Association of access to exercise opportunities and cardiovascular mortality

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Abstract We sought to examine the patterns of cardiovascular disease (CVD) mortality in varying degrees of access to exercise opportunities at county level in the United States. Access to exercise opportunities was significantly associated with adjusted CVD mortality ($P < .001$); higher access to exercise opportunities correlated with lower CVD mortality. Counties with lower access to exercise facilities had higher prevalence of obesity and diabetes when compared with counties with higher access ($P < .001$). Furthermore, the states with fewer people living in close proximity to a park had higher percentage of people not engaging in any leisure physical activity ($P < .001$). (Am Heart J 2019;212:152-6.)

Physical activity is strongly associated with cardiovascular health, to the extent that even a single episode of exercise has protective effects against cardiovascular events.[1] Despite the Department of Health and Human Services endorsing at least 150 to 300 minutes of moderate-intensity aerobic physical activity per week,[2] 80% of American adults do not meet the national physical activity recommendations for aerobic activity and muscle strengthening.[3] With high burden of mortality from cardiovascular diseases (CVDs) in the United States, it is critical to assess tangible policy options to improve the physical activity and curb the burden of CVDs.

Neighborhood walkability is associated with lower cardiovascular risk[4]; however, it only captures a limited spectrum of how people pursue physical activity. To better understand the utility of access to exercise among US communities, it is critical to evaluate whether it is associated with cardiovascular mortality given the close association between cardiovascular health and physical activity.[5] In a country where 1 in 3 deaths each year is due to CVD, such an effort can provide comprehensive information to policymakers for knowledge generation and resource allocation in the fight against heart diseases. Accordingly, we examined the patterns of CVD mortality in varying degrees of access to exercise opportunities at county level in the United States.

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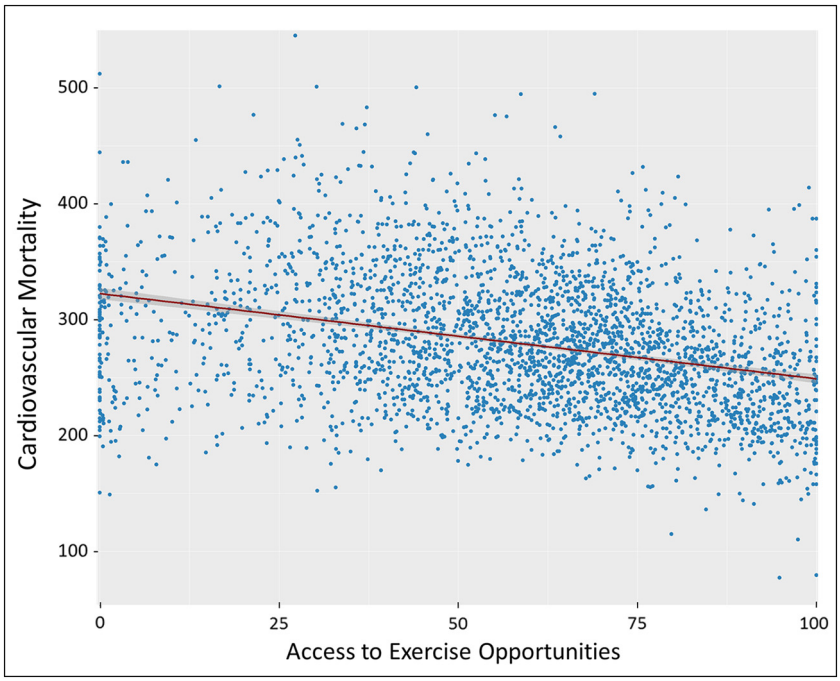
Methods

County-level access to exercise opportunities for the year 2014 was obtained from County Health Rankings and Roadmaps data.[6] *Access* was defined as the percentage of individuals in a county who live reasonably close to a location for physical activity. These facilities were identified through Standard Industry Classification codes as defined by the US Securities and Exchange Commission[7] and included parks or recreational facilities like gyms, community centers, dance studios, pools, and other exercise facilities. *Individuals considered to have adequate access for opportunity for physical activity* were defined as those residing in a census block within a half-mile of a park, or residing within 1 mile of a recreational facility in urban census blocks, or residing within 3 miles of a recreational facility in rural census blocks.

Data on county-level age-standardized CVD mortality were obtained from the National Vital Statistics System, the details of which have been published earlier.[8] We used linear regression model to assess the association of access to exercise opportunities with county-level age-standardized CVD mortality rates, further adjusting for sex distribution, race distribution, urban-rural distribution, percentage of population under the age of 65 years who are uninsured, median household income, and percentage of *adult smokers* (defined as adults who currently smoke every day or smoke most of days and have smoked at least 100 cigarettes in their lifetime). To further understand this association, we compared CVD mortality of counties with ≥91% access to those with ≤10% access using Welch *t* test. Furthermore, we compared the obesity and diabetes prevalence in these 2 county groups. *Obesity* was defined as the body mass index ≥30 kg/m^2. Diabetes was assessed using self-reported response to the question, "Has a doctor ever told you that you have diabetes?". Women who reported gestational diabetes mellitus were excluded.

Figure 1



Association of access to exercise opportunities and cardiovascular mortality at county level. Increased access correlated with lower cardiovascular mortality (access to exercise opportunities was significantly associated with adjusted cardiovascular mortality; $P < .001$, adjusted R^2 of 0.48). Cardiovascular mortality in deaths per 100,000 population. Access to exercise opportunities in percentage of people living in close proximity to a location for physical activity.

We also assessed the population-level behavioral patterns of physical activity and how it correlates with living in close proximity to a facility of physical activity. We used data from the Behavioral Risk Factor Surveillance System, a health-related survey that collects data about US residents regarding their health-related risk behaviors, chronic health conditions, and use of preventive services. Although county-level data were not available, state-level data on self-reported physical activity were available. We assessed the correlation of percentage of population living less than half a mile away from a park with the percentage of population reporting no leisure physical activity using paired *t* test. Analyses were performed in R programming language version 3.1.1. No extramural funding was used to support this work. The authors are solely responsible for the design and conduct of this study, all study analyses, the drafting and editing of the paper, and its final contents.

Results

Data were available for 3,069 counties. Median access to exercise opportunities was 61.8% (interquartile range, 42.7-77.1). Nationally, the mean CVD mortality (per 100,000 population) was 252.7 (95% CI, 247.1-258.3) in 2014. At the county level, for a 10% increase in access, the CVD mortality decreased by 7.4 per 100,000 population (Figure 1). After adjusting for various sociodemographic factors, access to exercise opportunities was significantly associated with CVD mortality ($P < .001$).

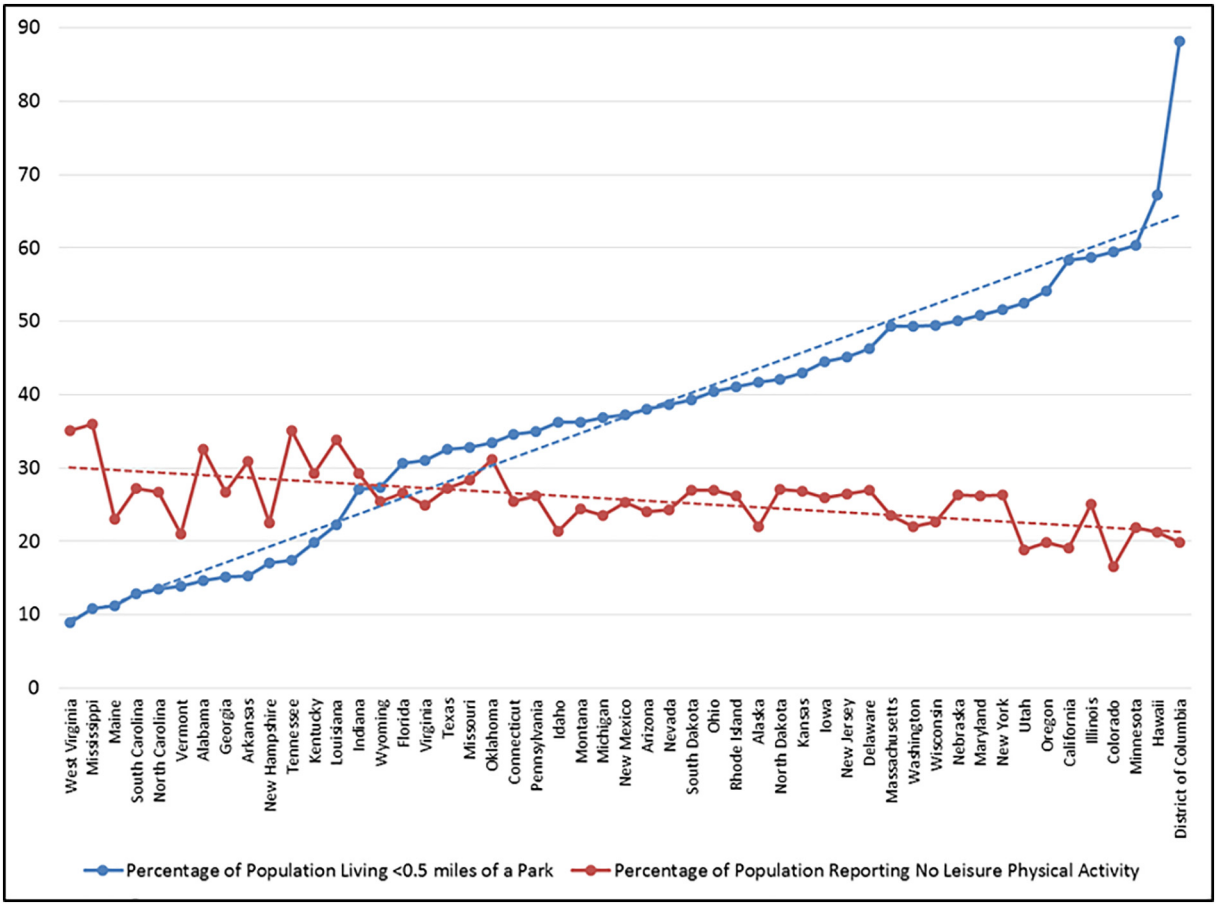
There were 172 counties with ≤10% access and 290 counties with ≥91% access. Whereas the mean CVD mortality in counties with ≤10% access was 289.3 (95% CI, 280.0-298.7), it was 239.4 (95% CI, 233.3-245.6) for counties with ≥91% access, accounting for a 17.2% relative risk reduction for CVD mortality. The counties with ≤10% access to exercise opportunities comprised more frequently of older population and lower proportion of women residents than counties with ≥91% access; race distribution was similar (Table 1). Furthermore, the counties with ≤10% access were predominantly rural, had lower annual household income, and had higher percentage of uninsured population than counties with ≥91% access. The prevalence of obesity and diabetes was significantly higher in counties with ≤10% access to exercise opportunities when compared to the counties with ≥91% access ($P < .001$).

States with higher proportion of people living less than 0.5 miles away from a park had fewer people that reported no leisure physical activity ($P < .001$). Figure 2

Table 1. Characteristics of counties with ≤10% and ≥ 91% access to exercise opportunities

	Counties with ≤10% access (n = 172)	Counties with ≥91% access (n = 290)	*P* value
CVD mortality	289.3 (95% CI, 280.0-298.7)	239.4 (95% CI, 233.3-245.6)	<.001
Demographics % (mean [SD])			
Age	41.8 (6.1)	39.1 (5.8)	<.001
Female	48.9 (3.6)	50.7 (1.5)	<.001
Whites	69.6 (27.2)	68.9 (20.2)	.8
Blacks	12.4 (20.6)	10.4 (12.9)	.3
Population living in rural areas	90.5 (19.3)	22.9 (30.6)	<.001
Uninsured population	24.9 (6.2)	18.8 (6.6)	<.001
Annual household income ($)	41,011.7 (9510.0)	59,103.3 (18,446.2)	<.001
Percentage of adult smokers	20.2 (5.4)	16.1 (3.7)	<.001
Morbidity % (mean [SD])			
Obesity	33.1 (4.2)	26.3 (4.8)	<.001
Diabetes	12.9 (2.7)	9.8 (2.1)	<.001

Figure 2



Population living in close proximity to a park and population reporting no leisure physical activity in the United States.

shows the inverse correlation between the percentage of people living less than half a mile from a park and percentage of people reporting no physical activity.

Discussion

This is the first study, to our knowledge, that examines the association of variation in access to exercise

opportunities with cardiovascular mortality. Counties with lower access to exercise opportunities had higher CVD mortality with higher prevalence of obesity and diabetes when compared with counties with higher access. Furthermore, the states with fewer people living in close proximity to a park had higher percentage of people not engaging in any leisure physical activity.

Higher access to exercise facilities correlated with lower CVD mortality. While the causes of lower CVD mortality are multi-factorial, one may be a higher likelihood of using exercise facilities by those living in close proximity of them, leading to a lower prevalence of CVD risk factors such as obesity and diabetes, which have been shown to improve with increased physical activity.[9-11] Hence, decreasing barriers to healthy lifestyle and promoting physical activity can be critical toward improving the CVD mortality at the population level. In particular, the areas with fewer exercise facilities should be identified, and resources should be allocated to these communities. Providing equitable access and reducing heterogeneity may help address the formidable public health burden of CVDs through greater engagement in communities.

The results of this study should be viewed in light of the following limitations. First, this analysis is limited by its ecological design. Hence, a direct causal effect cannot be ascertained. However, after accounting for sociodemographic factors across a large sample size, a significant correlation between access to exercise opportunities and CVD mortality was observed. Furthermore, at state level, correlation was found between reported physical activity and living in close proximity to a park. Secondly, given that our study is a more sociodemographically adjusted population-based study, patient-level direct risk factors were not included in our analysis. Furthermore, we were unable to adjust for other factors, like health status, which may impact the cardiovascular health of the population. However, at population level, sociodemographic factors play a significant role in determining the cardiovascular health.[12] Finally, we were not able to account for barriers to using these exercise facilitates. However, we did account for the distance from an exercise facility and household income which can be critical in an individual's use of such facilities.

In conclusion, the counties with better access to exercise opportunities exhibited lower CVD mortality. Our findings support broad-based opportunities to improve access and to reduce the heterogeneity in access to resources for physical activity in the United States.

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Disclosures

Dr Gupta serves as an expert witness (on behalf of the plaintiff) for litigation related to inferior vena caval filters. The content of the current manuscript is not related to that litigation. Dr Gupta is also a co-founder of Heartbeat Health, Inc, a heart disease prevention platform. Dr Desai works under contract with the Centers for Medicare & Medicaid Services to develop and maintain performance measures that are publicly reported, and is a recipient of research agreements from Johnson & Johnson (Janssen), through Yale, to develop methods of clinical trial data sharing. Dr Desai also reports research grants and consulting with Amgen, Boehringer Ingelheim, Novartis, and Relypsa. The other authors report no potential conflicts of interest.

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