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Predicting Outdoor Recreation Area Use in a Southeastern US County: A Signal Detection Analysis

Danielle E. Schoffman[1], **Sara Wilcox**[2,3], **Andrew T. Kaczynski**[1,3], **Stephanie Child**[1], **Daheia J. Barr-Anderson**[3,4], **Patricia A. Sharpe**[2,3], and **Melinda Forthofer**[3,4]

[1]Department of Health Promotion, Education, and Behavior, Arnold School of Public Health, University of South Carolina, Columbia, SC 29208, USA

[2]Department of Exercise Science, Arnold School of Public Health, University of South Carolina, Columbia, SC 29208, USA

[3]Prevention Research Center, Arnold School of Public Health, University of South Carolina, Columbia, SC 29208, USA

[4]Department of Epidemiology and Biostatistics, Arnold School of Public Health, University of South Carolina, Columbia, SC 29208, USA

Abstract

BACKGROUND: Use of outdoor recreation areas is correlated with physical activity in community-dwelling adults. Additionally, the wide spread availability of outdoor recreation areas, including their placement in disadvantaged neighborhoods, make them an especially promising venue through which to promote physical activity. The purpose of this study was to examine the combination of individual-level factors associated with outdoor recreation area use in a socioeconomically diverse Southeastern U.S. county.

METHODS: A 2011 random digit-dial survey included 829 adults aged 18+ years with complete data; questions assessed physical activity level and use/perceived safety of outdoor recreation areas. Signal detection analysis, a non-parametric recursive partitioning technique, identified cutpoints for defining subgroups of respondents based on outdoor recreation area use.

Address correspondence to Dr. Sara Wilcox, Public Health Research Center, 1st Floor, 921 Assembly Street, Columbia, SC 29208. wilcoxs@mailbox.sc.edu.

Author Contact Information

Danielle E. Schoffman, BA, Department of Health Promotion, Education & Behavior, Arnold School of Public Health, University of South Carolina, 921 Assembly Street, PHRC 1St Floor, Columbia, SC 29208, schoffmd@email.sc.edu

Sara Wilcox, PhD, Department of Exercise Science; Prevention Research Center, Arnold School of Public Health, University of South Carolina, 921 Assembly Street, PHRC 1St Floor, Columbia, SC 29208, Phone: (803) 777-8141, Fax: (803) 777-9007, Email: swilcox@sc.edu

Andrew T. Kaczynski, PhD, Department of Health Promotion, Education & Behavior, Arnold School of Public Health, University of South Carolina, Discovery I, 915 Greene Street, Room 529, Columbia, SC 29208, atkaczyn@mailbox.sc.edu

Stephanie Child, MPH, Department of Health Promotion, Education & Behavior, Arnold School of Public Health, University of South Carolina, Discovery I, 915 Greene Street, Room 529, Columbia, SC 29208, childst@email.sc.edu

Daheia J. Barr-Anderson, PhD, Department of Epidemiology and Biostatistics, Arnold School of Public Health, University of South Carolina, Discovery I, 915 Greene Street, Room 529, Columbia, SC 29208, dbarrand@mailbox.sc.edu

Patricia A. Sharpe, PhD MPH, Department of Exercise Science, Arnold School of Public Health, University of South Carolina, 921 Assembly Street, PHRC 1St Floor, Columbia, SC 29208, sharpep@mailbox.sc.edu

Melinda Forthofer, PhD, Department of Epidemiology and Biostatistics , Arnold School of Public Health, University of South Carolina, Discovery I, 915 Greene Street, Room 529, Columbia, SC 29208, forthofer@sc.edu

RESULTS: Seven subgroups were defined ranging from 77.2% outdoor recreation area use (younger, met physical activity recommendations) to 31.8% outdoor recreation area use (older, perceived outdoor recreation areas to be less safe). Signal detection did not identify gender or race as important for defining subgroups.

CONCLUSIONS: Results suggest that gendered and ethnically-focused outdoor recreation area promotion campaigns might be unnecessary. Instead, efforts could focus on increasing awareness of outdoor recreation area facilities among older, less active adults.

Keywords

physical activity; outdoor recreation area; parks; survey research; signal detection

BACKGROUND:

The health benefits of physical activity (PA) are well established and supported by extensive observational and clinical trial evidence.(1–4) PA is a recommended behavioral strategy for preventing and controlling many chronic diseases, including diabetes, cardiovascular disease, and cancer,(5–8) and expert recommendations have been set to encourage people to engage in the minimum amount of activity to acquire the associated health benefits of PA.(9) However, self-reported estimates from the 2007 Behavioral Risk Factor Surveillance System (BRFSS) show that only 48.8% of adults meet the minimum recommendation of PA in a typical week.(10) Concerned with the low levels of PA in the US population, the Healthy People 2020 report calls for increased PA for all age groups, and underscores the importance of environmental supports for PA (e.g., sidewalks, bike lanes, trails, parks).(11)

Availability and quality of outdoor recreation areas, such as parks and green spaces are correlates of PA in community-dwelling adults.(12, 13) Parks can serve as important areas for gatherings of families, sports and recreation for children, and safe spaces for adults to utilize walking tracks.(14–16) A growing body of evidence demonstrates that the presence of parks, quality of park equipment, ease of access to parks, and perceived safety of parks are strong predictors of park use.(17–19) Parks offer convenient community locations for PA, and are associated with leisure-time PA in adults.(20, 21) Additionally, a recent review found exercising outdoors (versus indoors) to be associated with a range of emotional benefits such as decreased tension and depression and increased energy.(22)

Outdoor recreation areas are a prime target for public health attention as they are located in a broad range of neighborhoods throughout the US, offering access to PA resources for residents of all races/ethnicities and socioeconomic levels.(23) An analysis of the distribution of neighborhood-level PA resources in a diverse sample of neighborhoods found that while there was a higher density of recreations facilities (such as gyms) in White, high socioeconomic status neighborhoods, there was a fairly equitable distribution of parks across neighborhoods.(23)

Leaders from PA promotion groups such as Active Living Research are champions for the advancement of outdoor recreation areas to increase community-level PA, and suggest steps to achieve this goal beginning with work to make parks available, upgrade their features and

safety, and finally promote their use.(24, 25) Additionally, there is support at the level of the US federal government to outdoor recreation areas and the integration of human, environmental, and ecological health, including a current campaign by The National Park Service (NPS), a division of the US Department of the Interior.(26) Through the 2011 NPS Healthy Parks Healthy People Strategic Action Plan, the initiative, the NPS works with organizations across the country at all levels (local, state, and national) as well as experts from business, healthcare, science, and the nonprofit sector, to create a network for engaging the public in a using outdoor recreation areas for health improvement.(26) The NPS is committed to promoting health in a wide sense (physical, mental, spiritual) as well as social well being, all through linking people with nature, both within and beyond parks.(26)

Despite the growing evidence about the benefits of outdoor recreation area use and the availability of these spaces across a range of neighborhoods, less is known about individual-level factors that predict outdoor recreation area use within a community with a variety of parks and trails available for use. (12, 13, 22) Targeted campaigns to raise awareness for parks and other outdoor recreation areas as well as interventions directed at low users of these resources could help to increase use and ultimately PA in adults.(21) Factors associated with lower PA levels include older age, gender (female), overweight/obesity, low socioeconomic status, and low education (e.g., did not complete high school).(27, 28) Targeted campaigns might be an effective means to encourage increased PA in generally sedentary populations,(29, 30) and highlighting outdoor recreation areas that are free and open to the public may increase awareness of avenues for being active regardless of financial status. Thus, it would be helpful to understand more about the individual-level correlates of outdoor recreation area use among a diverse group of community-dwelling adults.

Although the impact of environmental interventions on individual behavior has received increased study, several limitations in this literature exist, including the lack of diversity of participants.(31) A report by the President's Council on Physical Fitness and Sports recommends that research into park use and active transport needs to focus on more diverse groups of people, including older adults and racial/ethnic minorities.(31)

The purpose of our study was to examine behavioral, attitudinal, sociodemographic, and health-related correlates of outdoor recreation area use in a county in the Southeastern US, representing a diverse area in terms of land use (rural and urban) as well as socioeconomic status and race. Using signal detection analysis, a novel method of analyzing data on outdoor recreation area use, we aimed to explain higher-order relationships between predictors of outdoor recreation area use for PA, and to identify subgroups of potential priority populations for future outdoor recreation area use campaigns.

METHODS:

Participants and Procedures

A dual sample random digit-dialed survey was conducted in 2011 (main survey period from May 9 to June 21) in a South Carolina county, with 1010 non-institutionalized adults age 18 years and older. The sample was taken from a random sample of landline telephone numbers (n=2,952) in the county and cell phone numbers (n=1,295) randomly selected from a list of

cell phone numbers in the county. All phone numbers were provided by Survey Sampling, Inc.; interviews were conducted by the University of South Carolina Institute for Public Service and Policy Research. This research was approved by the Institutional Review Board at the University of South Carolina, registration number: 00000240.

For the landline sample, interviewers first determined whether a private residence was reached, then randomly selected a respondent (≥ 18 years old) from the household's occupants. No proxy interviews were accepted. For the cell phone sample, the interviewer confirmed that the number called was a cell phone, the respondent lived in the targeted county, the person was at least 18 years old, and the person did not have a landline in their household (those people reached by cell phone who also had landlines were ineligible).

Multiple attempts were made to reach someone at numbers that were unanswered. The initial calls were made on a weekday evening. At least ten attempts were made to unanswered numbers. Subsequent callbacks were made so that each number received at least one call in the morning, the early afternoon, the late afternoon, the early evening, the late evening and on Saturday and Sunday. Since the survey was primarily about respondents' knowledge of and use of PA resources in the county, the interview began with a brief screening to ensure that individuals were able to perform PA. They were first asked if they were completely physically able, partially physically able, or physically unable to do activities such as exercise, recreation, sports, work around the house such as gardening, or simply going for a walk at a moderate pace. Those who answered "physically unable" were then asked, "Can you get out of the house by yourself to go for a walk?" Those who answered "no" to this question were ineligible to participate in this study. In the landline component of this study, a total of 865 completed interviews (29.3%) were conducted, while the cell phone component consisted of 145 completed interviews and one partial completion (11.2%). Within the completed interviews, a few participants had missing data for specific items; only participants with complete data for all variables of interest were used in the final analysis (n=829).

Measures

Dependent variable

Use of outdoor recreational areas.: Participants were asked to report the number of days in a typical month that they "use an outdoor area with a public trail, track, pathway or mapped out route in [specified] County for any type of physical activity," and then they were also asked to report the number of days in a typical month that they "use any other public park or other outdoor recreation areas in [specified] County for any type of physical activity." A dichotomous variable was created for each participant, indicating whether they had used *any* outdoor recreation area in the past month (≥1 day), and this variable was used as the dependent variable in the analyses.

Independent variables

Perceptions of local outdoor recreational areas and supports for PA.: Awareness of local trails and parks was measured by single-item indicators that have been used in previous studies by the research team.(32) Single item measures of perceptions of the physical

environment by self-report have been shown to be at least moderately valid.(33) Participants were asked if they hear a lot about places to be physically active in their county (4-point Likert scale from strongly agree to strongly disagree); whether there are adequate parks, trails, and recreational areas in the county (yes or no); and how safe they feel participating in PA within local outdoor recreation areas (4-point Likert scale from very safe to very unsafe). Participants were also asked if they had ever heard of a community-based organization that works to promote PA in the county (yes or no).

Physical Activity.: PA was assessed with the moderate and vigorous PA questions of the 2001 version of the Behavioral Risk Factor Surveillance System (BRFSS) PA module which has been shown to be reliable and valid.(34)

Using 3 questions, the BRFSS PA module asked respondents whether in a usual week they participated in moderate activities for at least 10 min at a time, and if so, the number of days and total time per day spent in these activities. The same questions were repeated to assess vigorous activities. For both moderate and vigorous activities, examples were provided to participants. Consistent with current PA recommendations,(35) we weighted vigorous-intensity PA minutes by two and summed them with the moderate-intensity PA minutes to get total weighted minutes during a usual week. Participants were then classified into one of three groups: 1) regularly active—accrued at least 150 weighted minutes; 2) irregularly active—participated in at least 10 minutes of moderate- or vigorous-intensity PA but less than 150 weighted minutes; or 3) inactive—participated in no physical activities for more than 10 minutes.

Demographics and Health Status.: Respondents were asked to report their age, race, gender, highest grade completed, and height and weight. Body mass index was calculated as kg/m^2, and weight status was defined using standard procedures and cut points.(36) Information on the participant household was used for descriptive purposes, including marital status as well as how many children under the age of 18 years old lived in their household.

Statistical Analysis

Basic descriptive statistics were used to examine the characteristics of the entire sample, as well as to describe the characteristics of each of the subgroups identified by the signal detection using SAS version 9.2 (SAS Institute, Cary, NC, USA).

To define subgroups of individuals with similar likelihood of using outdoor recreation areas, we used signal detection analysis; ROC version 4.19.(37) Signal detection is an empirically-driven nonparametric recursive partitioning technique that divides subgroups of people based on likelihood of achieving a binary outcome.(38) The partitioning process creates a series of and/or rules using the predictor variables, identifying subgroups of individuals who are more or less likely to meet a binary outcome, outdoor recreation area use in the present analysis.(38, 39) For each predictor variable, the signal detection determines the most efficient cutpoint at which to divide the pool of participants into subgroups based upon the specified outcome.(39) We chose *a priori* to weight false positives and false negatives equally as there was no precedent to do otherwise for this research area. Signal detection

uses empirically driven stopping points, continuing only as long as there are at least 10 individuals in a subgroup and a specified significance level (defined here as $p \leq 0.05$) is maintained for a 2 × 2 chi-square test.(38)

A strength of signal detection is its ability to detect high-order interactions in a systematic way, eliminating the need for investigators to hunt for interaction terms (as would be necessary in regression).(39) The technique also allows for the identification of subgroups that are identical on predictor and outcome variables, making it a powerful tool in exploratory data analysis for developing tailored interventions. Signal detection can also be used descriptively to examine the factors associated with success at achieving a particular outcome or with implementing a behavior.(39) Once the subgroups have been defined by the signal detection analysis, descriptive profiles are run for each of the subgroups to further describe the characteristics of the individuals in that group.

In the present analysis, signal detection was used to examine factors associated with our dichotomized outcome variable that captured whether an individual used any of the following in a typical month for PA: outdoor areas with a trail/track/pathway, public parks, or other outdoor recreation areas.

RESULTS:

Table 1 (first column) presents the demographic, health status, PA level, and park use and awareness data for all participants (N=829). Participants ranged in age from 18 to 99, with a mean age of 51.2±19.0 years. Respondents were mainly female (62.9%), Non-Hispanic (97.4%), and White (55.9%) or African American (41.7%); 27.6% of respondents were college graduates. The mean BMI was 28.5±6.2 kg/m^2, and similar to the overall prevalence in the U.S. population, 33.1% of respondents were obese.(40) Overall, most participants reported engaging in some PA—88.3% of respondents indicated that they do moderate PA for at least 10 minutes at a time at least once a week during a usual week (e.g., brisk walking, bicycling, vacuuming, gardening), though only 54.9% of respondents met PA recommendations.

The signal detection analysis identified seven subgroups of respondents with distinct rates of outdoor recreation area use, which are pictured in Figure 1. Overall, 53.6% of respondents reported having used an outdoor recreation area in the past 30 days; across the seven subgroups, outdoor recreation area use ranged from a low of 31.8% to a high of 77.2.4%. The dependent variable, independent variables, and descriptive variables for the seven subgroups are shown in Table 1.

Subgroups 1, 2, and *4* had the lowest percentages of outdoor recreation area use (range 31.8–38.7%). *Subgroup 1* was the largest of the subgroups (n=239) and had the lowest level of outdoor recreation area use (31.8%). Respondents in this group were older than 55 years (mean age of 69 ± 11.8 years) and reported low perceived safety of outdoor recreation areas (0.0% selected “very safe”). They tended to be female (69.9%), White (63.6%), overweight (mean BMI of 28.5 ± 6.3 kg/m^2), married or living with a steady partner (54.2%), and very few had children living in their household (8.4%). *Subgroup 2* had low outdoor recreation

area use (38.7%). Unlike *Subgroup 1*, characterized by older age and lower safety, participants in *Subgroup 2* reported high perceived safety of outdoor recreation areas, and being over the age of 66 years (mean age of 77 ± 7.6 years). They also tended to be men (59.5%), White (59.7%), were well informed about parks (90.3%), and very few had children living in their household (3.2%). *Subgroup 4* had low outdoor recreation area use (37.5%). These participants were <55 years of age (mean age of 40±10.0 years), reported that they did not hear a lot about places to be active, and had a BMI ≥ 27.5 (mean BMI of 33.5 ± 5.5 kg/m^2). Many in this subgroup met PA recommendations (81.3%), and this subgroup had the highest percentage of households with a child in the household (54.7%), 45.3% of them were married.

Subgroups 3, 5, and *6* had more outdoor recreation area use (range 55.3%−64.2%) than the previous groups. *Subgroup 3* had the most outdoor recreation area use of the older (≥ 55 years) groups (64.2%), and they reported high perceived safety of outdoor recreation areas. *Subgroup 5* had moderate outdoor recreation area use (61.3%) and the subgroup was defined by age < 55 years (mean age of 36 ± 11.7 years), a BMI < 27.5 (mean BMI of 24.0 ± 2.4 kg/m^2), and their reports of not hearing a lot about parks. This subgroup also reported lower perceived safety (17.5%), had the most people who lived with a spouse or serious partner (56.3%), and many had children living at home (43.8%). *Subgroup 6* also had moderate outdoor recreation area use (55.3%) and were defined by age < 55 years (mean age 38 ± 11.6 years), reporting hearing a lot about parks, and not meeting PA recommendations. Many in this subgroup were also female (76.5%) and non-White (54.1%), and there were many married/serious partner households (50.6%) and households with children (44.7%).

Subgroup 7 had the highest percentage of outdoor recreation area users (77.2%). This group was defined by age < 55 years (mean age of 38 ± 11.1 years), reporting hearing a lot about parks, and meeting PA recommendations. They were also mostly White (57.7%), although they had the highest percentage of Hispanic respondents (5.3%). They tended to be female (56.5%), married or living with a partner (53.1%), and many had children < 18 years old (49.2%).

DISCUSSION:

Signal detection analyses identified meaningful subgroups that differed in their use of outdoor recreation areas, such that a group of younger, physically active adults who had heard of parks in the area had the highest use of the outdoor areas. Older adults (≥ 55 years old) had lower outdoor recreation area use, especially those with a lower perception of the safety of outdoor recreation areas. While some surveys of park usage have shown that older adults are the least likely group to use parks,(41) other research has shown that older adults are very likely to be active when their neighborhood facilitates activity.(42) Thus, the results of the signal detection indicate that park and other outdoor recreation area awareness campaigns and group events for older adults, where they can exercise together and increase their perceived safety at parks and trails, might be an effective way to engage this population.

As mentioned above, the group of people most likely to use outdoor recreation areas were younger, had heard a lot about parks, and were physically active (meeting recommendations). Adults in this group may not be the priority population for PA interventions, as they are already active, but our results suggest that these individuals are making use of the PA resources in their communities. Future research could also examine more about the location of PA in order to better understand how much these individuals are actually using outdoor recreation areas for their PA routines.

Signal detection was also able to discern more complicated higher order relationships than would have been possible in a regression model. For example, the signal detection showed that perceived safety in outdoor recreation areas operated differently for different groups. The younger respondents, who also tended to use more outdoor recreation areas, reported lower perceived safety, with only 17.5–33.7% of respondents in *Subgroups 5–7* reporting high perceived safety. However, in the older respondents (*Subgroups 1–3*), perceived safety was an important defining criterion, where those respondents in *Subgroup 3* had higher perceived safety in outdoor recreation areas as well as more outdoor recreation area use as compared to *Subgroup 1.*

Consistent with the community PA promotion literature(43) and recent research,(44) greater awareness of places to be active, like parks, emerged as an important predictor of outdoor recreation area use. For younger respondents, hearing about parks was also related to greater use of outdoor recreation areas. This finding indicates that future park promotion efforts might successfully increase park usage by increasing knowledge of parks, especially in younger community members (<55 years).

Interestingly, the signal detection analysis did not identify race, gender, or education level as important determinants of outdoor recreation area use. In general, White men tend to be the most active subgroup of adults, with women and racial/ethnic minority groups reporting lower levels of overall PA.(28) In the case of outdoor recreation area, it is worth noting that age, park awareness, and perceived outdoor recreation area safety were more important than the traditional demographic correlates of PA; this suggests that perhaps outdoor recreation area promotion efforts might be best served by targeting a general adult audience, with less emphasis on cultural or gender tailoring. Additionally, this supports the evidence that parks are widely available and present a somewhat universal method through which to promote PA regardless of the racial/ethnic or socioeconomic composition of the neighborhood.

BMI also played a relatively small role in the differentiation of subgroups, only emerging as a third-order variable for one subgroup. While estimates from the BRFSS indicate that adults of higher BMIs tend to have correspondingly lower levels of PA(45) and are more likely to report engaging in no PA in the past 30 days (33.0% of obese respondents vs. 21.4% of normal/underweight respondents),(45) some research indicates that BMI might play a larger role in the PA of obese adults as compared to normal weight adults.(46) *Subgroup 4* had the highest mean BMI (33.5 ± 5.5 kg/m^2), had low outdoor recreation area use (37.5%), and had the highest percentage of respondents with children <18 years in the household (54.7%). A recent study used GPS to track the joint PA of parent-child dyads and found that obese dyads did less PA together in open spaces such as outdoor recreation areas than did under/normal

weight dyads.(47) Thus, while the results of the signal detection indicate that although BMI might have played only a small role in being associated with outdoor recreation area use, perhaps it was an important factor where it was related. Future campaigns for park promotion could target family PA, especially for obese parents and children.

Limitations of this study include the cross-sectional nature of the data analyzed, the descriptive and exploratory nature of the signal detection analysis, and the use of several single-item measures. The low response rates to the phone survey should also be noted in considering the limitations of the study. With data from a single time point, we are unable to address causation of park use. Likewise, signal detection provides a unique and objective perspective on correlates of park use, but it is meant for exploratory purposes and cannot posit causation either.

Despite these limitations, the current analysis offers a unique perspective on the combination of individual-level correlates of park use in a community environment that includes a number of PA resources for all residents, and used a sample of community-dwelling adults of diverse backgrounds. Our results suggest that gendered and ethnically-focused park promotion campaigns might be unnecessary, and instead efforts should be placed on increasing awareness of park facilities among older, less active community members.

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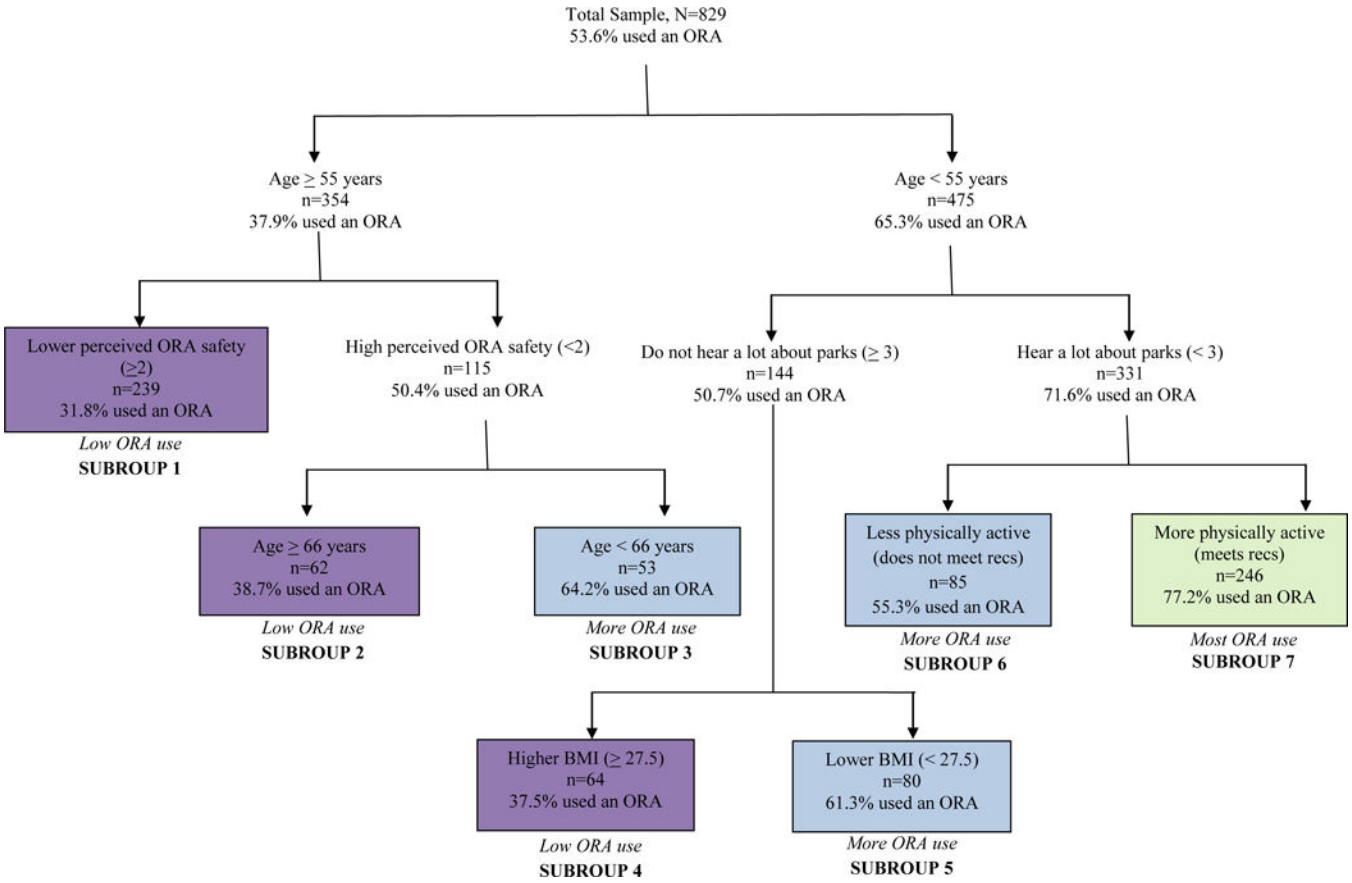

Figure 1:

Signal Detection Subgroups. Variables associated with outdoor recreation area (ORA) use. Each of the 7 subgroups is defined by the combination of predictor variables identified before the subgroup label.

Table 1:

Outcome, predictor, and profile variables for all participants (n=829) and by signal detection subgroup

		Signal Detection Subgroups, by level of outdoor recreation area (ORA) for PA use						
		Few Users			*More Users*			*Most Users*
	Full Sample	***Subgroup 1***	***Subgroup 2***	***Subgroup 4***	***Subgroup 3***	***Subgroup 5***	***Subgroup 6***	***Subgroup 7***
Variable	% or Mean(SD)	% or Mean(SD)	% or Mean(SD)	% or Mean(SD)	% or Mean(SD)	% or Mean(SD)	% or Mean(SD)	% or Mean(SD)
Sample size	n=829	n=239	n=62	n=64	n=53	n=80	n=132	n=199
Dependent variable								
Outdoor recreation area user (% yes)	53.6	31.8	38.7	37.5	64.2	61.3	55.3	77.2
Independent variables								
Age, years	51(19.0)	69(11.8)	77(7.6)	40(10.0)	59(3.2)	36(11.7)	38(11.6)	38(11.1)
BMI, kg/m^2	28.5(6.2)	28.5(6.3)	27.5(5.6)	33.5(5.5)	29.3(6.1)	24.0(2.4)	30.4(8.1)	28.0(5.4)
% obese (BMI≥30.0)	33.1	33.1	25.8	62.5	32.1	43.8	45.9	36.2
Gender (% female)	62.9	69.9	40.3	51.0	56.6	69.7	76.5	56.5
Race (%White)	55.9	63.6	59.7	40.6	39.6	43.9	45.9	57.7
Ethnicity (% Hispanic)	2.7	1.3	1.61	1.56	0.0	0.8	0.0	5.3
Education (% college graduate)	27.6	32.2	19.35	23.4	18.9	32.5	25.9	27.2
% meeting PA recs	68.9	61.1	54.8	81.3	56.6	78.7	0.0	100.0
Hear of places to be active (% strongly agree/agree)	75.2	78.7	90.3	0.0	90.6	0.0	28.2	24.5
Heard of County-level PA coalition (% yes)	30.5	37.2	24.2	18.8	37.7	6.3	41.2	31.3
Perceived safety of outdoor recreation areas (% very safe)	30.6	0.0	100.0	25.0	100.0	17.5	30.6	33.7
Descriptive variables								
Marital status (% married or living with a steady partner)	52.3	54.2	44.3	45.3	54.7	56.3	50.6	53.1
Children <18 years old living in household (% yes)	30.9	8.4	3.2	54.7	9.4	43.8	44.7	49.2