

RESEARCH REPORT

Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States

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Study objectives: Few studies have analysed the rates and correlates of physical activity in economically and geographically diverse populations. Objectives were to examine: (1) urban-rural differences in physical activity by several demographic, geographical, environmental, and psychosocial variables, (2) patterns in environmental and policy factors across urban-rural setting and socioeconomic groups, (3) socioeconomic differences in physical activity across the same set of variables, and (4) possible correlations of these patterns with meeting of physical activity recommendations.

Design: A cross sectional study with an over sampling of lower income adults was conducted in 1999–2000.

Setting: United States.

Participants: 1818 United States adults.

Main results: Lower income residents were less likely than higher income residents to meet physical activity recommendations. Rural residents were least likely to meet recommendations; suburban residents were most likely to meet recommendations. Suburban, higher income residents were more than twice as likely to meet recommendations than rural, lower income residents. Significant differences across income levels and urban/rural areas were found for those reporting neighbourhood streets, parks, and malls as places to exercise; fear of injury, being in poor health, or dislike as barriers to exercise and those reporting encouragement from relatives as social support for exercise. Evidence of a positive dose-response relation emerged between number of places to exercise and likelihood to meet recommendations for physical activity.

Conclusions: Both income level and urban rural status were important predictors of adults' likelihood to meet physical activity recommendations. In addition, environmental variables vary in importance across socioeconomic status and urban-rural areas.

Physical inactivity is one of the most important modifiable causes of chronic disease in the United States.¹ According to the BRFSS, fewer than 20% of adults achieve the recommended amount of regular physical activity.¹ Moreover, 25% of all adults are completely sedentary.

Considerable attention has been paid to racial/ethnic and gender differences in physical activity. More recently, analyses have included more diverse correlates including environment, socioeconomic status, intra-personal relationships, interpersonal barriers, and urban/rural dwelling.^{2,3} One recent study reported lower rates of physical activity among rural women.⁴ Rates of physical activity also tend to be lower among those of lower socioeconomic status. To develop individual level and policy level interventions, it is necessary to understand all aspects affecting physical activity in potentially disparate populations.

In a study of ethnically diverse women aged 40 years and older, it was shown that younger age, perception of fewer barriers to leisure time physical activity and presence of social support were related to increased physical activity levels in urban residents.⁵ For rural women, white race, higher educational attainment, and presence of enjoyable scenery in the neighbourhood in addition to the factors named above were associated with increased physical activity.⁵ Few studies to date have analysed the socioeconomic variations independently as indicators of factors encouraging or discouraging physical activity. As a basis for understanding patterns in activity and intervention opportunities, it is important to understand the independent contributions of urban-rural and socioeconomic factors. The purposes of this study were

fourfold: (1) examine urban-rural differences in physical activity by several demographic, geographical, environmental, and psychosocial variables, (2) describe patterns in environmental and policy factors across urban/rural setting and socioeconomic groups, (3) examine socioeconomic differences in physical activity across the same set of variables, and (4) explore possible correlations of these patterns with meeting of physical activity recommendations.

METHODS

Sampling

Data were collected via telephone survey, using a modified version of the sampling plan of the Behavioral Risk Factor Surveillance System (BRFSS). These survey methods have been described elsewhere and will be discussed briefly here.² The cross sectional risk factor survey used a random digit dialling technique to collect data.

To obtain a representative sample of lower income individuals, zip codes were over sampled that had $\geq 32\%$ of residents below the Federal poverty level. Once the zip codes were selected, the area code/exchange combinations that were at least 70% within the zip code defined area were determined and used as the final sample frame for this stratum. All area code/exchange combinations that were $< 70\%$ were eliminated from the sample frame. The random digit dialling sample that was used for this project can be best characterised as a single stage EPSEM (Equal Probability Selection Method) sample of all residential telephone numbers (including listed, unlisted, and unpublished numbers) in the defined sample frame. The

Table 1 Characteristics of 1818 urban, suburban and rural adults participating in the National Walking Survey†

	Urban		Suburban		Rural		χ^2
	Lower	Higher	Lower	Higher	Lower	Higher	
Overall number (%) Missing=327	359 (24.1)	490 (32.9)	95 (6.4)	125 (8.4)	205 (13.7)	217 (14.6)	
Age (%) Missing=9							142.28**
18–29	34.4	28.8	37.9	20.8	18.5	14.4	
30–44	27.9	36.0	25.3	37.6	20.0	41.2	
45–64	17.9	26.8	18.9	30.4	38.0	33.8	
65+	19.8	8.4	17.9	11.2	23.4	10.6	
Gender (%) Missing=0							32.66**
Male	31.5	39.0	25.3	43.2	25.9	37.3	
Female	68.5	61.0	74.7	56.8	74.1	62.7	
Education (%) Missing=1							240.29**
Less than high school	27.3	8.4	14.7	4.8	36.1	11.1	
High school graduate	35.7	21.0	40.0	28.8	34.1	34.1	
Some college or tech school	24.8	34.5	29.5	22.4	22.0	31.3	
College or post graduate school	12.3	36.1	15.8	44.0	7.8	23.5	
Race (%) Missing=6							186.04**
Black	49.3	32.0	24.5	8.0	31.9	11.1	
White	30.1	50.8	58.5	79.2	55.4	79.3	
Other	20.6	17.2	17.0	12.8	12.7	9.7	
Places to exercise (%) Missing=282							
Walking, jogging trails	24.2	27.0	27.0	23.6	20.3	26.5	3.48
Neighborhood streets	74.2	69.1	59.5	66.0	63.4	51.9	29.74**
Park	39.1	37.4	24.3	20.8	13.7	20.1	58.18**
Shopping mall	44.4	39.6	41.9	28.3	34.0	28.6	18.66**
Indoor gym	21.2	25.7	16.2	20.8	16.3	21.2	9.96
Treadmill	19.2	32.4	23.0	29.2	17.0	21.2	27.27**
Other equipment	20.5	32.7	23.0	30.2	19.0	23.3	24.07*
Summary score of places							73.96**
0–1 places to exercise	28.5	25.7	36.5	31.1	43.7	40.2	
2–4 places to exercise	64.9	67.5	56.8	64.1	53.0	57.7	
5 or more places to exercise	6.6	6.8	6.7	4.8	3.3	2.1	
Personal barriers (%)							
Others discourage	6.5	4.1	–	–	5.4	–	12.08*
Self conscious about looks	14.3	10.6	7.4	15.2	13.8	10.1	7.85
Afraid of injury	11.8	5.5	6.3	4.8	9.4	4.6	17.80**
Don't have time	19.2	25.6	21.1	27.2	19.3	25.8	9.43
Too tired	18.0	18.8	18.9	21.6	12.8	21.2	7.20
No safe place	9.6	5.5	6.3	4.8	8.4	6.9	8.71
No child care	7.1	4.5	5.3	1.6	4.5	–	8.71
Bad weather	7.3	8.0	8.4	5.6	7.4	6.9	1.21
Not in good health	11.0	5.9	13.7	6.4	17.2	9.7	27.15**
No energy	11.5	8.8	14.7	12.8	11.3	12.4	5.09
Get exercise at work	26.1	23.9	26.3	25.0	16.4	28.7	14.61*
No motivation	12.9	14.5	17.9	20.8	11.9	14.7	9.58
Do not like to exercise	11.2	13.3	11.6	19.2	7.9	12.9	10.90*
Summary score of barriers							83.91*
0–2 barriers	72.6	78.0	75.6	76.4	76.5	74.7	
3–5 barriers	22.2	17.5	19.2	17.1	20.4	22.1	
6 or more barriers	5.2	4.5	5.2	6.5	3.1	3.3	
Social support (%)							
Friends encourage exercise	59.6	62.8	72.6	67.7	62.1	59.9	9.54
Relatives encourage exercise	56.6	68.0	69.5	70.4	69.1	69.6	21.84**
Have at least one friend to exercise with	69.7	74.0	75.3	76.8	70.1	71.4	7.94
Have at least one relative to exercise with	60.4	63.4	64.9	64.8	71.1	64.4	8.13

**p<0.005, *p<0.05. †Because of rounding error sums in blocks may not equal 100%.

system used a database consisting of all residential telephone exchanges, working bank information, and various geographical variables such as state, county, and zip code. Additional details of the methods are described elsewhere.³

Instrumentation and data collection

The survey instrument was developed using a combination of questions from the BRFSS, the National Health Interview Survey, and other recent surveys.^{6–14} When valid and reliable scales were documented in the literature and available, every effort was made to use these with the scale intact. Psychometric properties of the questions and scales were reported elsewhere.³ In a few cases, adaptations were made from in-person to telephone administration. The final instrument contained a total of 90 questions, with an average administration time of 30 minutes.

Questions focused on the physical environment asked if participants normally completed physical activity in a series of places: walking/jogging trails, neighbourhood streets, at work, etc. Social support questions related to friends and family took the following forms: “Your relatives/relatives encourage you to exercise. Do you:” (four point scale from strongly agree to strongly disagree). Regarding personal barriers to being more physically active, respondents were asked about a series of barriers: “I am going to read you some things that interfere or prevent you from exercising or being physically active.” For each barrier (for example, “No child care”), a five point scale from “never” to “very often” was used. All responses given on a five point scale were subsequently recoded dichotomously (“often” or “very often” = yes, “sometimes”, “rarely” or “never” = no).

Newly developed questions on physical activity behaviour focused on moderate and vigorous physical activity in the

Table 2 Multivariate analysis-logistic regression of variables on meeting of US recommendations for physical activity among all urban, suburban, and rural adults*

	Urban	Suburban	Rural
Overall percentage	55.3	56.2	49.9
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Overall effect	1.24 (1.00 to 1.55)	1.29 (0.94 to 1.76)	1.00 –
Age			
18–29 (ref)	1.00 –	1.00 –	1.00 –
30–44	0.93 (0.65 to 1.33)	0.77 (0.36 to 1.62)	0.69 (0.37 to 1.30)
45–64	0.49 (0.33 to 0.73)	0.71 (0.32 to 1.58)	0.44 (0.24 to 0.81)
65+	0.38 (0.23 to 0.61)	0.50 (0.20 to 1.26)	0.63 (0.31 to 1.28)
Gender (%)			
Female (ref)	1.00	1.00	1.00
Male	1.23 (0.92 to 1.66)	1.38 (0.75 to 2.53)	1.06 (0.69 to 1.63)
Education			
Less than high school	0.71 (0.43 to 1.16)	0.63 (0.21 to 1.90)	0.72 (0.35 to 1.47)
High school graduate	0.63 (0.42 to 0.95)	0.77 (0.38 to 1.57)	0.77 (0.41 to 1.41)
Some college or tech school	0.98 (0.66 to 1.46)	0.98 (0.45 to 2.14)	1.07 (0.56 to 2.04)
College or postgraduate (ref)	1.00	1.00	1.00
Income (\$000)			
>50 (ref)	1.00	1.00	1.00
<10	1.05 (0.61 to 1.82)	0.77 (0.30 to 1.97)	0.45 (0.20 to 0.97)
10–20	1.21 (0.73 to 2.01)	1.00 (0.42 to 2.41)	0.61 (0.31 to 1.23)
20–50	1.24 (0.80 to 1.92)	1.07 (0.49 to 2.32)	0.70 (0.37 to 1.32)
Race			
White (ref)	1.00	1.00	1.00
Black	0.64 (0.46 to 0.89)	0.72 (0.32 to 1.63)	0.86 (0.51 to 1.45)
Other	0.65 (0.43 to 0.97)	0.92 (0.41 to 2.10)	0.65 (0.34 to 1.25)
Places to exercise Missing=282			
Walking, jogging trails	1.66 (1.16 to 2.38)	2.32 (1.05 to 5.09)	1.61 (0.93 to 2.78)
Neighbourhood streets	1.32 (0.95 to 1.85)	0.95 (0.49 to 1.82)	1.56 (0.98 to 2.49)
Park	2.20 (1.58 to 3.05)	2.17 (0.96 to 4.92)	1.46 (0.80 to 2.68)
Shopping mall	0.97 (0.70 to 1.32)	0.45 (0.22 to 0.92)	0.81 (0.50 to 1.32)
Indoor gym	1.87 (1.27 to 2.77)	4.10 (1.52 to 11.08)	2.06 (1.13 to 3.75)
Treadmill	1.64 (1.15 to 2.36)	1.76 (0.83 to 3.75)	1.20 (0.68 to 2.13)
Other equipment	1.65 (1.15 to 2.35)	1.59 (0.76 to 3.33)	1.25 (0.72 to 2.16)
Summary score of places			
0 place to exercise (ref)	1.00	1.00	1.00
1 place to exercise	1.63 (0.61 to 4.32)	0.66 (0.15 to 2.82)	2.42 (0.82 to 7.16)
2 places to exercise	2.99 (1.13 to 7.90)	0.62 (0.15 to 2.58)	2.61 (0.86 to 7.87)
3 places to exercise	4.87 (1.83 to 13.01)	0.77 (0.17 to 3.52)	1.34 (0.41 to 4.34)
4 places to exercise	5.29 (1.89 to 14.79)	2.16 (0.33 to 14.09)	3.87 (1.11 to 13.43)
Personal barriers			
Others discourage	1.12 (0.58 to 2.13)	0.14 (0.02 to 1.25)	1.16 (0.39 to 3.47)
Self conscious about looks	1.29 (0.83 to 2.01)	0.72 (0.30 to 1.73)	0.78 (0.42 to 1.47)
Afraid of injury	0.72 (0.43 to 1.21)	1.13 (0.33 to 3.82)	0.59 (0.25 to 1.38)
Don't have time	0.50 (0.35 to 0.71)	0.68 (0.35 to 1.31)	0.82 (0.50 to 1.35)
Too tired	0.58 (0.40 to 0.83)	0.74 (0.37 to 1.49)	0.38 (0.22 to 0.67)
No safe place	0.60 (0.35 to 1.05)	0.72 (0.21 to 2.44)	1.17 (0.55 to 2.49)
No child care	1.04 (0.56 to 1.92)	1.05 (0.21 to 5.24)	1.10 (0.38 to 3.19)
Bad weather	0.94 (0.55 to 1.60)	0.36 (0.12 to 1.12)	1.32 (0.61 to 2.90)
Not in good health	0.59 (0.35 to 1.01)	0.69 (0.26 to 1.84)	0.42 (0.22 to 0.79)
No energy	0.47 (0.29 to 0.76)	0.73 (0.33 to 1.62)	0.34 (0.17 to 0.68)
Get exercise at work	1.16 (0.82 to 1.65)	2.27 (1.13 to 4.56)	1.53 (0.93 to 2.51)
No motivation	0.55 (0.37 to 0.83)	0.67 (0.33 to 1.34)	0.52 (0.28 to 0.95)
Do not like to exercise	0.60 (0.39 to 0.91)	0.80 (0.37 to 1.73)	0.51 (0.26 to 1.01)
Summary score of barriers			
0 barrier	1.00	1.00	1.00
1 barrier	0.66 (0.45 to 0.96)	0.95 (0.46 to 2.00)	0.82 (0.48 to 1.41)
2 barriers	0.42 (0.26 to 0.66)	1.77 (0.69 to 4.54)	0.63 (0.34 to 1.89)
3 barriers	0.38 (0.23 to 0.65)	1.15 (0.34 to 3.88)	0.72 (0.35 to 1.49)
Social support			
Friends encourage exercise	1.12 (0.84 to 1.50)	2.05 (1.11 to 3.78)	1.25 (0.83 to 1.90)
Relatives encourage exercise	0.96 (0.71 to 1.29)	2.04 (1.11 to 3.77)	0.96 (0.62 to 1.48)
Friends exercise with	1.30 (0.94 to 1.78)	2.73 (1.37 to 5.41)	1.48 (0.95 to 2.31)
Relatives exercise with	1.24 (0.92 to 1.67)	1.82 (1.00 to 3.33)	0.99 (0.65 to 1.53)

*Adjusted for age, race, education, gender, and income.

domains of occupational physical activity, time spent in non-occupational walking, moderate intensity recreational activities, and vigorous intensity recreational activities. These questions are designed to estimate compliance with new public health recommendations and have been previously tested for reliability and validity.¹⁵

Interviews were completed between September 1999 and January 2000 for 1818 men and women. Interviewers with

previous experience conducted the interviews and each underwent at least 16 hours of training. The response rate of 61% was calculated according to the method of the Council of American Survey Research Organization (CASRO) and was based on the ratio of complete interviews to the sum of the completed interviews, refusals, and a standard fraction of numbers that were working but were either ring no answer or busy after multiple attempts.

Table 3 Multivariate analysis logistic regression of environmental variables on meeting of US recommendations for physical activity among urban, suburban, and rural adults with higher and lower income levels*

	Urban		Suburban		Rural	
	Lower	Higher	Lower	Higher	Lower	Higher
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Places to exercise†						
Walking, jogging trails	1.89 (1.06 to 3.41)	1.51 (0.95 to 2.39)	4.77 (1.16 to 19.71)	1.87 (0.64 to 5.47)	1.43 (0.60 to 3.39)	1.82 (0.87 to 3.80)
Streets	0.94 (0.53 to 1.65)	1.60 (1.05 to 2.45)	1.45 (0.51 to 4.17)	0.78 (0.32 to 1.89)	2.40 (1.10 to 5.22)	1.30 (0.71 to 2.40)
Park	1.95 (1.16 to 3.27)	2.39 (1.55 to 3.69)	14.50 (2.30 to 91.37)	1.07 (0.38 to 3.00)	1.14 (0.41 to 3.15)	1.78 (0.80 to 3.95)
Mail	1.10 (0.67 to 1.79)	0.83 (0.55 to 1.27)	0.76 (0.23 to 2.53)	0.35 (0.13 to 0.93)	1.39 (0.67 to 2.88)	0.50 (0.25 to 0.99)
Indoor gym	1.37 (0.72 to 2.61)	2.28 (1.37 to 3.77)	5.38 (0.93 to 31.24)	5.01 (1.23 to 20.35)	1.73 (0.68 to 4.40)	2.46 (1.07 to 5.62)
Treadmill	1.60 (0.84 to 3.03)	1.70 (1.10 to 2.64)	4.50 (1.09 to 18.59)	0.97 (0.38 to 2.45)	1.04 (0.43 to 2.51)	1.34 (0.62 to 2.87)
Other equip	1.63 (0.87 to 3.04)	1.66 (1.07 to 2.57)	4.50 (1.09 to 18.59)	0.86 (0.34 to 2.15)	1.23 (0.53 to 2.86)	1.30 (0.62 to 2.71)
Sum of places						
0 places (ref)	1.00 –	1.00 –	1.00 –	1.00 –	1.00	1.00
1 place	3.14 (0.57 to 17.43)	1.14 (0.32 to 4.04)	0.52 (0.06 to 4.72)	–	2.68 (0.60 to 11.91)	2.41 (0.46 to 12.62)
2 places	6.34 (1.15 to 34.90)	2.11 (0.60 to 7.42)	1.78 (0.20 to 15.93)	–	4.69 (0.97 to 22.66)	2.07 (0.39 to 10.97)
3 places	8.69 (1.51 to 50.09)	3.87 (1.10 to 13.60)	5.25 (0.54 to 51.20)	–	0.92 (0.16 to 5.24)	1.68 (0.29 to 9.64)
4 places	5.76 (0.97 to 34.13)	5.63 (1.47 to 21.49)	10.98 (0.60 to 201.74)	–	3.01 (0.56 to 16.60)	6.58 (0.92 to 47.27)

*Adjusted for age, race, education, and gender. †Reference is having no place to exercise.

Analyses

Data on physical activity behaviour were cleaned and edited following standard quality control procedures. Physical activity behaviour was grouped into one of three categories for the relations examined in the paper: (1) meets public health recommendations (2) insufficient activity, and (3) inactive. These algorithms are modified from those developed by the CDC for recent populations based surveys, which are discussed elsewhere.³

Respondent's residence was grouped into three categories based on census data. The census categories were urban, suburban, and rural. To allow comparability of data on the socio-economic influence on physical activity to other national studies similar household income groupings were used (less than \$20 000 per year and \$20 000 or more per year).³ For analyses, a composite urban/rural-household income variable was created consisting of two income levels for each type of residence (urban—low and high income, suburban—low and high income, and rural—low and high income) for a total of six possible strata.

Multivariate adjusted odds ratios (aOR) and 95% confidence intervals (CI) were calculated to compare meeting of recommendations for physical activity among the six urban/rural income categories. In developing logistic regression models based on multiple potential confounders, independent correlates were added to the model if they had been consistently shown to be significant predictors of physical activity in ours and other national studies. The variables selected in the final modelling included age, gender, race/ethnicity, household income, and education level. For logistic regression analyses, physical activity behaviour was dichotomised to meeting public health recommendations compared with insufficient activity or inactivity.

Differences between low and high income urban, suburban and rural participants were tested with χ^2 for all variables. Separate logistic regression analyses were conducted for each residence area and income level to assess associations between independent variables and meeting of recommendations for physical activity. All regression models were adjusted for age, gender, education, and race.

RESULTS

As shown in table 1, over 50% of study participants resided in urban areas. Women were more highly represented across all residence areas and income levels. All groups were predominantly white except for urban, low income residents. Low income participants were less educated (high school or less) in all residence areas. Most high income participants had some college or more education in urban and suburban areas. Most rural area high income participants had either a high school education or some college.

Overall, rural residents were the least likely to meet recommendations; suburban residents were the most likely to meet recommendations (table 2). There were differences in the importance of places to exercise on physical activity between urban-rural groups. There were also notable differences across urban-rural areas in the summary scores of places to exercise. Differences across urban-rural areas were found for certain personal barriers as well as the summary scores of total barriers. The only significant difference in social support variables was in participants reporting that their relatives encouraged them to exercise.

As seen in table 3, there were several interesting relations among the environmental variables. Among urban, lower income participants access to walking/jogging trails (OR=1.89) and parks (OR=1.95) were associated with increased physical activity. Urban, higher income participants with access to parks (OR=2.39) were more likely to meet recommendations. Other important environmental variables for urban, high income residents were indoor gyms, treadmills,

Table 4 Multivariate analysis logistic regression of personal barriers and social support variables on meeting of US recommendations for physical activity among urban, suburban, and rural adults with higher and lower income levels*

	Urban		Suburban		Rural	
	Lower	Higher	Lower	Higher	Lower	Higher
	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)	Odds ratio (95% CI)
Personal barriers†						
Others discourage	1.06 (0.43 to 2.61)	1.22 (0.46 to 3.25)	--	0.22 (0.02 to 3.26)	1.46 (0.39 to 5.50)	0.83 (0.11 to 6.31)
Self conscious about looks	1.36 (0.72 to 2.59)	1.24 (0.66 to 2.32)	2.42 (0.37 to 15.78)	0.58 (0.20 to 1.66)	1.35 (0.58 to 3.14)	0.39 (0.15 to 1.02)
Afraid of injury	0.58 (0.29 to 1.17)	0.92 (0.41 to 2.09)	0.87 (0.14 to 5.52)	1.28 (0.20 to 8.33)	0.85 (0.31 to 2.38)	0.24 (0.05 to 1.21)
Don't have time	0.71 (0.40 to 1.26)	0.42 (0.27 to 0.66)	0.89 (0.28 to 2.80)	0.54 (0.23 to 1.25)	1.89 (0.89 to 4.03)	0.47 (0.24 to 0.91)
Too tired	1.19 (0.67 to 2.12)	0.34 (0.21 to 0.56)	0.73 (0.21 to 2.56)	0.65 (0.26 to 1.62)	0.41 (0.16 to 1.07)	0.38 (0.19 to 0.77)
No safe place	0.75 (0.35 to 1.59)	0.48 (0.21 to 1.10)	0.60 (0.09 to 4.03)	0.53 (0.10 to 2.93)	0.87 (0.31 to 2.54)	1.53 (0.49 to 4.78)
No child care	0.67 (0.28 to 1.60)	1.72 (0.64 to 4.58)	1.08 (0.13 to 8.85)	0.82 (0.04 to 16.27)	1.03 (0.26 to 4.11)	1.45 (0.25 to 8.40)
Bad weather	1.09 (0.46 to 2.59)	0.86 (0.43 to 1.71)	0.57 (0.11 to 2.93)	0.18 (0.03 to 1.03)	1.69 (0.56 to 5.13)	0.93 (0.31 to 2.79)
Not in good health	0.70 (0.34 to 1.45)	0.47 (0.21 to 1.06)	0.53 (0.13 to 2.08)	0.92 (0.17 to 4.87)	0.54 (0.24 to 1.22)	0.28 (0.10 to 0.85)
No energy	0.79 (0.40 to 1.57)	0.29 (0.14 to 0.58)	0.64 (0.18 to 2.25)	0.72 (0.23 to 2.20)	0.66 (0.26 to 1.71)	0.20 (0.07 to 0.54)
Get exercise at work	1.44 (0.84 to 2.47)	1.00 (0.63 to 1.58)	2.37 (0.81 to 6.93)	2.05 (0.79 to 5.32)	1.38 (0.61 to 3.11)	1.69 (0.89 to 3.22)
No motivation	1.42 (0.73 to 2.75)	0.29 (0.17 to 0.51)	0.64 (0.20 to 2.10)	0.62 (0.25 to 1.54)	0.72 (0.28 to 1.83)	0.45 (0.20 to 1.00)
Do not like to exercise	1.06 (0.53 to 2.13)	0.38 (0.22 to 0.67)	0.92 (0.22 to 3.91)	0.87 (0.34 to 2.22)	1.04 (0.35 to 3.14)	0.30 (0.12 to 0.74)
Sum of barriers						
0 barriers (ref)	1.00 --	1.00	1.00	1.00	1.00	1.00
1 barriers	0.62 (0.34 to 1.14)	0.66 (0.40 to 1.10)	0.40 (0.11 to 1.47)	1.48 (0.52 to 4.21)	1.30 (0.59 to 2.89)	0.52 (0.24 to 1.1)
2 barriers	0.72 (0.34 to 1.51)	0.30 (0.17 to 0.55)	4.13 (0.87 to 19.48)	1.04 (0.30 to 3.66)	1.20 (0.49 to 2.94)	0.35 (0.14 to 0.8)
3 barriers	0.46 (0.22 to 0.99)	0.34 (0.16 to 0.72)	1.38 (0.25 to 7.69)	1.68 (0.24 to 12.03)	1.37 (0.51 to 3.70)	0.31 (0.11 to 0.8)
4 barriers	0.42 (0.13 to 1.37)	0.29 (0.13 to 0.65)	0.47 (0.08 to 2.76)	0.42 (0.11 to 1.66)	0.34 (0.07 to 1.77)	0.51 (0.17 to 1.55)
Social support						
Friends encourage exercise	1.14 (0.73 to 1.79)	1.13 (0.77 to 1.67)	2.72 (0.97 to 7.64)	1.62 (0.72 to 3.66)	1.34 (0.73 to 2.46)	1.20 (0.67 to 2.1)
Friends exercise with	1.83 (1.12 to 2.99)	1.00 (0.65 to 1.55)	4.39 (1.32 to 14.56)	1.99 (0.81 to 4.87)	1.16 (0.61 to 2.19)	1.96 (1.05 to 3.6)
Relatives encourage exercise	1.19 (0.76 to 1.86)	0.79 (0.52 to 1.18)	1.41 (0.53 to 3.75)	2.33 (1.03 to 5.28)	1.47 (0.78 to 2.77)	0.68 (0.37 to 1.2)
Relatives exercise with	1.03 (0.65 to 1.63)	1.39 (0.93 to 2.06)	1.92 (0.72 to 5.12)	1.90 (0.83 to 4.35)	1.07 (0.57 to 2.01)	1.00 (0.55 to 1.80)

*Adjusted for age, race, education, and gender. †Reference is reporting no personal barriers.

and other exercise equipment. Suburban, lower income participants with access to walking/jogging trails (OR=4.77), parks (OR= 14.50), treadmills, or other exercise equipment (OR=4.50). Were more likely to meet physical activity recommendations. Suburban, higher income participants with access to malls (OR=0.35) and indoor gyms (OR=5.01) were more physically active. Rural lower income participants reporting neighbourhood streets (OR=2.40) as a place to exercise were more active. For rural higher income participants, the only significant environmental variable was access to an indoor gym (OR=2.46).

A trend emerged in the summary scores of places to exercise among all six groups. Though the trend was most notable in urban participants, there was an increase in likelihood to meet physical activity recommendations with an increase in the number of places available for exercise. For urban lower income participants, the odds ratios were 1.14, 2.11, 3.87, and 5.63 respectively for having one, two, three, or four places to exercise. For urban higher income residents, the odds ratios were 3.14, 6.34, and 8.69 respectively for having one, two, or three places to exercise.

Fewer significant relations emerged among personal barrier and social support variables when stratified by geographical region and income level (table 4). Significant relations among personal barriers were found only for urban and rural higher income participants. There were no clear cut trends in the summary scores of personal barriers. The most significant relations were found in urban and rural higher income participants. In general, report of receiving social support seemed important in increasing likelihood to meet recommendations. For urban, lower income and rural higher income participants having at least one friend to exercise with nearly doubled (OR 1.83 and 1.96, respectively) the likelihood of meeting recommendations. Among suburban lower income participants, having at least one friend to exercise with increased this likelihood by over four times (OR 4.39). Receiving encouragement from relatives to be physically active increased likelihood (OR 2.33) of meeting recommendations for suburban higher income residents only.

DISCUSSION

This study analysed the correlates of physical activity among US adults of varying income levels and areas of residence. Results of our analyses confirm the status of perceived barriers, social support, and environmental characteristics as correlates of physical activity for adults overall. In addition, it was shown that many statistically significant relations between these factors and physical activity may be missed when both urban-rural gradient and income level are not used as stratifying factors. These data confirm that income level is as important if not more important than area of residence in analysing individual's physical activity levels.

Our results coincided with those of other national cross sectional studies³⁻⁵ in showing decreased levels of physical activity for rural and urban residents as well as lower income in comparison with suburban and higher income residents. In each area of residence lower income residents were less likely to meet recommendations. Rural residents were the least physically active; suburban residents were the most active with more than a twofold increase in likelihood to meet recommendations from the rural lower income to suburban, higher income residents.

There are differences in the physical environments of the six different groups of residents surveyed in this study. It has been suggested that attributes of the physical environment directly impact participation in physical activity.^{16 17} In our study, several significant environment related differences emerged. Urban, lower income residents were more likely to report using neighbourhood streets, parks, and malls as places to exercise but access to a number of places to exercise was only

Key points

- Lower income residents were less likely than higher income residents to meet physical activity recommendations.
- Rural residents were least likely to meet recommendations; suburban residents were most likely to meet recommendations.
- Suburban, higher income residents were more than twice as likely to meet recommendations than rural, lower income residents.
- Significant differences across income levels and urban/rural areas were found for those with certain places to exercise, certain barriers to exercise, and those reporting social support for exercise.
- Evidence of a positive dose-response relation emerged between number of places to exercise and likelihood to meet recommendations for physical activity.

related to increased physical activity for urban, higher income and suburban, lower income participants. Evidence of a significant dose-response relation that has not been documented elsewhere in the literature emerged in our analyses. Among urban, higher income residents each additional place available doubled the likelihood to meet recommendations.

Adults who experience higher numbers of personal barriers such as lack of time or lack of energy are known to be less active. Our results confirm that barriers are experienced differently by different segments of the population. Lower income residents from urban or rural areas were more likely than others to report poor health or fear of injury as barriers to physical activity. Interestingly enough, dislike of exercise was most prevalent among suburban, higher income residents (who were most likely to meet recommendations for physical activity). Evidence of a dose-response relation emerged among these personal barriers as well. For all urban residents each additional barrier reported resulted in an incremental decrease in the likelihood to meet physical activity recommendations.

Social support is often noted as an important predictor of physical activity. Here it is shown that the source of support is predictive of the impact on physical activity. Social support from friends was significantly related to activity for lower income residents from urban and suburban areas as well as rural, higher income residents. Receipt of support from relatives was only significant for suburban, higher income participants who may be more self efficacious for physical activity regardless of support.

One possible explanation for some of the key results of our analyses is that there may be interaction effects particularly between social support and environmental factors. The degree of interaction may vary between urban, suburban, and rural areas as much as the environmental characteristics themselves. In addition, the social characteristics may be inherently different between geographic areas. These possibilities must be investigated further.

There are several limitations to this study. Firstly, all data were obtained from a self reported telephone survey (CASRO response rate 61%). There are several inherent limitations of this type of survey including under-representation of low income residents, and non-objective measurement of items. To tackle the possibility of under-representation of lower SES segments of the population we over-sampled lower income zip codes. Though most physical activity behaviour questions on our survey were taken directly from the BRFSS some items, particularly the perceived access to walking trails and indoor exercise facilities, have not been systematically examined for validity and reliability. However, tested scales were used whenever possible. These environmental variables in particular are subject to bias due to self report. Perception of environmental characteristics may differ greatly between those who

are active and those who are not. Though we were not able to do so in this study, measures should ideally be taken to assess actual environmental characteristics in comparison to what is reported. A third limitation was that the survey was conducted only in English. Therefore, all non-English speaking residents were excluded from the survey including Asian and Latino populations. As this was a cross sectional survey no causal relations can be inferred from the data because of the inability to determine temporal sequence. A final limitation is that there may be inherent differences between people who agreed to participate in the study and those who did not. If these differences were associated with physical activity, they may have biased the results in either direction. Despite these limitations, this study provides national, population based data on a variety of physical activity correlates in six different segments of the US population.

To date, few studies have examined correlates of physical activity across residential areas and income levels simultaneously. Our data suggest important patterns in determinants of physical activity across populations that should help inform future interventions. For example, a community based intervention in an urban, lower income area may focus on increasing accessibility and safety of neighbourhood streets and parks while incorporating social support from friends. While we have shown that access to more places to exercise is likely to increase participation in physical activity it is also important to take into account the setting in which those places are offered. An exercise intervention focused on the use of home equipment or indoor gym attendance may not be appropriate for lower income residents. Likewise a programme to increase availability of outdoor walking/jogging trails, which are popular in suburban or rural areas, may not be as important in an urban area where indoor shopping malls are present. These examples imply the appropriateness of a tailored approach in development of interventions for different strata of the population. In summary, future studies, particularly longitudinal designs, are needed to determine how well the differences that exist among different population segments determine the adoption and/or maintenance of physical activity and the extent to which the dose-response effects seen here impact behaviour change over time.

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