Walk Score and poverty in American Cities

Authors:

Yael T Levine[1]

Shelly K McCrady-Spitzer MSc[1]

James A Levine MD PhD[1,2]

Affiliations:

[1] Department of Endocrinology, Mayo Clinic, Rochester, MN, USA;

E-mail: yaeltalia@hotmail.co.uk;

E-mail: mccrady.shelly@mayo.edu;

[2] Obesity Solutions, Mayo Clinic Arizona and Arizona State University, Scottsdale, AZ, USA;

E-mail: levine.james@mayo.edu.

Address correspondence to:

James A Levine,

Mayo Clinic Arizona and Arizona State University,

13400 East Shea Blvd, Scottsdale, AZ 85259,

E-mail: levine.james@mayo.edu

Phone: 480-301-4524.

Key words: Physical activity, urban planning

Abstract

Introduction. Environmental factors are thought to impact obesity; for instance, food deserts are urban areas with poor access to fresh foods. Similarly, environmental variance might explain differences in urban physical activity levels. Prior work has examined poverty, obesity and sedentariness in 3,139 counties across the United States. Poverty, obesity and sedentariness track together. Since three quarters of Americans live in cities, this paper examines whether cities with greater rates of poverty had the poorest Walk Score (a geospatial algorithm of an area's attractiveness of walking; a high score is walk-favorable).

Methods. Data were analyzed from 532 American cities (defined as a population >30,000 people), examining data from 103,405,474 people. Data on income were available from 102,586,417 people. The Walk Score for all 520 cities was determined from Street Smart Walk Score algorithm derived from the Active Living Research (Robert Wood Johnson Foundation http://activelivingresearch.org/). Walk Score and city demographics were compared between the 100 cities with the lowest poverty prevalence 6.4 ± (SD) 1.7% with the 100 cities of great poverty prevalence 27.4 ± 4.1%.

Results. The cities with greatest poverty had, as expected, lowest median family income ($43,604 ± $10,097 vs. $89,613 ± $19,058; for all 520 cities there was a log linear relationship between these variables r^2 = 0.77). Importantly too, the poorer cities had greater populations (197,128 ± 235,305 vs. 109,952 ± 58,375 people). There was no relationship between city population and Walk Score. Unexpectedly, the cities with greater poverty and lower income, have the most favorable Walk Score (50.1 ± 12.2 points) compared to wealthier cities (Walk Score 44 ± 12.2; P<0.001).

Discussion. Cities with high poverty rates do not appear to be more unfavorable to walking compared to wealthy cities. Thus, the known association between sedentariness, obesity & poverty may not relate to the walkability of the city.

1. Introduction

Overall, the physical environment influences both nutrition and daily physical activity; it is a critical social determinant of health. Another is socioeconomic status. Socioeconomic status affects a person's risk of developing obesity. If a person lives in a wealthy ZIP code, they are more likely to be active and less likely to have obesity and diabetes. People who live in areas of great poverty are more likely to develop obesity and have chronic non-communicable disease and mental illness. Living in dense poverty is not surprisingly therefore associated with sedentariness and impaired access to healthy nutrition.

This paper examines specifically whether the built environment accounts for why people living in poverty-dense locales are more sedentary. It is known that ZIP codes with the greatest rates of poverty, have also the greatest rates of sedentariness, obesity and diabetes [1]. Since three quarters of Americans live in cities, we wondered whether cities with the greater rates of poverty had the poorest Walk Score (a geospatial algorithm of an area's attractiveness of walking). Data were analyzed from 527 American cities (defined as a population >30,000 people), examining data from 103,405,474 people, a third of the US population. Data on income were available from 102,586,417 people. The Walk Score for all 527 cities was determined from Street Smart Walk Score algorithm [2,3] derived from the Active Living Research (Robert Wood Johnson Foundation http://activelivingresearch.org/). The hypothesis was that cities with the greatest rates of poverty have the greatest rates of sedentariness and the worst (lowest) walk scores. This would imply that sedentariness is associated with living in a place that is dense in poverty and inhibitory of walking. Conversely, people who live in wealthy places may walk more since their locales have better (higher) walkability scores. Health, sedentariness and Walk Scores were compared between the 100 cities with the lowest poverty prevalence (6.4 ± (SD) 1.7%) with the 100 cities of great poverty prevalence 27.4 ± 4.1%.

2. Methods

Data were collated from the 2010 US Census bureau based on Federal Information Processing Standards (FIPS) geographic location codes which are

similar to ZIP codes [4]. These data were aligned with data on Nutrition, Physical Activity and Obesity gathered by the Centers for Disease Control and Prevention [5]

From this data set, data from 532 American cities was analyzed; a city being defined as a region with a population of more than 30,000 people. The Walk Score for each of these cities was calculated from the Street Smart Walk Score algorithm derived from the Active Living Research (Robert Wood Johnson Foundation http://activelivingresearch.org/) where a high Walk Score is walk-favorable a low Walk Score reflects high car use). Data were examined from 106,515,702 people, a third of the US population.

3. Statistics

Analyses were performed using the 64-bit JMP® Pro 12.2.0 SAS platform (SAS, Cary, NC, USA). To address the hypotheses, variables were compared between the 100 cities with the lowest poverty prevalence, 6.4 ± (SD) 1.7%, with the 100 cities of great poverty, prevalence 27.4 ± 4.1%. After descriptive statistics were tabulated, multivariate analyses were performed to look at the relative contributions of poverty, Walk Score and sedentariness to obesity and diabetes rates.

4. Results

The characteristics of the 104,871,055 people in the 532 cities of populations greater than 30,000 are shown in Table 1. The mean Walk Score was 47.6 $\pm$ (SD) 12.9 affirming that there is substantial variance in Walk Scores across US cities. The average obesity rate (Body Mass Index of 30 kg/m^2 or above) was 25.4 $\pm$ 4.1 %, diabetes rate 8.5 $\pm$ 1.7 % and poverty rate 13.1 $\pm$ 4.6 %. The average leisure physical inactivity rate was 22.1 $\pm$ 4.1%.

Looking at the 532 cities as a whole, an analysis was performed for variance to examine the interactions of Walk Score on obesity and diabetes rates, sedentariness and poverty. The data are shown in Figure 1 and Table 2. Cities with the lowest Walk Scores did NOT have highest poverty rates. However, cites with low Walk Scores had high obesity rates. Although poverty and obesity were linked, the predominant influence on obesity rates for a city was inactivity. In fact there was no significant relationship between Poverty

and Walk Scores. Overall, people who live in obesity-dense cities walk less. This is not driven by poverty, however.

The poorest cities were compared with the wealthiest ones. As expected, more people live in the 100 poorest cities (28,154,022 people) than the 100 wealthiest cities (13,938,270 people). The data are shown in Table 1. As expected, obesity and diabetes rates were greater in the poorer cities, (28 ± 4% and 10 ± 2% respectively), than in the wealthier cities, (24 ± 3% and 8 ± 1%; both $P<0.001$). Importantly Walk Scores were similar in wealthy and poor cities (46 ± 13 vs 47 ± 12) despite three-fold differences in poverty rates (7 ± 2% vs 20 ± 4%, $P<0.001$). Walk Scores are measurements of physical environments; these data were NOT predictive of peoples' behaviors because inactivity rates were significantly greater in the poor cities (25 ± 4%) than in the wealthy cities (20 ± 3%, $P<0.001$).

Nutrition is impacted by poverty (Table 1) but only in specific ways. Access and use of fast food restaurants is similar between wealthy and poor cities and grocery stores are plentiful in poor cities. However, per capita soft drift consumption is 10% higher in poorer cities than wealthier ones.

Overall, poverty is associated with diabetes, obesity, sedentariness and certain aspects of poor nutrition. However, these poverty-linked factors may not relate to how walkable the built environment is. The Walkability of a city does not explain sedentariness and how poverty is linked with chronic metabolic disease.

5. Discussion

The notion of world poverty conjures up the image of emaciated, listless people[6]. On a global scale this may be true but the poorest Americans are not gaunt; the poorest Americans, on average, have the most body fat [1,7]. Wealthier countries have a lower prevalence of undernutrition and the greatest rates of obesity. The Organization for Economic Cooperation and Development (OECD), focusing on the world's wealthiest nations, reports that more than half of people in OECD countries are overweight or have obesity [8]. Of the OECD countries, the United States has amongst the greatest rates of obesity (35% of women and 34% of men). Projections suggest that by 2020, three-quarters of North Americans may be

overweight or obese. Although the wealthiest countries may have the most obesity; it is not the wealthiest Americans who have obesity but the poorest; the issue of poverty-associated obesity is growing.

There is evidence of the association between sedentariness, poor health, obesity, diabetes, other metabolic diseases, and premature death [9]. Sedentary individuals move 2 h per day less than active individuals and expend less energy, and they are thereby prone to obesity, chronic metabolic disease, and cardiovascular death (9). More than half of county-to-county variance in obesity within the USA can be accounted for by variance in sedentariness. Overall, the poorest regions in the US have the greatest rates of sedentariness and the greatest rates of obesity and chronic disease.

Several authors have highlighted the association between obesity and poverty [10-12] and emphasized that this is a viscous disease cycle because those living in poverty have less access to healthcare and opportunities for weight loss; hence poverty-obesity is harder to reverse and more likely to be associated with debilitation from chronic disease such as diabetes and asthma [13-16]. A prior big data analysis of 53 million North Americans living in 3,140 US counties showed that people living in counties with the greatest poverty rates have the greatest rates of obesity [1,7]. People living in the 100 wealthiest counties have three-fold greater incomes than people living in the 100 poorest counties, where poverty rates are 640% greater. People living in poverty are 34% more likely to have obesity and 60% more likely to have diabetes. Per capita vegetable consumption, fast food expenditures and access to farmers markets were similar when comparing the wealthiest counties to the poorest. In contrast, sedentariness was 50% more likely in people living in regions with high rates of poverty.

Poverty thresholds from the US Census Bureau were used for calculating the regional poverty rates described in this paper [4]. The methodology for determining poverty thresholds was based on the 1959 weighted average poverty thresholds, which are available for the United States organized by county and city (FIPS codes). Such data are consistent with the WHO view of poverty for middle- and

high income countries; "In reality, the consequences of poverty exist on a relative scale. The poorest of the poor, around the world, have the worst health. There is a social gradient in health that runs from top to bottom of the socioeconomic spectrum. This is a global phenomenon, seen in low, middle and high income countries" [17].

Sedentariness is a behavior that is directly impacted by environment [18-19]. Weather, for example, effects how often open air spaces are used [18]. The designs of workplaces and schools influence a person's daily activity, which is especially important because adults and children are using these spaces for many hours each day [19]. There are more subtle influencers of daily activity; for example stigmatization can discourage an overweight person from attending a gym [20]. There is evidence of the association between sedentariness, poor health, obesity, diabetes, other metabolic diseases, and premature death (8). Sedentary individuals move 2 hours per day less than active individuals and expend less energy, and they are thereby prone to obesity, chronic metabolic disease, and cardiovascular death [1]. More than half of county-to-county variance in obesity can be accounted for by variance in sedentariness. Overall, people's sedentariness is directly impacted by their environment [1].

Most people in the US live in cities and because there are validated scoring systems to assess the walkability of a city [18,21-23], this paper examines whether the walkability of a city correlated with the sedentariness of the people living there. More people that are sedentary live in poor neighborhoods than in wealthy ones; so are the walkability scores lower in poor neighborhoods than in wealthy ones? To address this question, the Walk Score for more than 500 cities were calculated, spanning the spectrum of wealth, and assessed how these scores tracked with sedentariness, obesity and poverty. What was discovered was surprising. People living in poverty were indeed prone to be sedentary but this was not predicted by the walkability of the city. Also, people living in wealthy areas were prone to be more active yet this was also not predicted by the walkability of the city in which they lived. The walkability of a city does not predict whether a person is sedentary or has obesity or lives in poverty. There may

be other factors such as violence, crime, education, health care access and poverty-associated behaviors – so called, Social Determinants of Health [24-26] - that explain why people who live in poverty dense regions tend to be more sedentary and have greater risks of obesity and chronic disease.

There are several limitations to this approach. First, the Walk Score, which has been validated in numerous studies [3], may not be sufficiently sensitive to reflect the environmental cues to be active. Nonetheless, this is the best scoring system currently available and represents the state of the art in assessing walkability [18]. Second, the data were gathered through national registry and questionnaire systems; for example, the definition of sedentariness is whether a person does not participate in any leisure-based activity. Questionnaires are notoriously inaccurate for assessing a person's level of activity especially in underserved areas [27] but nonetheless questionnaires are the only rational approach to gathering data in 100 million people and a similar approach has been used by others [28]. Lastly, cities are not homogenous and so a whole city's Walk Score may not be reflective of the disparity of wealth within the city. On balance, the conclusions are likely to be true and that the walkability of a city is not the primary predictor of whether a person is sedentary. Cities with high poverty rates do not appear to be more environmentally unfavorable to walking compared to wealthy cities. It would be useful to make a comparison between urban infrastructure and walking indexes. This could be the focus of future work. Thus, the known association between sedentariness, obesity & poverty may not relate to the walkability of a city. These data highlight the challenges of addressing obesity in America's poor because the Social Determinants of Health are multiplexed.

Conflict of Interest

None Declared

Acknowledgements

This work was funded by NIH grants: R42 DK085738-02, 5R01DK-085516-05 and R015R01HL114024-1 and a CODE Award from Mayo Clinic Center for Innovation.

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Table 1: Data for 532 US Cities and data for the 100 wealthiest and 100 poorest city regions.

	532 Cities		Poorest 100 cities		Wealthiest 100 cities		
	Mean	SD	Mean	SD	Mean	SD	t- test
Walk Score	**47.6**	**±12.9**	**46.4**	**±12.5**	**47.4**	**±11.8**	**ns**
Demographics (2008)							
% White	59	±19	50	±21	67	±16	0.000
% Black	12	±12	20	±16	8	±8	0.000
% Hispanic	21	±18	25	±26	14	±9	0.000
% Asian	6	±6	3	±3	8	±8	0.000
% Amer. Indian or Alaska Native	0.6	±0.9	0.6	±1.4	0.5	±0.8	0.417
% Hawaiian or Pacific Islander	0.2	±0.4	0.1	±0.1	0.3	±0.9	0.008
Wealth variables							
Poverty All Ages (%)	13.1	±4.6	19.7	±4.4	7.4	±1.5	0.000
Poverty Ages 5-17 (%)	16.1	±6.5	24.8	±6.5	8.2	±1.9	0.000
Per capita income ($/year)	25620	±8038	22548	±7298	30285	±7620	0.000
Median Household Income ($/year)	56301	±12723	42995	±6188	73973	±1073	0.000
Health variables							
Age Adjusted Obesity Rate (%)	25.4	±4.1	28.3	±3.9	23.7	±3.4	0.000
Age Adjusted Diabetes Rate, 2008 (%)	8.5	±1.7	9.6	±1.9	7.7	±1.1	0.000
Crude Death Rate/100,000	786	±196	855	±204	637	±174	0.000
Physical Activity							
Age Adjusted Leisure-Time Physical Inactivity (%)	22.1	±4.1	25.1	±3.5	19.8	±3.0	0.000
Recreation & fitness facilities/1,000, 2008	0.103	±0.037	0.089	±0.044	0.131	±0.039	0.000
Nutrition							
Grocery stores/1,000, 2008	0.185	±0.066	0.194	±0.079	0.173	±0.072	0.05
Convenience stores no gas/1,000, 2008	0.080	±0.052	0.099	±0.072	0.072	±0.042	0.001
WIC-authorized stores/ 1,000, 2009	0.120	±0.045	0.144	±0.062	0.099	±0.038	0.000
Fast-food restaurants/ 1,000, 2008	0.721	±0.196	0.712	±0.260	0.734	±0.180	ns
Fast-food expenditures per capita ($/year), 2007	685	±98.6	683	±89.7	672	±104	ns
Gals per capita soft drinks, 2006	62.5	±7.3	66.4	±5.9	60.6	8±.1	0.000

Table 2: Correlations from multivariate analysis for 532 Cities in the United States.

	Walk Score	Obesity	Poverty	Inactivity	Diabetes
Walk Score	1.00	-0.43	ns	-0.21	-0.24
Obesity	-0.43	1.00	0.37	0.76	0.70
Poverty	ns	0.37	1.00	0.41	0.36
Inactivity	-0.21	0.76	0.41	1.00	0.80
Diabetes	-0.24	0.70	0.36	0.80	1.00

Matrix of correlation coefficients in multivariate analysis. The table shows correlation coefficients between Walk Score and obesity (age adjusted per cent), diabetes (age adjusted per cent), inactivity (no leisure physical activity), and poverty. Except for poverty versus Walk Score, all relationships were statistically significant (Table 2). Data are for 104,871,055 people from the 532 US cities where populations are greater than 30,000, organized by FIPS codes [4].

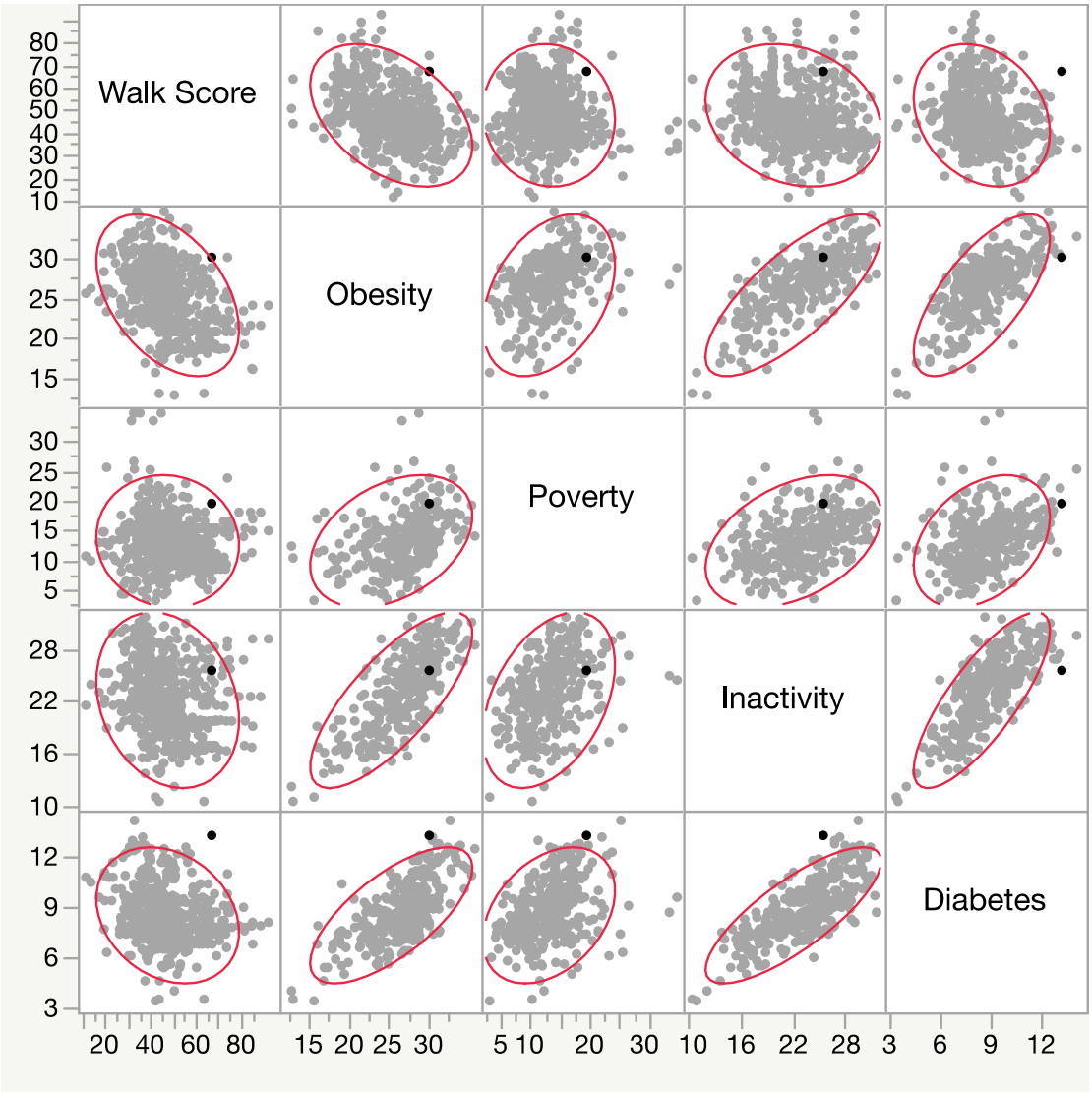

Figure 1: Multivariate Scatterplot Matrix. The figure shows relationships between Walk Score and obesity (age adjusted per cent), diabetes (age adjusted per cent), inactivity (no leisure physical activity), and poverty. Except for poverty versus Walk Score, all relationships were statistically significant (Table 2). Data are for 104,871,055 people from the 532 US cities where populations are greater than 30,000, organized by FIPS codes [4].

