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Macro-Linkages between Health and Outdoor Recreation: The Role of Parks and Recreation Providers

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EXECUTIVE SUMMARY: Physical inactivity, overweight, and obesity are growing national concerns owing to their associations with chronic diseases and overall well-being. Parks and recreation providers play a pivotal role in addressing these public health issues by providing the public with infrastructure that enables outdoor physical activity. Information about the health-related benefits of outdoor recreation can aid parks and recreation managers and policymakers in describing the benefits associated with recreation infrastructure and in their decision making regarding investments of scarce financial resources to provide high-quality recreation opportunities. Our analysis of county-level data for Oregon shows a measurable relationship between adult physical activity, overweight, obesity, and recreation supply and demand. The proportions of adults that are physically active are positively associated with the proportion of overweight adults, recreational trail densities, and the frequency of participation in recreational activities. The proportions of adults that are overweight are positively associated with the proportion of physically active adults, but negatively associated with hiking trail densities and frequency of participation in recreational activities. The proportions of adults that are obese, however, are negatively associated with frequency of participation in non-motorized trail-related recreational activities. The results of this macro-level model are consistent with information provided by micro-level analyses described in previous literature, in particular that the supply of and demand for recreation activities are associated with physically active people. In turn, counties comprising more active residents are associated with healthier counties as measured by the proportion of adults considered to be overweight. These macro-level relationships can be used by parks and recreation providers to indicate "at-risk" communities-those with low recreation supply and demand, and high proportions of overweight and obese people-and we provide an example using Oregon counties. Several policy recommendations emerge for parks and recreation providers based on our model results combined with evidence from the reviewed literature. First, parks and recreation providers should support the development of local recreation facilities, including non-motorized trails, and promote their use by providing information about them and other existing resources. Second, providers should promote the overall health benefits of being physically active via outdoor recreation. Third, providers should identify at-risk communities and allocate resources to these communities in developing and promoting recreation opportunities. We illustrate each of these recommendations with examples of how they are being addressed in Oregon.

KEYWORDS: health, macro model, parks and recreation, policy, recreation grant program, recreation demand, recreation supply, spatial analysis

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The U.S. Centers for Disease Control and Prevention (CDC), and other agencies and organizations, are concerned about dramatic increases in rates of physical inactivity, overweight, and obesity. Overweight and obesity are associated with increased health risks for chronic diseases and disorders, including coronary heart disease, type 2 diabetes, various cancers (e.g., endometrial, breast, and colon cancers), among others (Mokdad et al., 2003). Physical activity at recommended levels mitigates many of these health risks, regardless of weight class. Blair and Brodney (1999) conclude that: I) Regular physical activity clearly attenuates many of the health risks associated with overweight and obesity; 2) Physical activity appears to not only attenuate the health risks of overweight and obesity, but active obese individuals have lower morbidity and mortality than normal weight individuals who are sedentary; and 3) Inactivity and low cardiorespiratory fitness are as important as overweight and obesity as mortality predictors.

There is strong evidence of an inverse, linear relationship between physical activity and reductions in all-cause mortality, total cardiovascular and coronary heart disease incidence and mortality, Type 2 diabetes mellitus, and colon cancer (Haennel & Lemire, 2002; Rankinen & Bouchard, 2002). This lineal relationship suggests that as people move away from sedentary lifestyles, the health benefits of being physically active accumulate immediately and continue to accrue as they become more physically active. For example, physical activity levels that expend 500 kcal/week (about 100 minutes/week) provide slight favorable effects, whereas expending 1000 kcal/week (about 200 minutes/week) provides a 30% reduction in all-cause mortality rates (Rankinen & Bouchard, 2002). In their review of literature, Landers (1997) and Fontaine (2000) indicate that physical activity is associated with moderate reductions in depression, small to moderate reductions in anxiety, and small reductions in panic disorder, as well as large increases in energy and vigor, small to moderate increases in self-esteem, and small to moderate increases in positive affect (i.e., enjoyment, happiness).

Given the health benefits of physical activity, promoting physically active lifestyles is a primary focus of many public health programs. The CDC and the American College of Sports Medicine in 1995 changed their recommended daily allowance of physical activity. As described by the U.S. Surgeon General, recommended physical activity is an accumulation of at least 30 minutes of moderate physical activity or 20 minutes of vigorous physical activity most days of the week. Conceivably, parks and other infrastructure, including non-motorized trail corridors, bikeways, and sidewalks for example, provide important opportunities to meet recommended daily levels of physical activity through outdoor recreation.

The purpose of this study is to measure the direct and indirect relationships among aggregate-level data reflecting health status indicators, and recreation supply and demand. We are not testing any theories, but rather are evaluating whether a macro-level model using aggregate secondary data can reveal linkages among three related health metrics-county-level proportions of adults that are physically active, overweight, and obese-and the supply of outdoorrecreation infrastructure and demand for outdoor recreation activities. The empirical models show an association between the supply of recreation opportunities and rates of physical activity, overweight, and obesity in Oregon, which imply a set of state-specific policy recommendations. We conclude that information about the health-related outcomes of outdoor recreation is useful to managers and policymakers who are increasingly challenged to both describe the likely benefits resulting from recreation projects and to allocate scarce resources to providing high-quality recreation opportunities in addition to other public services.

Conceptual Model

Conceptually, our model measures the direct effect of recreation supply and demand on physical activity and weight status, while controlling for the indirect relationships (or dependence) of physical activity status on weight status. There are many factors associated with overall health and weight, including dietary habit, neighborhood design, and social and cultural influences, among others (Wells, Ashdown, Davies, Cowett, and Yang, 2007), that are not accounted for in our model. Instead, we are interested in isolating the relationship between recreation supply and demand and the proportions of county adults that are physically active, overweight, and obese as three important health indicators. Underlying our conceptual model are ecological models of behavior that relate to health and environment (Wells et al., 2007). Many studies demonstrate an association between environment and physical activity, as we will discuss below.

Leisure-time physical activity often connotes exercise. The *Dictionary of Sport and Exercise Sciences* operationally defines physical activity as "movement of the human body that results in the expenditure of energy at a level above the resting metabolic rate" (Anshel et al., 1991, p.113). Thus, physical activity can take place not only as deliberative exercise, but also at the workplace, in routine household activities, in various forms of transportation (e.g., walking and biking), and in leisure-time recreational activities (e.g., hiking, skiing, and rollerblading). Aggregate measures of public land density, trail miles, recreation facilities, and recreation participation rates should be associated with aggregate levels of physical activity.

Most epidemiological studies that link environmental factors with physical activity have been conducted in urban environments by examining land-use patterns, neighborhood designs, parks, and transportation infrastructure (e.g., sidewalks, bike lanes, and non-motorized trails). Therefore, some distinction between urban and rural areas and their resources may be warranted when deriving measures of recreation supply. In their reviews of literature, Humpel, Owen, and Leslie (2002) and Williams (2007) both conclude that accessibility, opportunities, and aesthetic attributes of places to be active have the strongest associations with physical activity. Access to parks and trails is consistently related to physical activity levels (Kaczynski, Potwarka, Smale, & Havitz, 2009; Sallis & Kerr, 2006; Roux et al., 2007). This may emerge as a spatial issue among aggregate data, because people are not only located within a county but are mobile and may access resources in neighboring counties. However, research literature suggests that for most people, their primary recreational resources are close to home. Individuals are less likely to use resources that are more distant from their residences.

Parks and other public lands that provide recreational (and transportation) opportunities may promote health through physical activity. For example, users of public open space are three times more likely to meet recommended physical activity levels (Giles-Corti et al., 2005). Gordon, Zizzi, and Pauline (2004) found that 25% of respondents surveyed at a newly constructed rail trail in a rural city were sedentary prior to the trail's development. Habitually active rail trail users modestly increased their activity levels (0-26%), whereas new (previously sedentary) exercisers increased their activity levels 51-100%. Thus, the presence of parks and recreation areas helps to move people up the dose response function that characterizes the health benefits resulting from physical activity.

Methods

We model the dependence of rates of physical activity, overweight, and obesity on each other, on measures of recreation supply, and on recreation demand (i.e., participation), while controlling for the influence of sociodemographic characteristics. The three equations estimated were:

Physical Activity = f (Overweight, Obesity, Recreation Supply, Recreation Demand, Sociodemographic Characteristics)

Overweight = f (Physical Activity, Obesity, Recreation Supply, Recreation Demand, Sociodemographic Characteristics)

Obesity = f (Physical Activity, Overweight, Recreation Supply, Recreation Demand, Sociodemographic Characteristics)

We assume that physical activity may affect overweight and obesity, overweight may affect physical activity and obesity, and obesity may affect physical activity and overweight. Thus, physical activity, overweight, and obesity may be simultaneously determined in the equations above (Rosenberger, Sneh, Phipps, & Gurvitch, 2005). This simultaneity in the regressors can lead to inconsistent and biased Ordinary Least Squares estimators. Simultaneity arises when a regressor is endogenous to the system, and is, therefore, likely correlated with the error term. An alternative estimator, such as Two-Stage Least Squares, is required to address this simultaneity.

Another statistical issue that should be addressed is the inherent spatial dependence of many types of data (Anselin, 1988; Rosenberger et al., 2005). Spatial dependence refers to the relative nature (i.e., relative space or relative location) of data distributed across space. In many cases, spatial dependence reflects arbitrary delineation of data based on jurisdictional boundaries (e.g., state or county). Not correcting for spatial dependence among the data can lead to biased, inconsistent, and inefficient Ordinary Least Squares estimators. Data used in this analysis contain spatial aspects based on the arbitrary delineation of the spatial units (county boundaries), the spatial distribution of the supply of recreation opportunities, and the inherent mobility of county residents to seek out recreation opportunities beyond their county boundaries.

A final model estimation issue arises from the form of the dependent variables. As proportions-the proportion ofthe county population that is physically active, overweight, and obese-s-they are limited in value between zero and one. This form permits resulting regression models to estimate predicted values outside of this zero to one range. A common method for analyzing proportions data relies on the logit transformation whereby proportions are converted to a new dependent variable equal to the natural log of [proportion/(1-proportion)] (e.g., Greene, 2008). This transformation bounds the model predicted values of the dependent variables to be between zero and one. A drawback of this method, however, is that resulting estimated coefficients become more difficult to interpret. We estimated the empirical models both ways (non-transformed and transformed) and found nearly identical results in terms of the signs, relative effects, and statistical significance of explanatory variables included in the models. Furthermore, the proportions data examined generally are not near in value either to zero or one, and predicted values from the non-legit-transformed versions ofthe models do not predict values outside of the zero to one bound. Given these results, we present the non-logit-transformed versions of the models to take advantage of their greater ease in interpretation.

Data Collection

Secondary data used in this analysis were collected during 2000 to 2001. We restricted our analysis to this period to draw upon data from the 2001 SCORP inventory data (Oregon Parks and Recreation Department [OPRD], 2001) and the 2002 SCORP participation survey (OPRD, 2003), the only period for which these types of data are available. All variables are aggregate measures at the county-level for Oregon. The health indicator variables-physical activity (M = 0.44, SD = 0.07), overweight (M = 0.39, SD = 0.03) and obesity (M = 0.22, SD = 0.04)-are measures of the proportion of adults in a county that meet each indicator's criterion (e.g., meet CDC minimum physical activity requirements or have specific BMI measures) as self-reported through the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is a cross-sectional, population-based, random digit dial telephone survey of adults (18 years of age or older) conducted by the CDC and state health departments (Oregon Department of Human Services [ODHS], 2003). Being physically active is defined as 30 or more minutes of moderate activity per day for at least five days per week. Overweight is defined as having a BMI between 25.0 and 29.9, whereas obese is defined as having a BMI greater than or equal to 30.0.

Recreation supply measures (e.g., trail miles, public land densities, and number of recreation facilities) are derived from a 2000-2001 mail survey of federal, state, county, and municipal recreation providers in Oregon conducted by Oregon Department of Parks and Recreation (OPRD, 2001), and are aggregated by the counties within which these resources are located. Trail miles are segregated according to hiking trail miles (M = 270, SD = 271) that are located primarily on federal and state land, and urban trail miles (M = 106, SD = 119) that are located primarily on county and municipal land. Urban trails are comprised of designated biking, walking, and jogging trails. Outdoor recreation facilities provide another means by which some people may be physically active. We measure the number of recreation facilities (M = 263, SD = 340) for each county, including baseball, softball, football, rugby and soccer fields, indoor and outdoor swimming pools, outdoor basketball nets, outdoor tennis courts, public and private golf courses, miscellaneous recreation centers, and baseball batting cages. Trail miles and facilities variables are normalized by county population density-we divide each variable by the number of households per county. This results in hiking trail miles density per household (M = 0.03, SD = 0.06), urban trail miles density per household (M = 0.01, SD = 0.02), and recreation facilities density per household (M = 0.01, SD = 0.01). Our final recreation supply measure captures general recreation land as the proportion of each county's acreage that is designated public land (M = 0.46, SD = 0.21), including federal, state, county, and municipal land.

Recreation demand variables are measured by the number of activity days in different recreation activity categories. These data are derived from a 2002 mail survey of Oregon residents and are aggregated by county of residence (OPRD, 2003). Annual trail-related activity days per household (M = 6.44, SD = 2.53) include hiking, mountain biking, and cross-country skiing, which typically take place at locations more remote from primary residences. Annual days per household participating in road and street activities (M =

31.49, SD = 5.25) includes walking, jogging, biking, skating, and skateboarding, which typically take place on urban trails. Annual days per household participating in outdoor sports and games (M = 8.30, SD = 1.96) includes playing soccer, football, baseball, golf, tennis, etc., which typically are associated with the facilities measure.

Sociodemographic characteristics such as mean age, distribution across age classes, income, and racial distribution among counties are captured, based on partial pairwise correlations, by simple measures of county characteristics related to the distribution of population. Household density (M = 0.06, SD = 0.16) is the number of households per acre in a county derived from the 2000 U.S. Census, College degree (M = 0.19, SD = 0.07) is measured as the proportion of adults 25 years old or more with at least a bachelor's degree; this measure is derived from the 2000 U.S, Census, Commute time (M = 20.26, SD = 3,67) is measured as the mean travel time to work in minutes for workers age 16 years or more, also provided in the 2000 U,S, Census, And finally, county classification is identified as dichotomous variables either as a metropolitan county (M = 0.31, SD = 0.47) or as a rural county (M = 0.14, SD = 0.35), A county is classified as metropolitan if it is included in a metropolitan statistical area, typically with an urban center of 50,000 or more in population, A county is classified as rural if any urban area within the county has a total population of less than 2,500, County classifications are derived from USDA Economic Research Service's 2003 urban-rural continuum codes based on 2000 U.S. Census population statistics, Counties classified as urban are the omitted class,

Data Analysis

All tests and models are estimated using LIMDEP 8.0. Simultaneity and endogeneity tests show that overweight and obesity are exogenous to physical activity; that physical activity and obesity are exogenous to overweight; and that overweight is exogenous to obesity (see Table 1), Only physical activity was found to be endogenous to obesity,

Table 1. Simultaneity Tests (n= 36)

Relationship	Test	Coefficient	P-Value
Obesity= *f*(Physical Activity)	Hausman	-0.08	0.36
	Pindyck & Rubinfield	-1.26	0.01
Overweight = *f*(Physical Activity)	Hausman	0.26	0.01
	Pindyck & Rubinfield	0.16	0.39
Physical Activity = *f*(Obesity)	Hausman	-0.12	0.73
	Pindyck & Rubinfield	-0.74	0.22
Overweight = *f*(Obesity)	Hausman	-0.20	0.20
	Pindyck & Rubinfield	0.14	0.54
Physical Activity = *f*(Overweight)	Hausman	1.25	0.01
	Pindyck & Rubinfield	2.13	0.03
Obesity = *f*(Overweight)	Hausman	-0.33	0.22
	Pindyck & Rubinfield	0.08	0.88

Given that overweight and obesity are exogenously determined, we do not need to model simultaneity among the health data and may proceed with Ordinary Least Squares.

All equations were tested for spatial dependence as lagged independent variables and as spatial error (see Table 2). Spatial dependence was rejected for the physical activity and overweight equations, but was accepted as spatial dependence in the error term in the obesity equation. All models are corrected for heteroskedasticity. The final models estimated are:

Physical Activity Proportion $= B_0 + B_1$ Overweight Proportion $+ B_2$ Obesity Proportion $+ B_3$ Hiking Trail Miles Density per Household $+ B_4$ Urban Trail Miles Density per Household $+ B_5$ Public Land Density $+ B_6$ Trail Activity Days per Household $+ B_7$ Road and Street Activity Days per Household $+ B_8$ Sports and Games Activity Days per Household $+ B_9$ Household Density per Acre $+ u$;

Overweight Proportion $= B_0 + B_1$ Physical Activity Proportion $+ B_2$ Obesity Proportion $+ B_3$ Hiking Trail Miles per Household $+ B_4$ Urban Trail Miles per Household $+ B_5$ Trail Activity Days per Household $+ B_6$ Road and Street Activity Days per Household $+ B_7$ Sports and Garnes Activity Days per Household $+ B_8$ Metropolitan County Status $+ B_9$ Rural County Status $+ u$;

Obesity Proportion $= B_0 + B_1$ Physical Activity Proportion $+ B_2$ Overweight Proportion $+ B_3$ Hiking Trail Miles Density per Household $+ B_4$ Urban Trail Miles Density Per Household $+ B_5$ Trail Activity Days per Household $+ B_6$ Road and Street Activity Days per Household $+ B_7$ Sports and Games Activity Days per Household $+ B_8$ Household Density per Acre $+ B_9$ College Education $+ B_{10}$ Commute Time $+ u \quad u = \hat{}u_{-1} + E$.

The Bs are the coefficients to be estimated and show the association between independent variables and the dependent variable. Error in the models *(u)* is assumed to be identically, independently, and normally distributed. For the Obesity Model, the error process is corrected for spatial dependence ($\hat{}u_{-1}$) between each observation (county) and its weighted spatially lagged neighbor, where the spatial weights are derived using a Queen Contiguity procedure (Rosenberger et al. 2005). The remaining error in the Obesity Model (E) is identically, independently, and normally distributed.

Table 2. Spatial Dependence Tests (n= 36)

Test	Physical Activity Model	Overweight Model	Obesity Model
Moran-I	-0.111	0.048	-0.132
LM error	0.968	0.178	1.360
	(17.611)	(17.611)	(17.611)
LR Test	1.536	0.294	7.743
	(6.635)	(6.635)	(6.635)
Wald test	2.811	0.211	75.663
	(6.635)	(6.635)	(6.635)
LM error in SAR model	3.933	2.336	6.200
	(6.635)	(6.635)	(6.635)

Critical value in parentheses.

Results

Estimated coefficients, their standard errors, and other results of the Ordinary Least Squares models are reported in Table 3. The estimated coefficients represent the change in the dependent variable associated with a one-unit change in the independent variables. The sign of the coefficient is the direction of the association. These coefficients are estimated associations between the dependent variable and the independent variable, and should not be confused with causality. While some of the independent variables may cause changes in the dependent variable, we cannot prove causality with our data. However, patterns in associations among county-level data could mirror physical and behavioral results reported for individual-level data (Rosenberger et al., 2005).

In addition to coefficient estimates and their standard errors, we provide elasticity measures for the independent variables. Elasticities are unitless measures of the relationships between the dependent variable and the independent variables. An estimated elasticity may be interpreted as the percent change in the dependent variable associated with a one-percent change in the independent variable evaluated at the mean value of the independent variable. As we move from county to county, elasticities tell us the general effect of changes in recreation supply and demand on the counties' average physical activity and weight status rates. Overall model goodness offit is provided by the adjusted-R2, which may be interpreted as the percent of the variation in the dependent variable explained by the independent variables.

The estimated Physical Activity Model is statistically significant based on the F-test and explains 30% of the variation in physical activity proportions as reflected in the adjusted-R2. The overweight variable is positively associated with physical activity proportion such that every 1% increase in overweight proportion across counties is associated with a 0.83% increase in the proportion of the county that is physically active. The obesity variable is not associated with physical activity proportion. Trails are positively associated with physical activity. One-percent increases in both hiking trail miles per household and urban trail miles per household are associated with 0.01% higher physical activity proportions. The density of public land is not significantly related to physical activity proportion. This result suggests that ifthe prevalence of public land has a positive influence on physical activity, it is through its provision of outdoor recreation resources such as trails and sports facilities, which are already accounted for in the model by other variables. The frequency of participation in various recreation activities is positively associated with physical activity proportion across counties. The average annual days that households participate in trail or off-trail related activities, in road and street activities, and in outdoor sports and games are associated with higher physical activity proportion-elasticities range from 0.10% to 0.13% for a 1% increase in annual participation in the various activities. Household density per acre is negatively associated with physical activity proportion, meaning more densely populated counties have lower rates of physical activity.

The estimated Overweight Model is statistically significant based on the F-test and explains 46% of the variation in overweight proportions as reflected in the adjusted-R2. The physical activity variable is positively associated with overweight proportion such that for every 1% increase in physical activity proportion, there is an associated 0.27% increase in overweight proportion. The obesity variable is negatively associated with overweight proportion such that for every 1% increase in obesity proportion, there is an associated 0.15% decrease in overweight proportion. Hiking trails are negatively associated with overweight proportions. A 1% increase in miles per household of hiking trails is associated with a 0.01% lower overweight proportion. The urban trail miles per household variable, however, is not statistically associated with overweight proportion.

Table 3. OLS Regression Results for Macro Models (n= 36).

Variable	Physical Activity Model	Overweight Model	Obesity Model
Constant	-0.05426 (0.1259)	0.4296*** (0.0397)	0.2689*** (0.0700)
Physical Activity	Dependent Variable	0.2374*** (0.0690) [0.2714]	-0.0803 (0.0835) [-0.1621]
Overweight	0.9531*** (0.2559) [0.8342]	Dependent Variable	-0.1804 (0.1399) [-0.3186]
Obesity	-0.0448 (0.2232) [-0.0222]	-0.2688** (0.0994) [-0.1522]	Dependent Variable
Hiking trail miles per household	0.1612** (0.0792) [0.0119]	-0.1348** (0.0500) [-0.0113]	-0.1160 (0.0806) [-0.0172]
Urban trail miles per household	0.7185** (0.2988) [0.0133]	-0.2298 (0.2748) [-0.0048]	0.0049 (0.3712) [0.0002]
Public land	-0.0461 (0.0496) [-0.0478]	---	---
Trail activity days per household	0.0070** (0.0030) [0.1016]	-0.0043** (0.0020) [-0.0713]	-0.0060** (0.0029) [-0.1757]
Road and street activity days per household	0.0018* (0.0010) [0.1277]	-0.0005 (0.0008) [-0.0405]	0.0002 (<0.0001) [0.0286]
Sports and games activity days per household	0.0059* (0.0031) [0.1103]	-0.0037** (0.0018) [-0.0790]	0.0014 (0.0024) [0.0528]
Household density	-0.0556** (0.0251) [-0.0073]	---	-0.0669** (0.0291) [-0.0177]
Metro status	---	-0.0368*** (0.0081)	---
Rural status	---	0.0272** (0.0122)	---
College degree	---	---	-0.3457*** (0.0606) [-0.3014]
Commute time	---	---	0.0025** (0.0012) [0.2302]
λ	---	---	-0.9900*** (0.2075)
F-test	2.66**	4.37***	5.02***
Adj-R^2	0.30	0.46	0.53

Standard errors in parentheses; elasticities in square brackets calculated at mean values.
****p-value <0.01; **p-value<0.05; *p-value<.0.1.*

The frequency of participation in various recreation activities is negatively associated with overweight proportion across counties, although road and street activities are not statistically significant. A 1% increase in trail or off-trail related activities and in outdoor sports and games is associated with 0.07% and 0.08% decreases in overweight proportion, respectively. Metropolitan counties had lower overweight proportions than rural counties.

The estimated Obesity Model is statistically significant based on the F-test and explains 53% of the variation in obesity proportion as reflected in the adjusted-R2. This is the only model for which we needed to correct for the error form of spatial dependence. The physical activity and overweight variables are not statistically associated with obesity proportion. Likewise, hiking and urban trail densities are not significantly associated with obesity proportion patterns at the county level. Only the variable describing annual days per household participating in trail or off-trail-related activities is statistically significant, and negatively associated with obesity proportion such that a 1% increase in trail or off-trail participation is associated with a 0.18% reduction in obesity proportion. Also, household density is negatively associated with obesity proportion. The more educated a county's population, the lower its obesity proportion. A 1% increase in the adult population with at least a bachelor's degree has a -0.30% response in obesity proportion. Lastly, counties with longer average commute times tend to have higher obesity proportion. A 1% increase in commute time results in a 0.23% response in obesity proportion.

Discussion

Multivariate regression analyses of aggregate, county-level data in Oregon show that the prevalence of hiking and urban trails is associated with higher proportions of physically active adults. The models also show that counties in which people are more engaged in non-motorized trail-related activities, road and street activities (e.g., walking, jogging, biking), and other outdoor sports, overall physical activity proportions are higher. The results suggest that park and recreation providers in Oregon can playa significant role in the health and well-being of Oregon's residents by providing outdoor recreation infrastructure such as trails and sports facilities. These results led OPRD to develop a statewide trails website that will provide information on the location, accessibility, and attributes of trails in Oregon. Conceivably, more local efforts could link into this statewide program. OPRD also is leading a partnership effort with local health care providers and Portland Parks and Recreation to develop and test a pilot physician physical activity prescription program in the Portland metropolitan area that would generate exposure to parks and recreation facilities and programs, and create additional incentives for youth to become more physically active through parks and recreation.

Health risks appear to vary across Oregon in terms of proportions of county residents not meeting physical activity requirements and/or being overweight or obese. The use of recreation opportunities measured as trail mile densities and intensity of use in various recreational outdoor activities varies across the state. At-risk communities likely are communities with higher proportions of adults in health risk categories, communities whose trends in health-risk categories are flat or trending in the wrong direction, and communities offering relatively few outdoor recreation opportunities in terms of availability, accessibility, and diversity.

As an extension ofthis study, the Population Research Center, Portland State University has projected health status indicators to 2020 for OPRD as part of the 2008-2012 Oregon SCORP. Eleven of Oregon's 36 counties with less than 50% of the adult population (18+ years of age) meeting CDC recommended levels of physical activity in 2010 and those having a negative trend over time with less than 50% meeting recommended levels in 2020 were identified as 'in need' counties (including Baker, Columbia, Crook, Douglas, Harney, Hood River, Josephine, Morrow, Tillamook, Umatilla, and Wallowa County).

To address disparities in health status and recreational opportunities, Oregon is assigning priority points to be awarded for the development of close-to-home non-motorized trail opportunities in identified high-priority counties through the Oregon Land and Water Conservation Fund Program. Close-to-home non-motorized trails are qualified as having at least one trail access point within a five-mile radius of an urban growth boundary, unincorporated community boundary, or a Tribal community. A similar priority has been included in the Oregon Recreational Trails Program. As a result, OPRD-administered grant programs are targeting funds in areas of the state that could greatly benefit from the health outcomes associated with increased recreational trail use.

Policy Recommendations

Outdoor recreation is one way people may attain their recommended daily dose of physical activity. The results from our study suggest that park and recreation providers can play a significant social role in promoting the health and well-being of U.S. residents by providing outdoor recreation infrastructure such as trails and sports facilities. While the focus of our study was on Oregon, our results and recommendations may be broadly applicable to other states. For example, all states in the U.S. administer the state-wide Land and Water Conservation Fund (LWCF) grant program, federal Recreational Trails Program (RTP), and many others have an equivalent of Oregon's Local Grant Program supported by an allocation of state lottery proceeds. Based on the results of our analysis as well as literature reviewed, several recommendations emerge for parks and recreation providers.

Support close-to-home non-motorized trails and other recreation facilities. Trails provide important opportunities for people to be physically active. Our models show that counties with higher densities of hiking and trail miles are associated with higher proportions of adults meeting CDC's physical activity recommendations. Local accessibility, including proximity from home, is an important attribute of recreational facilities including trails (Humpel et al., 2002; Williams, 2007; Sallis & Kerr, 2006; Roux et al., 2007). Close-to-home non-motorized trails provide opportunities for daily physical activity, while remote trails could provide diversity in opportunities that are not available from local trails alone.

Promote the use of recreation facilities by providing information about them. People may not be aware of available places to be physically active. Our model shows that proportions of overweight people are lower in counties with higher densities of hiking trail miles. Increasing people's awareness of trail networks, sport facilities, and other recreation resources may help people become more active. Linking local promotion and educational efforts to broader statewide efforts might help enhance the delivery of information.

Promote the health benefits of outdoor recreation generally, but note the importance of nutrition in a weight loss regimen. The literature shows physical activity promotes good health, regardless of weight class (Blair & Brodney, 1999; Haennel & Lemire, 2002). While physical activity may help prevent weight gain, it is not necessarily sufficient for weight loss without a nutritional plan (Rankinen & Bouchard, 2002; Welk & Blair, 2000). Media campaigns should focus on health and active living, not weight (Wing, 1999). For example, a chart that shows the potential health gains from various types of activities by frequency and duration of participation may help keep people motivated. People need to be aware that even though they may not be lowering their weight, they can lower their risks for various chronic diseases. Recreation also could be prescribed by physicians as an important disease prevention program.

Identify and target at-risk people and communities. At-risk people and communities could be targeted with recreation development funds by identifying preferences for trail attributes, supply gaps in trail networks, and physical and perceived barriers to participating in physical activity and outdoor recreation. Getting sedentary people physically active will lead to health benefits for them and a reduction in the healthcare burden on society. Gaps in recreation supply are not simply the lack of facilities (although this is important), but also their location, accessibility and diversity of opportunities (e.g., trails, settings, social events, etc.; Giles-Corti et al., 2005; Roux et al., 2007; Williams, 2007). Identifying gaps may need to be user-driven-who is using resources and why; who is not using resources and why; and what resources would they use that are currently not available to them.

Parks and recreation providers and administrators can play an important role in combating the social and health epidemics of physical inactivity, overweight, and obesity. Partnerships with health-related agencies and institutions, education institutions, and transportation agencies leverage scarce resources in health and related research, health education, and the development of infrastructure and other built opportunities for promoting physically active lifestyles. Current efforts in Oregon provide a few examples of how parks and recreation providers can promote healthy lifestyles.

Our macro-level models show linkages between recreation supply and demand and physical activity proportions in counties. However, the linkages between physical activity proportions and overweight and obesity proportions are not clear. Micro-level analyses (based on primary data collected on the individual person level) are necessary to evaluate the efficacy of specific programs or projects on physical activity, and health and weight status. As Giles-Corti et al. (2005) and Kaczynski et al. (2009) note, more specificity is needed in ecological physical activity research. Nonetheless, our macro-level models do support broad recreation policies designed to address the health crisis in the U.S. related to physical inactivity and weight status.

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