect ordinances from the local and/or county government buildings, and visit up to 30 tobacco and alcohol retailers. This would ensure that field staff would gain an overall impression of the catchment area’s business sections and some of its residential areas. In 2003, data collection was modified to ensure a more systematic and inclusive method for identifying information on the site summary form. First, the catchment area map was divided by drawing both a horizontal and a vertical line that intersected in the centre of the map, thus creating equal quadrants. Field staff were instructed to drive through as many of the major roads in each quadrant as possible. Because our sample includes communities of varying degrees of urbanicity, no particular number of streets was specified in advance.

### Variable constructs

The variables used in this study include observational indicators of community-level physical activity-related space (ie sports areas, parks, playgrounds, public pools, beaches and bike paths), SES measures of median household income and poverty, race, population density, region and year. Table 1 reports summary statistics for all variables used in this study.

### Observation measures

The physical activity-related measures represent the survey observer’s general impression of the defined catchment area; therefore, there is only one variable for each site. The information is recorded using a four-point scale (none, 1 or 2, some, many). Field staff were instructed to code the most

**Table 1** Summary statistics

Variable	Nr observed	Mean	SD
<b>Community/recreational space</b>			
Sports areas	407	0.9214	0.2695
Parks/green spaces, playgrounds, golf courses	408	0.9020	0.2977
Public pools/beaches	406	0.3300	0.4708
Presence of bike path	405	0.3975	0.4900
Scale: community recreational space (dichotomous indicator for availability) (4-item) (0–4)			
	399	2.5439	0.9937
Scale: community recreational space (4-item) (0–20)			
	399	6.7769	4.2656
<b>Control variables</b>			
Race – white	409	0.7547	0.2465
Race – African American	409	0.1349	0.2189
Race – Asian	409	0.0274	0.0532
Race – other race	409	0.0829	0.1126
Ethnicity – Hispanic	409	0.1127	0.1807
Median household income (US\$, in thousands)	409	46.0141	17.7958
Percentage of total households in poverty	409	0.0386	0.0200
Population density – rural	409	0.2494	0.4332
Population density – town	409	0.1247	0.3308
Population density – suburban	409	0.1809	0.3854
Population density – urban	409	0.4352	0.4964
Region – South	409	0.3178	0.4662
Region – Northeast	409	0.2200	0.4148
Region – Midwest	409	0.2689	0.4440
Region – West	409	0.1907	0.3933
Year 2002	409	0.5110	0.5005
Year 2003	409	0.4890	0.5005

**Increasing levels of availability of community recreational space**

Community/ recreational space	Nr observed	None (%)	1–2 (%)	Some (%)	Many (%)
Sports areas	407	7.86	38.33	42.51	11.30
Parks/green spaces, playgrounds, golf courses	408	9.80	34.56	40.44	15.20
Public pools/beaches	406	67.00	19.46	10.34	3.20
Presence of bike path	405	60.25	19.51	9.88	10.37

SD, standard deviation

appropriate category for the catchment area that indicated the frequency of observing these items. The variables used in this analysis include:

- sports areas (eg baseball diamonds, basketball and tennis courts, soccer fields)
- parks/green spaces, playgrounds, golf courses
- public pools/beaches
- presence of bike paths/lanes.

Physical activity variables were constructed based on a 0–1 dichotomous indicator of the presence of each of the physical activity-related settings (equal to 1 if there exists one or more; equal to 0 otherwise). In addition, we examined the availability of the four ordered categories of none, 1 or 2, some, and many. We also created two scale measures to

capture the overall presence of our individual physical activity measures. The first scale measure is a summation of the dichotomous indicators for our four different settings. This scale takes on a value of 0–4 (the mean value is 2.5). The second scale measure is based on the summation across the four settings where each setting is assigned a value based on the increasing categorical levels of availability as follows: none is assigned a value of 0; 1 or 2 is assigned a value of 1.5; some is assigned a value of 3; and many is assigned a value of 5. Hence, the range for the second scale is 0–20, with a mean value of 6.8.<sup>7</sup>

## Socioeconomic, demographic and control measures

Community socioeconomic data were mapped to the catchment area at the census block group level using Federal Information Processing identification codes. The SES data were obtained from the 2000 Census and consist of information on race and ethnicity, median household income and the poverty rate. SES data were collected for all census block groups located within the catchment areas and are reflective of the socioeconomic make-up of the communities in which the schools are located. The race variable is defined as the percentage of the population in the categories of Caucasian, African American, Asian and ‘other’ race.<sup>8</sup> Ethnicity is defined by the percentage of Hispanic persons in the catchment area. The income variable is defined by median household income. The poverty rate measure is defined as the percentage of households that fall below the Census Bureau measure of poverty.<sup>9</sup> For each catchment area, a variable was also added that described its degree of urbanisation (rural, town, suburban and urban) (obtained from the National Center for Education Statistics). We also controlled for region (South, West, Midwest and Northeast) and year of data collection (either 2002 or 2003).

## Analysis

This paper uses several empirical models to examine the association between the availability of various community-level physical activity-related settings and race, ethnicity and SES variables. Specifically, for each of our individual physical activity setting measures, we estimate a probit and an ordered probit model of the prevalence and ordered categorical availability, respectively, of our individual physical activity measures. Ordinary least squares (OLS) regressions are implemented to examine our dependent scale measures of the overall presence of the physical activity settings. All regression models include race, ethnicity and

SES variables and controls for population density, region and year. To further assess the potential association between SES indicators and the availability of community-level physical activity-related settings, simulations based on our regression results are performed at different SES levels. Our simulations report the predicted level of availability of the physical activity settings based on the estimated regression coefficients evaluated at both the mean and various specified levels of our SES measures.

## Results

Table 2 presents the estimation results based on our probit model of our dichotomous measure of the prevalence of each of the community physical activity settings. The results show that higher levels of poverty significantly reduce the likelihood of having parks and green spaces and bike paths/

lanes in the community and that higher median income levels are also associated with an increased probability of having bike paths. The two SES variables were not found to be significantly associated with the presence of sports areas or public pools and beaches. Communities with higher percentages of African American populations were significantly less likely to have either parks and green spaces or public pools or beaches in the area. Greater Hispanic populations were positively associated with the presence of public pools and beaches. Examining the overall presence of the individual physical activity-related settings, the results from the OLS regression for the scale variable showed that communities with lower poverty rates, lower proportions of African American populations and higher proportions of Hispanic populations were more likely to have an increasing number of alternative physical activity-related settings in the

**Table 2** Prevalence of community recreational space<sup>a</sup>

Variable	Probit model: marginal effects				OLS regression coefficient
	Sports areas	Parks and green spaces	Public pools/beaches	Bike paths/lanes	Scale: overall presence (0–4)
Medium household income	–0.0000002 (0.0009)	0.0018 (0.0012)	–0.0003 (0.0018)	0.0040** (0.0019)	0.0039 (0.0034)
Poverty rate	–0.3192 (0.5925)	–1.2535** (0.5874)	–0.2783 (1.2291)	–6.5283*** (2.1460)	–5.9777** (2.5534)
Race – African American	–0.0767 (0.0628)	–0.1480** (0.0673)	–0.2609* (0.1409)	–0.0922 (0.1399)	–0.6265** (0.2561)
Race – Asian	–0.1196 (0.2811)	0.0071 (0.3163)	1.3791** (0.6010)	0.2840 (0.6058)	1.4230 (1.0856)
Race – other race	0.0683 (0.2384)	–0.1540 (0.2180)	–1.2817** (0.5454)	–0.6391 (0.5037)	–1.5906* (0.8210)
Ethnicity – Hispanic	0.0212 (0.1558)	0.1037 (0.1442)	0.8071*** (0.3096)	0.3698 (0.2855)	1.0261** (0.4848)
Density – town	0.0472 (0.0250)	–0.0304 (0.0521)	0.0577 (0.0913)	–0.0431 (0.0911)	0.0795 (0.1677)
Density – suburban	0.0661** (0.0221)	0.0426 (0.0350)	0.1795 (0.0852)	0.0114 (0.0856)	0.3368** (0.1545)
Density – urban	0.0781** (0.0352)	0.0178 (0.0415)	0.1324 (0.0755)	0.1233 (0.0796)	0.3842*** (0.1462)
Region – West	–0.0078 (0.0499)	–0.0691 (0.0686)	0.0602 (0.0894)	0.3018*** (0.0910)	0.2658 (0.1669)
Region – Midwest	–0.0152 (0.0356)	–0.0411 (0.0430)	0.0696 (0.0676)	–0.0064 (0.0725)	–0.0055 (0.1285)
Region – Northeast	–0.0420 (0.0446)	–0.0550 (0.0510)	–0.0915 (0.0662)	0.2021*** (0.0752)	0.0059 (0.1367)
Year 2003	0.0217 (0.0252)	0.0136 (0.0270)	–0.0733 (0.0478)	–0.0081 (0.0516)	–0.0401 (0.0946)
Constant					2.3950*** (0.2389)
Number of observations	407	408	406	405	399

<sup>a</sup> The overall community recreational measure is a four-item scale based on the availability of sports areas, parks/green spaces, public pools/beaches, bike paths/lanes (Cronbach's alpha is 0.49).

NOTE: Standard errors are shown in brackets. The symbols \*, \*\* and \*\*\* represent statistical significance at the 10%, 5% and 1% levels, respectively. OLS, ordinary least squares.

**Table 3** Simulations of the effects of socioeconomic status variables on the prevalence of community recreational space

Variable	Sports area	Green space and parks	Public pools/beaches	Presence of bike path	Scale (0–4)
Baseline	0.9328	0.9201	0.3194	0.3772	2.5439
<b>Income</b>					
US\$25 000	0.9326	0.8743	0.3251	0.2985	2.4637
US\$75 000	0.9326	0.9604	0.3078	0.4971	2.6574
<b>Poverty rate</b>					
1%	0.9413	0.9497	0.3259	0.5721	2.7159
5%	0.9289	0.9039	0.3148	0.3066	2.4768
10%	0.9107	0.8111	0.3011	0.0862	2.1779

community. Suburban and urban communities compared with rural areas and towns were also associated with a higher number of physical activity settings.

Simulations based on the probit models of the prevalence of each physical activity setting and the OLS regression results for the 0–4 scale indicating the total presence of

physical activity settings reveal the extent to which communities with different SES conditions are associated with differential rates in physical activity settings. Table 3 shows that the greatest impact is revealed for the presence of bike paths, where moving from a community with a 1% poverty rate to a 10% poverty rate is associated with a decreased prevalence of bike paths of 57% to 9%, respectively. On the other hand, as shown by our regression results, the presence of sports areas is not shown to differ according to either median household income or the poverty rate. Based on the average characteristics across all communities, our model predicts the mean number of physical activity settings out of a potential of four to be 2.5. Communities with a median income level of US\$25 000 versus US\$75 000 are estimated to be associated with 2.5 versus 2.7 settings, while community-level poverty rates of 1% versus 10% are associated with a total presence of 2.7 versus 2.2 settings (approximately a 20% difference).

**Table 4** Availability of increasing levels of community recreational space<sup>a</sup> (none, 1 or 2, some, many)

Variable	Ordered probit model: coefficients				OLS regression coefficient
	Sports areas	Parks and green spaces	Public pools/beaches	Bike paths/lanes	Scale: overall presence (0–20)
Medium household income	0.0030 (0.0040)	0.0071* (0.0040)	0.0027 (0.0044)	0.0089** (0.0043)	0.0264* (0.0145)
Poverty rate	-4.9887* (2.9558)	-5.6170* (2.9106)	-1.7603 (3.1165)	-19.4110*** (5.4427)	-26.4615** (10.7311)
Race – African American	-0.6463** (0.2984)	-0.6569** (0.2947)	-0.7147* (0.3771)	-0.0690 (0.3411)	-2.1119** (1.0764)
Race – Asian	0.9343 (1.1727)	-0.0517 (0.1616)	2.4547** (1.1732)	-0.1219 (1.2844)	4.0153 (4.5625)
Race – other race	-1.8699* (0.9711)	-1.8765** (0.9564)	-3.3278*** (1.2614)	-2.5303** (1.2397)	-10.6907*** (3.4503)
Ethnicity – Hispanic	1.5431** (0.5821)	1.1379** (0.5700)	2.0913*** (0.6700)	1.4163** (0.6885)	6.7382*** (2.0375)
Density – town	0.2767 (0.1949)	0.0969 (0.1903)	0.1942 (0.2289)	-0.0865 (0.2344)	0.6208 (0.7048)
Density – suburban	0.8091*** (0.1811)	0.6595*** (0.1776)	0.4491** (0.2060)	0.1725 (0.2072)	2.4017*** (0.6493)
Density – urban	0.5506*** (0.1695)	0.3468** (0.1663)	0.2956 (0.1957)	0.3396* (0.1926)	1.7208*** (0.6146)
Region – West	-0.0676 (0.1926)	-0.0210 (0.1902)	0.0798 (0.2228)	0.9215*** (0.2184)	1.2207* (0.7012)
Region – Midwest	0.0575 (0.1481)	-0.0458 (0.1458)	0.1303 (0.1714)	0.0397 (0.1803)	0.0800 (0.5400)
Region – Northeast	-0.1318 (0.1576)	-0.1707 (0.1557)	-0.1767 (0.1886)	0.5132*** (0.1776)	0.0917 (0.5745)
Year 2003	0.1463 (0.1091)	0.0003 (0.1077)	-0.1916 (0.1246)	-0.2232* (0.1230)	-0.4211 (0.3977)
Constant					5.5794*** (1.0041)
Number of observations	407	408	406	405	399

<sup>a</sup> The overall community recreational measure is a four-item scale based on the availability of sports areas, parks/green spaces, public pools/beaches, bike paths/lanes (Cronbach's alpha is 0.74).

NOTE: Standard errors are shown in brackets. The symbols \*, \*\* and \*\*\* represent statistical significance at the 10%, 5% and 1% levels, respectively. OLS, ordinary least squares.

While our probit model provides evidence on the existence of the physical activity settings, Table 4 presents the results of our ordered probit model where we examine the probability of increasing levels of availability. We find stronger evidence of the association between race, ethnicity and SES and increasing levels of availability of our physical activity setting compared with examining only the existence of such settings.

Table 4 shows that a higher poverty rate is significantly associated with reduced availability of sports areas, parks and green spaces, and bike paths. Higher levels of median household income are associated with increased availability of parks and green spaces and bike paths. In terms of race, the results show that communities with higher African American populations are associated with the likelihood of fewer available sports areas, parks and green spaces, and public pools and beaches. Communities with an increased population base of the 'other' race category are significantly associated with fewer of all the physical activity settings. In

terms of ethnicity, a higher Hispanic population is associated with increasing levels of all physical activity settings. Turning to our scale measure, reflecting the overall level of availability of all of our physical activity setting measures, the results show that the race, ethnicity and SES variables are all significantly associated with the overall availability of physical activity-related settings in the community.

The simulations presented in Table 5 show the differential distribution of availability of each of the four separate physical activity settings and the overall scale measure that reflects the increasing level of availability of our combined set of physical activity opportunities. Focusing here on our scale measure, the simulations reveal that on a scale of 0–20 the average community has 6.8 physical activity opportunities. Moving from a community with a median household income level of US\$25 000 to a community with that of US\$75 000 would be associated with an increase in the availability of physical activity settings as measured by our scale from 6.2 to 7.6. Communities with poverty rates of

**Table 5** Simulations of the effects of socioeconomic status variables on the increasing levels of availability of community recreational space

<i>Variable</i>	<i>Sports areas</i>	<i>Green space and parks</i>	<i>Public pools/beaches</i>	<i>Presence of bike path</i>	<i>Scale (0–20)</i>
Baseline					6.7769
None	0.0622	0.0837	0.6809	0.6239	
1–2	0.3955	0.3560	0.2017	0.2172	
Some	0.4488	0.4242	0.0942	0.0934	
Many	0.0934	0.1366	0.0233	0.0656	
Income = US\$25 000					6.2312
None	0.0703	0.1090	0.7005	0.6916	
1–2	0.4125	0.3898	0.1927	0.1901	
Some	0.4339	0.3949	0.0865	0.0732	
Many	0.0833	0.1062	0.0204	0.0451	
Income = US\$75 000					7.5502
None	0.0523	0.0562	0.6528	0.5222	
1–2	0.3713	0.3038	0.2138	0.2478	
Some	0.4677	0.4535	0.1055	0.1243	
Many	0.1087	0.1864	0.0278	0.1058	
Poverty rate = 1%					7.5386
None	0.0465	0.0616	0.6626	0.4049	
1–2	0.3551	0.3157	0.2097	0.2660	
Some	0.4788	0.4483	0.1015	0.1588	
Many	0.1196	0.1744	0.0262	0.1703	
Poverty rate = 5%					6.4802
None	0.0694	0.0940	0.6880	0.7040	
1–2	0.4108	0.3710	0.1985	0.1846	
Some	0.4355	0.4123	0.0914	0.0696	
Many	0.0844	0.1227	0.0222	0.0419	
Poverty rate = 10%					5.1571
None	0.1092	0.1501	0.7184	0.9340	
1–2	0.4699	0.4264	0.1841	0.0517	
Some	0.3688	0.3489	0.0796	0.0108	
Many	0.0520	0.0746	0.0179	0.0035	

1%, 5% and 10%, respectively, are found to be associated with 7.5, 6.5 and 5.2 physical activity opportunities based on our overall scale measure. This reveals that moving from a high-poverty area (10% poverty rate) to a low-poverty area (1% rate) is associated with a 50% increase in the overall availability of physical activity opportunities represented in this study.

## Discussion

Based on the known health risks associated with physical inactivity and obesity, a clear public health goal is to promote a more active lifestyle among the American population. The ways in which we can mobilise a more active population range from individual and family commitments, school and workplace supports, to a supportive community-level environment.

Our results reveal that the availability of environmental factors that are conducive to physical activity such as sports areas, parks and green spaces, public pools and beaches, and the presence of bike paths/lanes is significantly associated with race, ethnicity and SES variables. Overall we find that higher median household income and lower poverty rates are associated with increasing levels of available physical activity-related settings. Communities with higher proportions of minority races such as African American and the 'other' race category are associated with fewer physical activity settings. This highlights the importance of targeting interventions in low SES areas and communities with high proportions of minority populations where the associated barriers are relatively high and the levels of physical activity are known to be relatively low.

Interestingly, the results show that Hispanic versus non-Hispanic neighbourhoods are associated with increased community physical activity settings. However, data on physical activity levels have shown that both male and female Hispanic populations are less physically active than their non-Hispanic counterparts. This highlights the importance of the link between availability and usage. While this study provides observational evidence on the availability of a series of alternative community physical activity-related settings, we do not provide evidence on usage levels. This is clearly an important issue. If a park is available to the community but is unsafe to walk or play in, it will not help to promote an active lifestyle.

A further limitation of this study is that it focuses on only one of many potential barriers to physical activity. As noted earlier, survey data reveal that differences in several perceived barriers to physical activity (such as expense,

safety etc) exist by race and SES. And, as highlighted above, many of these barriers may be interrelated.

It is also important to note that while our sample of communities is nationally based, it is drawn from a sample of 8th, 10th and 12th grade schools and hence our results may not be reflective of the nation as a whole. With this caveat in mind, however, by drawing on a national sample, we are able to build on the existing research by Duncan et al (2002) that examines similar associations (for perceived rather than objective measures of physical activity spaces) based on a sample of 56 neighbourhoods in a single metropolitan city.

While this study provides objective observational data on the availability of community physical activity settings, the aggregate nature of the data collection has several drawbacks. Individual-level data would be useful to ascertain individuals' perception of the availability of community-level physical activity settings to determine whether homogeneity within communities exists in terms of physical activity opportunities. Individual data would also allow us to examine physical activity patterns. In our future work, we propose to link the objectively observed physical activity-related opportunities to physical activity participation among youths, which would allow us to examine the impact of potential environmental barriers to physical activity, controlling for important factors such as race, ethnicity and SES.

Overall, the results suggest that communities with low-SES populations and higher proportions of minority racial groups who are most at risk to be inactive and overweight are also associated with the fewest community-level physical activity-related settings. Hence, targeted interventions to improve access to neighbourhood physical activity-related opportunities may help to reduce the persistent disparities in health related to SES. Broadly speaking, in addition to income redistribution policies, interventions to improve the health of low-income individuals should include proactive urban planning policies to reduce barriers related to physical activity.

Although the data have limitations, this paper offers an important first step in studying these issues nationally using observational data and will, it is hoped, lay the groundwork to aid policymakers in addressing access and availability of physical activity-related settings to underserved populations.

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## Notes

<sup>1</sup> Obesity is defined for an adult with a body mass index (BMI) greater than or equal to 30.0, and overweight (but not obese) is defined as BMI between 25.0 and 29.9. BMI is defined as weight in kilograms divided by height in metres squared (<http://www.cdc.gov/nccdphp/dnpa/obesity/defining.htm>).

<sup>2</sup> <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overwght99.htm>

<sup>3</sup> <http://www.cdc.gov/nccdphp/dnpa/physical/stats/tarecsex.htm>

<sup>4</sup> <http://apps.nccd.cdc.gov/brfss>

<sup>5</sup> <http://www.impactteen.org>

<sup>6</sup> For a detailed description of the school sampling design, see Bachman et al (2001).

<sup>7</sup> Field staff were instructed to code the category 'some' based on an observed frequency of about 3–4 and 'many' based on a frequency of 5 or more.

<sup>8</sup> The 'other' race category includes the census race categories of American Indian, Alaska Native, Native Hawaiian, other Pacific Islander and some other race.

<sup>9</sup> See <http://www.census.gov/hhes/poverty/povdef.html> for a description of the Census Bureau poverty measure.

NOTE: All websites accessed 25 March 2004.

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