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Access to Parks and Recreational Facilities, Physical Activity, and Healthcare Costs
for Older Adults: Evidence From U.S. Counties

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Abstract

Although research has documented the health benefits of physical activity and use of park and recreational facilities, the relationships of these factors to healthcare costs remain unexplored at the population level. Building upon a social-ecological model, we analyzed county-level data to examine the extent to which physical activity rate and access to parks and recreational facilities were related to the healthcare costs for older adults (i.e., those 65 years and above) in U.S. counties. The results revealed that older adults' physical activity rate in a county was negatively associated with the county's healthcare costs of these adults. Also, access to parks and recreational facilities was negatively associated with older adults' healthcare costs through the physical activity rate. These findings indicate that access to parks and recreational facilities correlates with increased physical activity levels among older adults, which might reduce their healthcare costs in communities.

Keywords: physical activity, parks, recreation, exercise, aging, health

Access to Parks and Recreational Facilities, Physical Activity, and Healthcare Costs for Older Adults: Evidence From U.S. Counties

The cost of healthcare continues to rise in the United States. In 2016, national healthcare spending was \$3.3 trillion, which equals 17.9 percent of GDP (Hartman, Martin, Espinosa, Catlin, & The National Health Expenditure Accounts Team, 2018). This issue will likely intensify in the coming decades in the United States, as the number of people aged 65 years and above is projected to reach 98 million in 2060 (Mather, Jacobsenm, & Pollard, 2015). Average health spending increases with age and people aged 65 and over accounted for 34% of U.S. healthcare spending in 2015 (Sawyer & Sroczynski, 2017). It is thus important for policymakers to find possible solutions to mitigate healthcare costs for older adults.

An effective way to address the rising healthcare costs for older adults is to promote their leisure-time physical activity. For instance, Wang, McDonald, Reffitt, and Edington (2005) reported that, among 42,520 retired individuals aged 65 and over in a U.S. manufacturing corporation, physically active retirees tended to have lower healthcare costs than their sedentary counterparts. Although findings from prior research have demonstrated the costs of physical inactivity, these studies are limited by their individual-level research designs. Given that the effects of physical activity on health and healthcare costs can be influenced by multilevel factors, such as social environments, physical environments, and policies (McLeroy, Bibeau, Steckler, & Glanz, 1988; Sallis et al., 2006), it is critical that any empirical examination of such effects consider environmental differences among communities using a macro-level analysis. A better understanding of the macro-level benefits of physical activity for older adults' healthcare costs will help recreation and public health officials further their efforts to support, administer, and

develop effective programs that promote health in communities (Ofstedal & Schneider, 2013; Wilhelm Stanis, Ofstedal, & Schneider, 2014).

Although promoting regular physical activity has become a global public health priority, in 2014 over 30% of older adults in the U.S. were inactive (Watson et al., 2016). A growing body of research has documented the health benefits of parks and recreational facilities for offering physical activity opportunities (Gómez, Baur, Hill, & Georgiev, 2015; Kaczynski & Henderson, 2007; Kaczynski, Potwarka, Smale & Havitz, 2009; Larson, Whiting, Green & Bowker, 2014; O'Dell, 2016; Parsons et al., 2015; Rosenberger, Sneh, Phipps, & Gurvitch, 2005). The role of parks and recreation services in promoting physical activity has been recognized by public health departments and health-related organizations, such as the Centers for Disease Control and Prevention and the Robert Wood Johnson Foundation (Godbey & Mowen, 2010). Indeed, better access to parks and recreational facilities is associated with higher levels of physical activity (Ofstedal & Schneider, 2013; Veitch, Ball, Crawford, Abbott, & Salmon, 2012; Kaczynski et al., 2009). For instance, residents who live in higher parkland density areas tend to be physically active and to maintain a healthy body weight (West, Shores, & Mudd, 2012). Thus, investment in parks and recreational facilities may be an effective way to boost older adults' physical activity opportunities and produce health benefits. To our knowledge, however, no research has examined whether such investment may be associated with reducing older adults' healthcare costs in a community.

In the United States, the federal budget proposal calls for significant cuts to the national park service in 2019, decreasing its funding by nearly \$200 million from 2018 (U.S. Department of the Interior, 2018). Additionally, there is a congressional debate regarding a federal budget cut for locally run parks and recreation programs (Sims, 2017). Over three-quarters of operating

budgets of local parks and recreation services come from the general funds of the local governments, and public policies made by the federal and local governments directly influence operations and maintenance of parks and recreational facilities in the communities (Walls, 2009). Given the uncertainty over federal funding for parks and recreational services, it is vital for researchers and practitioners to empirically verify the health benefits of community-based parks and recreational facilities.

To this end, this study investigated the extent to which access to parks and recreational facilities and physical activity rate were related to the healthcare costs for older adults in U.S. counties using a macro-level analysis. In particular, we examined (a) whether older adults' physical activity rate in a county would be negatively associated with the healthcare costs of these adults and (b) whether access to parks and recreational facilities in a county would be negatively associated with older adults' healthcare costs through any increased physical activity rate. The county was an appropriate unit of analysis because, in the United States, most local health departments that offer community health services are county based (National Association of County and City Health Officials, 2017).

Literature Review

Theoretical Foundation

A social-ecological model served as the theoretical foundation of this study. The social-ecological model is concerned with people's interactions with their sociocultural and physical environments (Stokols, 1992, 1996). A key assumption of the social-ecological model is that individual health and behavior are influenced by multiple levels of factors (Sallis et al., 2006). For instance, McLeroy et al. (1988) proposed five levels of factors in their social-ecological model: intrapersonal factors (e.g., individual characteristics, psychological variables),

interpersonal processes (e.g., social networks, social support), institutional factors (e.g., organizational settings such as schools, workplace), community factors (e.g., relationships among organizations, institutions, and social networks), and public policy (e.g., local, state, national laws and policies). Among intrapersonal factors, socioeconomic status (e.g., income, education), demographics (e.g., age, gender), health-related behaviors (e.g., smoking, alcohol consumption), and attitudinal orientation toward health have been identified as correlates of health (e.g., Andreasson et al., 2013; Boutin-Foster et al., 2013; Meyer, Castro-Schilo, & Aguilar-Gaxiola, 2014; Sato, Jordan, & Funk, 2014; Senn, Walsh, & Carey, 2014). Correlates of health-related outcomes also include interpersonal processes (e.g., family support, social capital, club and membership association), institutional factors (e.g., programs that support employees' health, access to the workplace), community factors (e.g., neighborhood environment, recreational facilities), and public policy (e.g., improvements in housing quality and food environment; Butler, Clark, Burlis, Castillo, & Racette, 2015; Edwards, Jilcott, Floyd, & Moore, 2011; Meyer et al., 2014; Rosenberger et al., 2005; Sato, 2018; Senn et al., 2014; von Hippel & Benson, 2014; Yu & Lin, 2015; West et al., 2012). Previous health studies using social-ecological models have examined how various levels of factors contribute to the health of a population (Sato, Inoue, & Du, 2016; Stokols, 1992, 1996), as well as to individuals' health-related behaviors, such as physical activity promotion (Meyer et al., 2014; Sallis et al., 2006).

Scholars have realized that many public health challenges, such as encouraging people to engage regularly in physical activity, are too complex to be fully understood from single-level analyses. The complexity of these challenges requires a more comprehensive approach that incorporates multilevel determinants of population health, which refers to the health outcomes of a group of individuals (Kindig & Stoddart, 2003). Given that the average healthcare costs

represent key outcome measures of population health (Barr et al., 2003), the social-ecological model constitutes an effective framework for understanding the role of physical activity in reducing older adults' healthcare costs by considering multilevel factors in the community.

Role of Physical Activity Rate in Healthcare Costs

Physical activity represents a potential correlate that can reduce healthcare costs. Research suggests that up to 2.6% of national healthcare costs can be attributed to physical inactivity (Pratt, Norris, Lobelo, Roux, & Wang, 2014). In the United States, an examination of medical claims data from 1.5 million health plan holders estimated that the insurers' expenditures resulting from insufficient physical activity were \$83.6 million, or \$56 per member (Garrett, Brasure, Schmitz, Schultz, & Huber, 2004). Carlson, Fulton, Pratt, Yang, and Adams (2015) also estimated physical inactivity costs at \$117 billion per year for the U.S. population aged 21 years and older, which is equivalent to \$530 per capita. More germane to the current study, Wang et al. (2005) reported that very active or moderately active retirees aged 65 and over had lower annual healthcare costs, ranging from \$581 to \$3,279, than their sedentary counterparts. Given that previous studies used numerous data sources, measures, and methods to assess the relationship between physical activity and healthcare costs, it is difficult to directly compare these estimates across studies (Candari, Cylus, & Nolte, 2017). Nevertheless, evidence consistently shows the financial burden of physical inactivity, which highlights the importance of further investigating the relationship between physical activity and healthcare costs in each research context.

The social-ecological model suggests that the community average of intrapersonal factors, interpersonal processes, institutional factors, community factors, and public policy influence people's engagement in physical activity and other healthy lifestyle behaviors. Accordingly,

these factors can be associated with older adults' healthcare costs. However, healthcare-cost research has relied primarily on individual-level research designs, and, therefore, it is unclear whether the findings would have been different if community-level environmental factors had been utilized into the analyses. One notable exception was a study by Rosenberg et al. (2005), who found that, among 55 counties in West Virginia, a 1% increase in physically active adults would decrease healthcare expenditures on hospital treatments of disease and circulatory disorders by \$3.42 per capita, controlling for county-average factors of the availability of healthcare, socioeconomic status, and demographics. Nevertheless, Rosenberg et al. acknowledged that their findings were limited to a specific geographic area and type of healthcare costs.

The current analysis was designed to replicate and extend Rosenberg et al.'s (2005) study by examining whether the physical activity rates in counties across the United States would negatively correlate with a comprehensive measure of those counties' healthcare costs for older adults. Drawing upon the social ecological model (McLeroy et al., 1988; Sallis et al., 2006), our analysis also considered aggregate socioeconomic status, demographic characteristics, health-related behaviors, and institutional and community factors that might influence the relationship between physical activity and healthcare costs. Based on the tenets of the social ecological model, it is expected that older adults' physical activity rate in a county would be negatively associated with the county's healthcare costs for these adults.

Access to Parks and Recreational Facilities, Physical Activity Rate, and Healthcare Costs

Physical activity rate by itself is an important predictor of healthcare costs for older adults; however, access to parks and recreational facilities might be also associated with healthcare costs through increased physical activity levels. Leisure research has demonstrated the

importance of parks and recreational facilities as neighborhood environment characteristics that provide physical activity opportunities and lead to health benefits (Floyd, Spengler, Maddock, Gobster, & Suau, 2008; Gómez et al., 2015; Kaczynski et al., 2009; Koohsari, Kaczynski, McCormack, & Sugiyama, 2014; Larson et al., 2014; Moore et al., 2010; Oftedal & Schneider, 2013; O'Dell, 2016; Parsons et al., 2015; Rosenberger et al., 2005). Evidence supports that, in communities with more or bigger parks and recreational facilities, a higher proportion of the population reports recommended physical-activity levels (Cohen et al., 2010; Kaczynski et al., 2009; Larson et al., 2014; Schipperijn et al., 2017). In addition, closer proximity to neighborhood parks and recreational facilities is associated with higher rates of physical activity (Cohen et al., 2010; Kaczynski et al., 2009; Veitch et al., 2012).

However, findings from meta-analyses suggest that the evidence of a positive association between parks and recreational facilities and physical activity remains ambiguous (Ekkel & de Vries, 2017; Ferdinand, Sen, Raurkar, Engler, & Menachemi, 2012; Kaczynski & Henderson, 2007; Lachowycz & Jones, 2011). For instance, among the 50 studies that examined the relationship between parks and recreational facilities and physical activity, 20 studies found a positive association, 29 found mixed relationships or did not find a significant relationship, and one found a negative relationship (Kaczynski & Henderson, 2007). In a similar review of the 50 quantitative studies examining the association between greenspace access and physical activity, 20 studies reported positive relationships, 28 found no evidence of any association or mixed results, and two found negative relationships (Lachowycz & Jones, 2011). A possible reason for these inconsistent findings is that the strength of the association between physical activity and access to park and recreational facilities might vary by subpopulation (e.g., gender, age, race; Kaczynski et al., 2014) or geographic area (Lachowycz & Jones, 2013). Consequently, it is

important for examination of this relationship to account for sociodemographic and geographic factors.

Research findings are also mixed regarding the role of parks and recreation access in health. In a study of 44 U.S. cities, Larson, Jennings, and Cloutier (2016) found that park quantity (i.e., percentage of city area covered by public parks) was positively associated with overall well-being in the community, whereas park access (i.e., percentage of city population within 0.5 miles of a park) was not. A county-level study in North Carolina also reported that access to recreation resources, as assessed by the per-capita acreage of park and recreational facilities and per-capita recreation operation expenditures in each county, was negatively associated with the county's obesity rate (Edwards et al., 2011). By contrast, Rosenberger et al. (2005) found no association between obesity rate and the number of indoor and outdoor parks and recreational facilities among 55 counties in West Virginia. Oftedal and Schneider (2013) further found that, among 87 counties in Minnesota, the per-capita acreage of state and national park and recreation areas was not associated with county-average health-related outcomes, such as obesity rate and poor mental health.

The seemingly equivocal extant findings could be partly due to studies not including potential mediators of the relationship between access to parks and recreational facilities and health outcomes. Based on a social-ecological model, Lachowycz and Jones (2013) suggested several mediators that could be responsible for this relationship, such as recovery from stress, better air quality, facilitation of social connections, and encouragement of physical activity. The current study explored physical activity rate as a potential mediator because of its consistent association with healthcare costs in the literature (e.g., Candari et al., 2017; Carlson et al., 2015; Pratt et al., 2014). We expect that benefits of access to parks and recreational facilities for older

adults' healthcare costs will be achieved at least partially through increased levels of their physical activity rates. In other words, access to parks and recreational facilities in a county should be positively associated with older adults' physical activity rate, which, in turn, should be negatively associated with healthcare costs for older adults.

Summary and Hypotheses

In summary, there is a lack of research on the relationship between physical activity rate and healthcare costs among older adults after accounting for multilevel factors in the community. Additionally, although the health benefits of parks and recreational facilities have been documented in the literature, empirical findings remain mixed because of the methodologies used and the limited research examining the potential mediators of the relationship between access to parks and recreational facilities and health outcomes. To address these limitations, we examined the extent to which county-level physical activity rate and access to parks and recreational facilities could be related to healthcare costs for older adults. The following are the hypotheses tested in this study:

H₁ The physical activity rate of older adults in a county will be negatively associated with the county's healthcare costs for older adults.

H₂ The physical activity rate of older adults in a county will mediate the relationship between access to parks and recreational facilities and the county's healthcare costs for older adults.

Method

Study Design and Data Source

We used secondary data to assess the county-level relationships between access to parks and recreational facilities, physical activity rate, and healthcare costs among older adults. We

chose the county as the unit of analysis primarily because, in the United States, most local health departments that provide or facilitate public health services in communities are county based (National Association of County and City Health Officials, 2017). The current focus on counties is also justified by our adoption of Roubal, Jovaag, Park, and Gennuso's (2015) county-level measure of access to parks and recreational facilities. Although local and regional park and recreation agencies differ greatly in size and serve different types of jurisdictions (e.g., a town, city, county; National Recreation and Park Association, 2017), this county-level measure allows researchers and park and recreation officials to undertake activities to promote the built environment (e.g., parks, recreational facilities) for physical activities (Roubal et al., 2015). For these two reasons, the county was the most suitable unit of analysis to assess the relationship between access to parks and recreational facilities, physical activity rate, and healthcare costs among older adults for the current study.

County-level data were obtained from two secondary sources: the County Health Ranking (CHR) database (University of Wisconsin Population Health Institute, 2017) and the Behavioral Risk Factor Surveillance System (BRFSS) survey (Centers for Disease Control and Prevention, 2018). The CHR database ranks health-related outcomes using county-level measures collected from multiple national data sources, including the National Center for Chronic Disease Prevention and Health Promotion, the American Community Survey, and the National Center for Health Statistics. Data from the BRFSS survey consist of annual telephone-survey responses from adults aged 18 years or older; the survey is conducted by the health departments of all 50 states and the District of Columbia. From the CHR database and the BRFSS data, we created two datasets for 2013 (Dataset 2013) and 2014 (Dataset 2014).

To alleviate concerns of reverse causality, we followed Carlson et al.'s (2015) approach by using the physical activity rate data (2012 in Dataset 2013; 2013 in Dataset 2014) that preceded the healthcare cost data (2013 in Dataset 2013; 2014 in Dataset 2014). We removed counties that did not include data for the healthcare costs or the physical activity. The final datasets included 3,134 usable counties in Dataset 2013 and 3,133 usable counties in Dataset 2014, which represented over 99% of the 3,143 counties and county equivalents in the United States.

Measures

Healthcare costs in older adults were measured by the average Medicare reimbursements (Part A and Part B) per enrollee in each county. This variable was originally obtained from the Dartmouth Atlas of Health Care data and was adjusted for age, sex, race, and regional price differences. People are eligible for Medicare at age 65 or older, or under age 65 if they have received Social Security disability insurance for 24 months or have end-stage renal disease or amyotrophic lateral sclerosis (Barry, 2016); therefore, the average Medicare reimbursements in a given county do not exactly measure the average healthcare costs among older adults in that county. Nevertheless, given that 85% of Medicare beneficiaries qualified for coverage based on age status (Board of Trustees, 2018), the healthcare costs per Medicare enrollee were considered to serve as a proxy for the county's average healthcare costs for older adults.

Second, because none of the existing secondary data sources offered country-level data specific to older adults' physical activity rates, we created county-level estimates of these rates using the physical activity data available in the CHR database and the BRFSS data. First, we obtained the percentage of adults aged 20 and over reporting leisure-time physical activity in a county from the CHR database. Second, from the BRFSS data, we obtained (a) the percentage of

adults aged 20 and over reporting leisure-time physical activity in each state and (b) the percentage of adults aged 65 and over reporting leisure-time physical activity in each state. Third, using these percentages, we calculated the state-level ratio of older adults' physical activity rate to the physical activity rate of adults aged 20 and over for each state. Finally, the following formula was used to obtain estimates of older adults' physical activity rate in each county:

$$\text{Estimate of \% of adults aged 65 and over reporting leisure-time physical activity in a county} = \text{\% of adults aged 20 and over reporting leisure-time physical activity in that county} \times (\text{\% of adults aged 65 and over reporting leisure-time physical activity in the state where the county is located} \div \text{\% of adults aged 20 and over reporting leisure-time physical activity in the state where the county is located})$$

The above measure represented the adjusted percentage of adults aged 65 and over reporting leisure-time physical activity in each county.¹

Access to parks and recreational facilities represented the percentage of the population with adequate access to locations for parks and recreational facilities in each county. Based on Roubal et al. (2015), individuals who reside in a census block within a half mile of a park, 1 mile of a recreational facility in urban areas, or 3 miles of a recreational facility in rural areas were considered to have adequate access to parks and recreational facilities. These distances correspond to what individuals would walk to visit a park or drive to visit a recreational facility and are intended to approximate a 10-minute trip, as trips longer than 10 minutes are associated with decreased activity (Roubal et al., 2015). The Roubal et al.'s measure was originally created using three data sources. The park data were aggregated from two sources (The DeLorme

¹ For instance, older-adults' physical activity rate in Philadelphia County in 2012 (65.63) was calculated as: 73.70 (% of adults aged 20 and over reporting leisure-time physical activity in Philadelphia County in 2012) × 66.11 (% of adults aged 65 and over reporting leisure-time physical activity in the state of Pennsylvania in 2012) ÷ 74.23 (% of adults aged 20 and over reporting leisure-time physical activity in the state of Pennsylvania in 2012)

MapMart and Ersi geographic information system data) to obtain 2010 projected data on parks at the local, state, and national levels across the United States. In addition, the recreational facility data were obtained from OneSource Global Business Browser in 2012 (Dataset 2013) and ArcGIS Business Analyst in 2013 (Dataset 2014). Recreational facilities included all businesses classified as recreational facilities according to the North American Industry Classification System, such as gyms, golf courses, country clubs, community recreational sport centers, and dance studios (Roubal et al., 2015).

Based on the social-ecological model, the analysis included 16 county-level control variables that might predict healthcare costs (Sallis et al., 2006; Senn et al., 2014; von Hippel & Benson, 2014). State dummies were also included for all analyses to control for state-specific effects on older adults' physical activity rate and healthcare costs. Variable descriptions are presented in Table 1.

[Table 1 about here]

Statistical Analysis

In the current dataset, 17.6% of counties in Dataset 2013 and 7.3% of counties in Dataset 2014 had at least one missing observation. In Dataset 2013, 13.4% of cases were missing data for smoking rate, and 4.3% of cases were missing data for primary care physician. In Dataset 2014, 4.2% of cases were missing data for primary care physician. The analyses presented in this study were based on a dataset with the imputed values using an expectation-maximization (EM) algorithm. The EM-based approach is considered more reliable than list-wise deletion for handling missing data because it produces less-biased estimates (Gefen, Rigdon, & Straub, 2011; Schafer & Graham, 2002).

There were two phases of analysis in this study. The first phase of analysis consisted of ordinary least squares (OLS) regression analyses, which was undertaken to assess the relationship between the physical activity rate and healthcare costs among older adults (Hypothesis 1). The second phase of analysis consisted of mediation analyses using Hayes's (2013) PROCESS macro for SPSS (Model 4), which were conducted to examine the indirect associations of access to parks and recreational facilities with older adults' healthcare costs through the physical activity rate (Hypothesis 2). For the mediational analyses, 10,000 bootstrap samples with replacement were used, with bias-corrected bootstrapping adopted to account for population skew. Significance tests for indirect associations were determined by the 95% confidence interval (CI).

Results

Descriptive statistics of the samples are shown in Table 2. The average healthcare costs in each county were \$9,322 per person in 2013 and \$9,402 per person in 2014. The mean estimated physical activity rate ranged from 66% to 69% across the two datasets, suggesting that, on average, around two-thirds of older adults in each county were involved with leisure-time physical activity. Finally, 52% of the population had adequate access to parks and recreational facilities in Dataset 2013, whereas 62% had adequate access to parks and recreational facilities in Dataset 2014. A 10% difference in access to parks and recreational facilities might be explained because the recreational facilities data were obtained from different sources for Dataset 2013 (i.e., OneSource Global Business Browser) and Dataset 2014 (i.e., ArcGIS Business Analyst).

[Table 2 about here]

Table 3 (Dataset 2013) and Table 4 (Dataset 2014) summarize the regression results by different combinations of independent variables. Adjusted R-squared values of the full model

(Column 3) were .70 in Dataset 2013 and .67 in Dataset 2014. In support of Hypothesis 1, the results of the full model showed that the physical activity rate was negatively associated with healthcare costs among older adults in Dataset 2013 ($B = -15.32, p = .03, 95\% \text{ CI} = [-28.83, -1.82]$) and Dataset 2014 ($B = -20.79, p < .01, 95\% \text{ CI} = [-35.76, -5.82]$). The results indicate that a 1% increase in the physical activity rate in a county might be associated with reducing older adults' healthcare costs per person in that county by \$15.32 in 2013 and \$20.79 in 2014. Among the control variables, income, preventable hospital stays, population living in rural area, long commute, and air pollution were positively associated with older adults' healthcare costs in both datasets ($p < .05$).

[Table 3 and Table 4 about here]

Figure 1 reports the findings of the mediation analysis with Hayes's (2013) bootstrapping approach. Results showed that access to parks and recreational facilities was positively associated with the older adults' physical activity rate ($p < .01$), which in turn was negatively associated with their healthcare costs ($p < .05$) in both datasets. By contrast, the direct path from access to parks and recreational facilities to older adults' healthcare costs was nonsignificant in both datasets ($B = 1.41, p = .13$ in Dataset 2013; $B = .88, p = .49$ in Dataset 2014). In support of Hypothesis 2, these path coefficients produced a significant, indirect association of access to parks and recreational facilities with older adults' healthcare costs through the physical activity rate in Dataset 2013 (effect = $-.18; 95\% \text{ CI} = [-.39, -.03]$) and in Dataset 2014 (effect = $-.16; 95\% \text{ CI} = [-.37, -.03]$). The results indicate that a 1% increase in the percentage of the older population with adequate access to parks and recreational facilities in a county might be associated with reducing older adults' healthcare costs per person by \$0.18 in 2013 and \$0.16 in 2014 in that county through increased rates of physical activity.

[Figure 1 about here]

Discussion

Despite the government's continued focus on macro-level public health policy targets, extant research on physical activity and health has focused on individual-level research designs. Based on the social-ecological model and prior research related to healthcare costs, this study examined the county-level relationships between access to parks and recreational facilities, physical activity rate, and healthcare costs among older adults. Findings from the regression analyses suggest that the physical activity rate in a county is negatively associated with healthcare costs in that county among older adults, after considering multilevel factors in the community. Specifically, the higher the percentage of older people engaging in leisure-time physical activity in a county, the lower healthcare costs they have in that county. It should be noted that reverse causality is less likely to explain our findings, because the information on the county-level physical activity rate preceded the healthcare cost data over a 2-year period. The results enrich the extant individual-level research by supporting the idea that engaging older adults in physical activities plays a significant role in reducing the healthcare costs for these adults. Using an inclusive measure of older adults' healthcare-cost data from over 99% of U.S. counties, our results also corroborate and extend the work of Rosenberger and colleagues (2005), who found a negative association between physical activity rate and healthcare costs on hospital treatments of circulatory diseases and disorders in West Virginia counties.

Another key finding from this research is that increasing access to parks and recreational facilities in a county has the capacity to reduce older adults' healthcare costs in that county. The results of the mediational analysis revealed that access to parks and recreational facilities had a negative, indirect association with older adults' healthcare costs through increased rates of

physical activity. These findings seem to indicate that communities with better access to parks and recreational facilities have a higher county-level physical activity rate among older adults, which could reduce these adults' healthcare costs in that county. Although leisure research has documented the importance of parks and recreational facilities that provide physical activity opportunities and health benefits, empirical findings are mixed regarding the health benefits of parks and recreational facilities (Edwards et al., 2011; Larson et al., 2016; Oftedal & Schneider, 2013; Rosenberger et al., 2005; West et al., 2012). Moreover, although the general public supports investment in parks and recreational facilities that are capable of eliciting higher levels of physical activity health benefits (Godbey & Mowen, 2010; Gómez et al., 2015), research has not actually examined whether such investment is associated with reducing healthcare costs at the population level. The present analysis suggests that access to parks and recreational facilities has no direct association with older adults' healthcare costs, which supports prior research suggesting potential mediators that may explain the relationships between access to parks and recreational facilities and health outcomes (Lachowycz & Jones, 2013). Our analysis seems to imply that investment in parks and recreational facilities per se does not contribute to a reduction in healthcare costs. Rather, such investment should be matched with programs that promote physical activity in those facilities to leverage their health benefits. Overall, our results suggest that better access to parks and recreational facilities can provide potential benefits for reducing older adults' healthcare costs through promoting physical activity, which might offer an additional justification for public investment in those facilities.

Although the current study focused on the relationships between access to parks and recreational facilities, the physical activity rate, and healthcare costs among older adults, it is worth exploring how our results for the relationships between other control variables and

healthcare costs are similar to or different from extant findings. Among the intrapersonal factors examined in this research, the regression analysis revealed that the percentages of obesity and smoking adults were not associated with healthcare costs. These findings are supported by studies that indicate minimal effects of body weight and smoking status on healthcare costs using individual-level analyses (Wang et al., 2005; Wang, Pratt, Macera, Zheng, & Heath, G, 2004). Among the institutional and community factors, long commute and air pollution were positively associated with older adults' healthcare costs. These results are also corroborated by studies that observed adverse health effects associated with longer commutes (Hoehner, Barlow, Allen, Schootman, 2012) and long-term exposure to air pollution (Di et al., 2017). The significant associations between these factors and older adults' healthcare costs support the notion that it is critical to investigate the health benefits of physical activity by considering multilevel influence in the community (Ofstedal & Schneider, 2013; Wilhelm Stanis et al., 2014).

Our findings provide several practical implications for local governments and communities to guide their policy making and funding. As noted, the results of our regression analysis indicate that a 1% increase in the physical activity rate in a county may be associated with a \$15.32 (in 2013) to a \$20.79 (in 2014) reduction in older adults' healthcare costs per person in that county. If these results are applied to a county of 10,000 older people,² a 1% increase in the physical activity rate might realize a savings of \$153,200 to \$207,900 in older adults' healthcare costs in that county. Local parks and recreation departments can make a case for increased prioritization of and investment in physical activity intervention programs that motivate people to increase their physical activity levels.

² According to the CHR database, around 27% of U.S. counties ($N = 861$) had estimated populations (aged 65 and older) of over 10,000 in 2014.

Similarly, our test of Hypothesis 2 indicated that, in a county of 10,000 older people, a 1% increase in access to parks and recreational facilities (i.e., 100 more individuals residing in a census block within a half mile of a park, 1 mile of a recreational facility in urban areas, or 3 miles of a recreational facility in rural areas) would reduce older adults' healthcare costs by \$1,800 in 2013 and \$1,600 in 2014 through promoting residents' participation in physical activity. Although this number may appear small, the results could provide an insight into the ongoing conversation regarding cutting funds for national parks and recreation programs (National Recreation and Park Association, 2018; Sims, 2017). Moreover, it is estimated that small to medium park facilities that can promote physical activity cost \$30,000 or less to develop, including a small exercise area (\$20,000), a multicourt sport facility (\$20,000), and a medium-length trail (\$30,000; Floyd, Suau, Layton, Maddock, & Bitsura-Meszaros, 2015). Annual maintenance costs of these facilities would also range from \$0.40 (a medium-length trail) to \$2,500 (a multicourt sport facility; Floyd et al., 2015). Given these cost estimates, a potential reduction of \$1,600 to \$1,800 in older adults' healthcare costs might be considered substantial. Importantly, better access to parks and recreational facilities provide health benefit for all residents in the community. Local park and recreation officials, particularly in a populous county, could use our findings as a justification to develop initiatives to maintain and enhance residents' access to parks and recreational facilities to promote physical activity, thereby reducing healthcare costs in the community.

Limitations and Future Directions

This study has several limitations. First, the data were cross-sectional and thus do not allow conclusions to be drawn about causality. Future research is encouraged to use a

longitudinal research design to assess causal relationships among access to parks and recreational facilities, physical activity rate, and healthcare costs.

Second, because county-average physical activity data for older adults were unavailable in existing secondary data sources, we created the estimates of county-level physical activity rate for older adults using the state-level ratio of physical activity rate among adults aged 65 and over to physical activity rate aged 20 and over. We also used the healthcare costs per Medicare enrollee as a proxy for average healthcare costs for older adults in each county. The relationships examined in this study could be investigated using the county-average physical activity rate and healthcare costs for older adults to strengthen confidence in our findings if such data become available in the future.

Finally, we used physical activity rate as a mediator between access to parks and recreational facilities and older adults' healthcare costs; however, parks and recreational facilities could offer benefits beyond physical activity promotion, such as recovery from stress, better air quality, and facilitation of social connections (Lachowycz & Jones, 2013; Larson et al., 2016). The relationship between physical activity rate and healthcare costs among older adults could be investigated with other mediating variables that represent these and other benefits derived from parks and recreational facilities.

Conclusions

Building upon a social-ecological model, this study extends the field's understanding of the link between access to parks and recreational facilities, physical activity, and healthcare costs for older adults at the county level. The findings suggest that communities tend to have lower healthcare costs when more older adults are physically active, which is consistent with the main tenet of the social-ecological model. Our findings also suggest that better access to parks and

recreational facilities lowers older adults' healthcare costs in the community by promoting physical activity. These findings add new evidence in support of parks and recreational facilities as providers of physical activity opportunities that can lead to health benefits.

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Table 1. Variable Descriptions

Variable	Description	Dataset 2013	Dataset 2014
Healthcare cost	Average price-adjusted Medicare reimbursements per enrollee	2013	2014
Physical activity rate	Adjusted % of adults aged 65 and over reporting leisure-time physical activity	2012	2013
Access to parks and recreational facilities	% of population with adequate access to locations for parks and recreational facilities	2010/2012	2010/2013
Income	Median household income	2013	2014
Children in poverty	% of children (under age 18) living in poverty	2013	2014
Unemployed	% of adults age 16+ unemployed and looking for work	2013	2014
Age 65 and over	% of the population aged 65 and over	2013	2014
Female	% of female	2013	2014
College	% of adults with some post-secondary education	2009-2013	2010-2014
White	% of white population	2013	2014
Obesity	% of adults reporting BMI \geq 30	2013	2014
Smoking	% of adults that reported currently smoking	2006-2012	2014
Preventable hospital stays	Number of hospital stays for ambulatory-care sensitive conditions per Medicare enrollee	2013	2014
Primary care physician	Ratio of population to primary care physicians*1000	2013	2014
Food insecurity	% of population who did not have access to a reliable source of food during the past year	2013	2014
Population living in rural area ^a	% of population living in a rural area	2010	2010
Driving alone to work	% of the workforce that drives alone to work	2009-2013	2010-2014
Long commute	Among workers who commute in their car alone, the percentage that commute more than 30 minutes	2009-2013	2010-2014
Air pollution ^a	The average daily measure of fine particulate matter in micrograms per cubic meter (PM2.5)	2012	2012

Note. ^aThe same data were used for Dataset 2013 and Dataset 2014 because of data availability.

Table 2. Descriptive Statistics of the Sample, U.S. Counties

Variable	Dataset 2013 (<i>N</i> = 3,134)		Dataset 2014 (<i>N</i> = 3,133)	
	Mean	<i>SD</i>	Mean	<i>SD</i>
Healthcare cost	9322.42	1489.47	9402.13	1493.32
Physical activity rate	66.07	5.14	68.69	5.19
Access to parks and recreational facilities	52.01	24.50	62.29	22.98
Income	45956.20	11731.70	47108.03	12100.91
Children in poverty	24.59	9.57	23.67	8.94
Unemployed	7.25	2.66	6.25	2.27
Age 65 and over	17.17	4.38	17.58	4.43
Female	49.94	2.24	49.92	2.27
College	55.75	11.58	56.28	11.57
White	77.42	19.86	77.16	19.83
Obesity	31.03	4.52	31.48	4.51
Smoking	21.25	6.18	18.39	3.77
Preventable hospital stays	63.72	25.10	59.26	23.32
Primary care physician	54.65	35.13	54.08	35.47
Food insecurity	15.06	3.93	14.67	4.14
Population living in rural area	58.69	31.44	58.58	31.46
Driving alone to work	78.67	7.70	79.02	7.44
Long commute	29.84	12.06	30.17	12.06
Air pollution	8.90	1.66	8.91	1.64

Table 3. OLS Regression Analyses for Relationship between Physical Activity Rate and Healthcare Costs (Dataset 2013)

Independent variables	(1)		(2)		(3)	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Physical activity rate	-63.88***	5.21	-68.48***	5.93	-15.32*	6.89
Access to parks and recreational facilities			1.72	1.05	1.41	0.93
Income					-0.01*	0.00
Children in poverty					-0.72	4.89
Unemployed					0.47	14.20
Aged 65 and over					-5.45	5.57
Female					8.96	10.40
College					4.76	2.94
White					-1.77	2.16
Obesity					4.01	6.76
Smoking					4.46	3.63
Preventable hospital stays					31.01***	1.39
Primary care physician					0.63	0.61
Food insecurity					-22.06	12.95
Population living in rural area					-2.50*	0.99
Driving alone to work					5.68	3.96
Long commute					7.60***	1.98
Air pollution					164.07***	20.95
State dummies	Yes		Yes		Yes	
Adjusted R^2	0.53		0.53		0.70	

Note. Robust standard errors (SE) are reported. Geographical dummy variables for State ($n = 49$) were included to all models, but their coefficients are not shown in the table.

* $p < .05$. *** $p < .001$

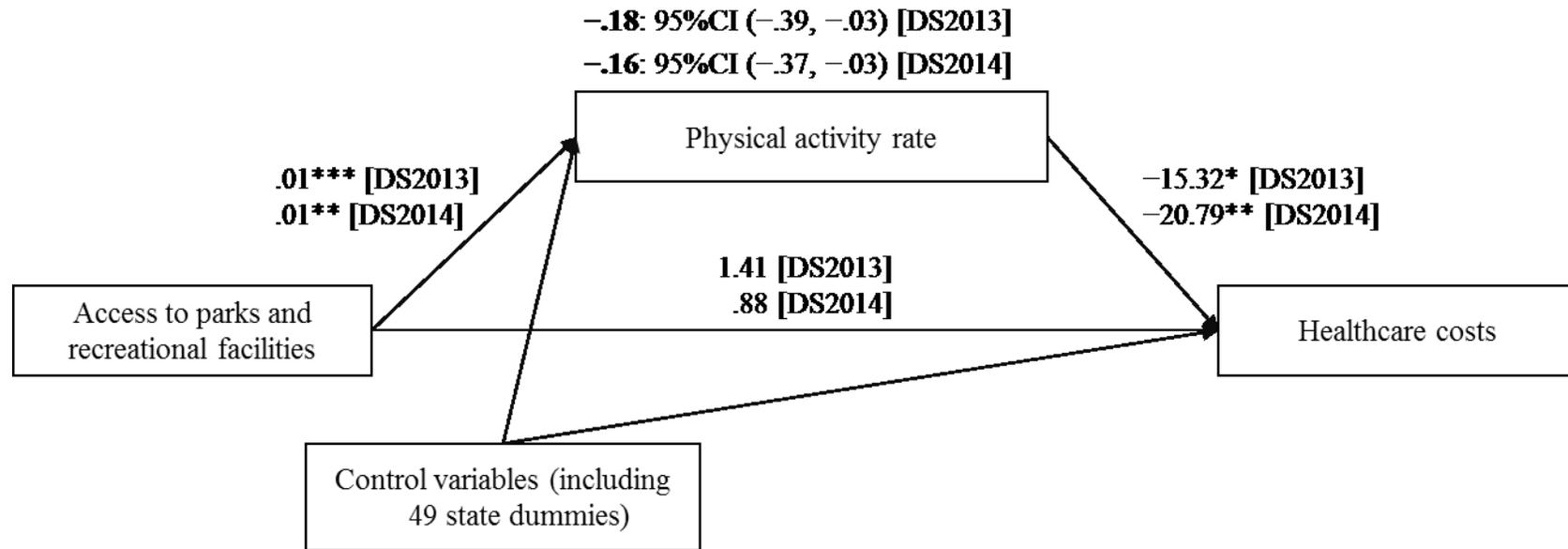
Table 4. OLS Regression Analyses for Relationship between Physical Activity Rate and Healthcare Costs (Dataset 2014)

Independent variables	(1)		(2)		(3)	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Physical activity rate	-66.09***	5.45	-66.05***	6.46	-20.79**	7.64
Access to parks and recreational facilities			-0.02	1.25	0.88	1.26
Income					-0.01*	0.00
Children in poverty					3.26	5.58
Unemployed					-8.95	16.53
Aged 65 and over					-5.80	6.60
Female					-3.16	10.40
College					8.40**	3.17
White					-0.51	2.32
Obesity					-3.03	6.65
Smoking					-3.45	15.89
Preventable hospital stays					32.70***	1.47
Primary care physician					0.10	0.60
Food insecurity					-19.56	12.08
Population living in rural area					-2.37*	1.11
Driving alone to work					5.66	4.44
Long commute					6.88***	2.06
Air pollution					181.88***	21.71
State dummies	Yes		Yes		Yes	
Adjusted R^2	0.50		0.50		0.67	

Note. Robust standard errors (SE) are reported. Geographical dummy variables for State ($n = 49$) were included to all models (Alabama was used as the reference group), but their coefficients are not shown in the table.

* $p < .05$. ** $p < .01$. *** $p < .001$

Figure 1. Results of Regression Analysis with Hayes (2013) Bootstrapping Approach



Note. DS2013 = Dataset 2013; DS2014 = Dataset 2014. Boldface highlights significant indirect associations as determined by the 95% bias-corrected confidence interval.

* $p < .05$, ** $p < .01$, *** $p < .001$.