Changes in physical activity after building a greenway in a disadvantaged urban community: A natural experiment

Amy H. Auchincloss[a,b,*], Yvonne L. Michael[a,b], Julia F. Kuder[a], Jinggaofu Shi[a], Sumaiya Khan[a], Lance S. Ballester[b]

[a] Drexel University School of Public Health, United States of America
[b] Urban Health Collaborative, Drexel University School of Public Health, United States of America

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ABSTRACT

Few studies have evaluated physical activity changes in response to active transportation investments in low-income disadvantaged communities. This quasi-experimental pre-post paired location design assessed physical activity responses to a 1.5-mile urban greenway constructed in 2013 along arterial streets in a poor, high-crime, predominantly African-American neighborhood in Philadelphia, Pennsylvania. Pre-construction (2011) and post-construction (fall 2014), systematic observations (N = 8783) and environmental audit data were collected at the greenway and a comparison area. Post-construction intercept surveys were collected at the greenway (N = 175). Secondary data sources included census 2010–2014 and crime rates. Post-construction, there were notable improvements in street and sidewalk design, however, conditions remained sub-optimal and crime remained high. Most greenway users resided in the neighborhood and were daily users. Systematic observations at the greenway found slight increases in non-walking MVPA after construction (running or bicycling rose from 4% to 9%) and MVPA that included walking-fast (rose from 16% to 18%). However, the magnitude of the increase was similar to the increase in MVPA observed at the comparison site, which suggested that intensity of physical activity did not change as a result of the greenway (p-value > 0.15 for adjusted interaction between pre-post and location). Greenways, absent comprehensive improvements to the built and social environment, may be insufficient to promote MVPA in very disadvantaged high-crime urban communities.

1. Introduction

In June 2013, a new 1.5-mile urban greenway (58th Street Greenway) was constructed along neighborhood arterial streets in the center of a poor, high-crime, predominantly African-American neighborhood of Philadelphia, Pennsylvania (Fischer and Street, 2014). The City obtained construction funds from the U.S. Department of Transportation (supplemented by private foundations) to completely retrofit designated sidewalks and street segments into a wide, tree-lined asphalt paved greenway. The greenway plan also included major intersection improvements (sidewalk bump-outs, count-down pedestrian signals, ADA ramps, improved intersection markings/paint), bus stop shelters, street trees, bicycle racks, signage, and enhancement of storm water management (see archived online plan, community engagement materials and news article (Bauers, 2013; PEC, 2013). The City intended the

greenway to connect residents to under-utilized neighborhood recreational facilities (two parks and a public recreation center) as well as to provide transportation infrastructure and a critical link in a larger regional and national trail network (East Coast Greenway (Nussbaum, 2010)).

Physical activity promotion was not a primary goal of the greenway; however, prior research suggests that new built environment infrastructure may have co-benefits for health (Hunter et al., 2015). Greenways are free to users (no user cost barriers (Lindsey et al., 2001)) and may be more likely to promote activity than other greenspaces like parks (Cohen et al., 2010) because they serve dual purposes, they provide a transit corridor (for travel to school/work/recreation center) and a destination for leisure activity (Burbidge and Goulias, 2009).

Few studies have tested pre-post changes in physical activity after building a neighborhood greenway, and among the small number of

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studies results have been mixed (Hunter et al., 2015). Studies in two mid-sized southern cities both retrofitted approximately 3 miles of an existing urban trail in predominantly White areas to connect the pedestrian infrastructure with nearby retail establishments, schools, and parks. In one study, the number of people using the greenway increased (walking or bicycling) compared to control neighborhoods (Fitzhugh et al., 2010). However, in the other study, while moderate or vigorous activity levels increased over time, the increase was similar to the control sites (West and Shores, 2011; West and Shores, 2015).

Evidence of the effect of built environment interventions in densely populated low income/disadvantaged areas is limited. Active living interventions and evaluations are needed in low-income, urban neighborhoods where obesity and chronic disease risk is high and high quality physical activity resources are scarce (Sallis et al., 2011; Vaughan et al., 2013). One of the only evaluations of changes in physical activity in low-income African-American urban communities studied the construction of a short path in the median of a neighborhood boulevard (6 blocks or about 1/3 mile). Relative to a control area, moderate-vigorous activity increased in the area where the new path was built (Gustat et al., 2012).

Philadelphia's 58th Street Greenway is particularly novel because it is in a disadvantaged area (whereas most greenways have been situated in suburban or rural environments and/or areas that would be used by high-income, college educated populations (Lindsey and Nguyen, 2004; Librett et al., 2006)) and because its design/location could promote use. First, the path is visible from residents' homes, cars, and buses; thus potentially improving perceptions of safety from crime (visible from houses/eyes on the street (Loukaitou-Sideris, 2006)). Second, the designers obtained a permit so that cyclists could ride on the sidewalk (a "sidewalk bicycling permit") (PCPC, 2011), which could promote cycling among non-traditional cyclists who have well-known preferences for off-road bicycle lanes (Broach et al., 2012).

Millions of public dollars have been invested in greenways (ECGA, 2013) yet very few evaluations have been done to assess changes in physical activity and even fewer in disadvantaged areas (Hunter et al., 2015). The goal of this study was to test the hypothesis that a new greenway would result in an increase in moderate and vigorous levels of physical activity. A quasi-experimental pre-post paired location design was used to observe residents' response to the new bicycle and pedestrian infrastructure. Additionally, we used a brief environmental audit to document changes in the environment at the greenway and comparison sites.

2. Methods

2.1. Site description (greenway and control site)

The greenway area was a 1.5-mile section of arterial streets in a southwest area of the city of Philadelphia, Pennsylvania. The comparison area was a 1-mile section of arterial streets in the northwest of the city. The comparison area was located sufficiently far from the greenway (3 miles away [7.5 km]) and not historically/culturally linked to the greenway thus preventing contamination bias (Delgado-Rodriguez and Llorca, 2004). The comparison area was selected because population demographics, behaviors, and crime reports were similar to the greenway site and the comparison area shared similar built environment features. Each area had a park, a recreation center, a 2-way busy thoroughfare and three city bus/trolley routes that served to connect the neighborhoods to the city-center (approximately 6.4 km or 4 miles away). The Drexel University Institutional Review Board examined the study protocol and deemed it exempt from human subjects concerns due to anonymized data collection and non-sensitive data.

2.2. Primary data collection

Construction of the greenway began in winter 2012 and completed

in late spring 2013. Systematic observations and environmental audits were collected in fall 2011 (prior to construction) and in fall 2014 (after construction). Intercept surveys were collected fall 2014 after systematic observations had finished.

2.2.1. Physical activity on the greenway

We assessed outdoor physical activity before and after the greenway was built using a direct systematic observation method, "System for Observing Play and Recreation in Communities" (SOPARC). SOPARC is a validated (McKenzie et al., 2006) tool that utilizes momentary time sampling to systematically and periodically scan individuals and contextual factors. We completed 36 scans annually (18 at the greenway and 18 at the comparison area), totaling 72 hourly scans (details in Supplement text). Ultimately, activity at the greenway and comparison sites was logged for 8783 persons. Because we were interested in moderate or vigorous activity, our primary objective was to log each person passing through the observation area, as to whether the person was engaged in MVPA (walking fast, bicycling, or running/jogging) or engaged in activity that was lower intensity (standing, sitting, walking slow/regular pace).

2.2.2. Environmental audit

An environmental audit tool was based on the validated Path Environment Audit Tool (PEAT) (Troped et al., 2006) and focused on two domains that may deter or promote outdoor physical activity: "design and amenities" and "social disorder" (details in Table 1 footnote). The presence of favorable environmental features was summarized into percentile scores with a possible range 0% (worst) to 100% (best).

2.2.3. Greenway intercept survey

At the greenway, we collected anonymous intercept surveys post-construction (in 2014) in order to assess users' purpose on the greenway (leisure, transportation), perception of the environment, and enhance socio-demographic and physical activity information that we obtained via systematic observation. A total of 175 greenway users participated (details in Supplement text).

2.3. Secondary data compilation

2.3.1. Automated pedestrian and bicycle counts

Automated pedestrian and bicycle counts were used to assess whether trends in counts concurred with the pre- and post-construction trends seen in the systematic observations. The counts were collected by the Delaware Valley Regional Planning Commission (DVRPC, the local metropolitan planning organization) at the greenway and at the comparison site (Pedestrian and, 2018) (details in Supplement Table 1 footnote).

2.3.2. Census data

Census tract data from the American Community Survey 2010–2014 describe area-level socio-demographics, housing, and transportation.

2.3.3. Crime incidents

Because crime can be a deterrent to outdoor physical activity (Harrison et al., 2007), we explored whether crime rates changed after greenway construction. We used the City of Philadelphia Police Department's publicly available data (OpenDataPhilly, 2018). Crimes were classified into three levels and average annual incidents summarized for pre-construction period 2009–2012 and post-construction period 2014–2017 (details in Table 1).

2.4. Statistical analyses

Following standard analyses of systematic observations (Joseph and Maddock, 2016), we used descriptive statistics (means and proportions)

Table 1
Community characteristics at the intervention area and comparison site; (a) census, (b) environmental audits, and (c) crime incidents.

	Intervention site (greenway)		Comparison site	
Section A. Census socio-demographics, housing, and transportation (2010–2014)[a]				
Census population				
Number of census block groups	25		30	
Number of people in area block groups	21,488		18,746	
Population density (per km^2), mean	5666		9588	
Socio-demographics	Mean	STD	Mean	STD
Race/ethnicity: non-Hispanic black, percent	91%	12%	95%	5%
Income: median household, $	$27,240	$8600	$21,150	$8520
Poverty (income < 150% of the Federal Poverty Level), %	49%	16%	54%	20%
Education: only high school diploma/GED, %	44%	8%	37%	12%
Education: Bachelor's Degree or higher, percent	8%	6%	11%	7%
Employment: employed, %	43%	9%	42%	13%
Language: speaks only English at home, %	89%	12%	98%	3%
Transportation to work				
Housing units with no vehicle, %	44%	16%	54%	13%
Uses private vehicle (drove alone), %	44%	14%	34%	19%
Uses public transportation, %	46%	13%	51%	17%
Uses bicycle, %	0%	0%	1%	2%
Walked, %	3%	4%	4%	5%
Section B. Environmental audit data from 3 location at each site[b]	Years pre- and post-construction			
Data shown are percent favorable, mean (minimum-maximum) (scores have a possible range 0 (worst) to 100 (best))	Pre-2011	Post-2014	Pre-2011	Post-2014
Better design and amenities (12 items)	42 (17–67)	61 (42–75)	42 (33–50)	50 (42–58)
Less social disorder (11 items)	58 (45–73)	67 (55–82)	73 (73–73)	64 (45–82)
Section C. Median annual crime incidents, per 100,000[c]	Years pre- and post-construction			
Crime incidents, City of Philadelphia Police Department	Pre-2009–12	Post-2014–17	Pre-2009–12	Post-2014–17
Lower level: drugs, incivilities, weapons violations	3591	2254	3995	3877
Higher level (property): theft, burglary	2872	2476	3041	2933
Highest level (violent): homicide, assault, battery, robbery, rape	3434	3519	4471	4415

Abbreviations: STD standard deviation, km kilometer.

[a] U.S. Census Bureau, 2016. Summary File. 2010–2014 American Community Survey. Small-area census data are only available for five-year moving averages.

[b] The greenway study collected environmental audit data for two domains that may deter or promote community level physical activity. Design/amenities were curb cuts, crosswalk paint, cross-signals, cross-safety, bike lanes, trees, drinking fountain, safety call-box, bike racks, lighting, benches, signage. Social disorder conditions were available public garbage can availability and whether they were overflowing, litter, beer/liquor bottles visible, condoms visible, drug paraphernalia, graffiti, murals, abandoned vehicles, broken/boarded up windows, vandalism, unkempt lawns/greenspace or home in utter disrepair.

[c] Crime incidents reported by the City of Philadelphia Police Department. Results summarize crime rates for 8 census tracts at the greenway site and 8 census tracts at the comparison site. See Appendix for trends.

to examine people observed per hour and percent of people engaged in a particular activity, by greenway and comparison site at baseline (2011) and follow-up (2014). We calculated unadjusted change via difference-in-difference (Wing et al., 2018) ([greenway area post-construction minus pre-construction] – [comparison area post-construction minus pre-construction]). To test the adjusted contrast in physical activity between the greenway and comparison site for pre- vs. post-construction, we used a hierarchical logistic model (SAS Institute Inc., 2018) with individual-level data (N = 8783 persons) and cluster-level random intercepts for standpoint location, day of the year, and time of day. There were three outcome variables; we modeled the odds of observing someone (1) running or biking or walking fast, (2) running or biking, or (3) biking. Regression control variables were the individual's age (age group), sex, side of the street, bus activity (person moved to/from/waited at bus stop), in a group vs. solo, weekday or weekend day, and an indicator for daylight savings (because 13% of the data were collected after Eastern Time Zone daylight savings, details are in Supplement text).

3. Results

At the greenway and comparison areas, approximately 50% of the residents were poor and approximately 10% were college educated (Table 1 section A). Over 90% of residents were non-Hispanic black and English-speaking. Among the employed, residents' commuting mode was split between public transit and automobiles; with < 5% using active transport (≤4% walked and virtually no one bicycled to work [median at both sites was 0%]).

During the study period, the prevalence of favorable features at the greenway improved (Table 1 section B). "Design and amenities" scores increased markedly reflecting improvements to the quality of the greenway streetscape (greenway pre-construction mean score 42% [range 17%–67%] and post-construction mean score 61% [range 42%–75%]). Greenway improvements included a newly paved continuous surface, cross-walks painted and re-designed for safety, trees were planted, bike racks and street lights added, a bus shelter and bus stop benches were added, and graffiti removed. At baseline, the "social disorder" score was less favorable at the greenway relative to the comparison area (baseline 58% vs. 73%, respectively). The score improved post-construction but nevertheless remained sub-optimal (greenway 67% [range 55%–82%]). For example, post-construction at the greenway, there was still "a lot of litter" and beer/liquor bottles visible from the path.

Table 1 section C summarizes crime rates for the pre- and post-construction periods. Crime rates at the comparison site were higher than the greenway site, but in general, time trends were similar between the two sites and rates were stable (see Supplement for trend). The exception to this was lower-level crimes which declined over time at both sites (declines started before the greenway was built) and in recent years (2016–2017) lower level-crime sharply increased at the comparison site. Regardless of declines in some crime categories, crime rates near the greenway remained very high. For example, annual police incidents related to drugs, incivilities, and weapons violations were > 2200 per 100,000 persons and violent incidents > 3500 per 100,000 persons. Homicides alone were over 32.1 per 100,000 (not shown in table).

Pre-construction at the greenway area, 100 persons were observed per hour using the street/sidewalk; but less than one-fifth were engaged

Table 2

Systematic observations (N = 8783) represented as persons per hour (mean and standard deviation), by intensity of physical activity. Unadjusted results from the pre-construction (2011) and post-construction (2014) periods, at greenway and comparison areas, and difference-in-difference.

	Persons per hour										Difference-in-difference
	Greenway area					Comparison area					
	Pre		Post		Post − pre	Pre		Post		Post − pre	
	Mean	Std	Mean	Std		Mean	Std	Mean	Std		
Persons, per hour[a]	100	45	116	48		128	55	159	78		
Activity type, average per hour[a]											
Run, bike, or walk fast											
Number	16	9	21	11		25	12	34	21		
Proportion of observations	*16%*		*18%*		*+2*	*19%*		*22%*		*+3*	*−1*
Run or bike											
Number	4	3	11	8		6	4	14	14		
Proportion of observations	*4%*		*9%*		*+5*	*5%*		*9%*		*+4*	*+1*
Bike											
Number	3	3	8	6		5	5	11	10		
Proportion of observations	*3%*		*7%*		*+4*	*4%*		*7%*		*+3*	*+1*

[a] Systematic observation data come from 3 monitoring locations at each site, during day-time hours, during a 3 week period in fall season, pre-construction 2011 and post-construction 2014.

Table 3

Adjusted[a] odds ratios (95% confidence intervals) for observing an individual engaged in moderate or vigorous activity at intervention area (greenway) vs. comparison area, post-construction (2014) vs. pre-construction (2011). N = 8783.

		Outcome variable				Outcome variable				Outcome variable			
		A. Run, bike, walk fast				B. Run, bike				C. Bike			
		Odds ratios	95% confidence intervals		p value	Odds ratios	95% confidence intervals		p value	Odds ratios	95% confidence intervals		p value
			Low	High			Low	High			Low	High	
Year	Post-construction (2014)	1.45	1.06	1.98	0.0198	1.62	0.91	2.89	0.0983	1.35	0.73	2.50	0.3380
	Baseline pre-construction (2011)	Referent group											
Location	Intervention area (greenway)	0.77	0.47	1.24	0.2816	0.84	0.54	1.31	0.4493	0.64	0.35	1.17	0.1498
	Comparison area	Referent group											
Interaction: Year × location[b]		0.93	0.57	1.52	0.7627	1.37	0.74	2.56	0.3187	1.74	0.83	3.66	0.1456

[a] Model includes individual-level data (N = 8783 persons) and cluster-level random intercepts for standpoint location (observation zone), day of the year, and time of day. Regression control variables were the individual's age (age group), sex, side of the street, bus activity (person moved to/from/waited at bus stop), in a group vs. solo, weekday or weekend day, and an indicator for daylight savings (because 13% of the data were collected after Eastern Time Zone daylight savings).

[b] Interaction odds ratio > 1.0 indicates that MVPA was higher over time (post-pre) at the intervention site relative to the comparison area. Odds ratio < 1.0 indicates the opposite.

in moderate or vigorous physical activity (Table 2). Post-construction, persons observed per hour rose very slightly (116/h) and the proportion of people engaged in moderate or vigorous physical activity (MVPA) increased slightly. During the study period, the greenway was associated with a slight increase in cycling (4-percent point increase [from 3% to 7%]) and running or cycling (5-percent point increase [from 4% to 9%]) and running or cycling or walking-fast (2-percent point increase [from 16% to 18%]). The increase in MVPA over time was substantively equivalent to the increase in the comparison area (unadjusted difference-in-difference was −1 to +1 percent point, depending on the outcome, Table 2). After adjusting for confounders and accounting for the hierarchical structure of the data (Table 3), results were substantively the same as the unadjusted results, namely, that MVPA increased over time at the greenway and the comparison sites and the increase at the greenway was not substantive or statistically significantly different from the increase at the comparison site. For example, post-construction the odds of observing someone engaged in MVPA at the greenway (running, biking, or walking fast), was 45% higher than it was in 2011 (odds ratio 1.45, 95% confidences interval 1.06, 1.98). However, the adjusted change in MVPA over time did not

differ between the greenway and comparison site (time by location confidence intervals were wide and all interaction p-values were > 0.15, Table 3).

As expected, relative to the manual counts, the absolute values of hourly automated counts were much lower at both sites and both time periods (details in Supplement). Nevertheless, the trend was the same for systematic observations and automatic counters (relative to pre-construction, post-construction there was a slight increase in number of people per hour at both the greenway and comparison areas).

3.1. Greenway user characteristics and perceptions of the environment

Supplement Table 2 provides a brief snap-shot of greenway user characteristics. Most greenway users lived in the neighborhood, over 60% were daily users of the greenway, and almost all reported using the greenway to get from place to place (as opposed to using it for leisure activity/exercise). Among those who lived in the neighborhood and remembered what the greenway was like before the renovation (N = 95), 95% said they 'agreed' (N = 39) or 'strongly agreed' (N = 51) that the greenway was an improvement to the neighborhood.

Almost all users' felt safe from crime during the day (92%) but many (58%) felt unsafe at night. Most thought the greenway crosswalks were safe from traffic; however, even after greenway construction, about one-half said the pavement still had cracks (details in Supplement text).

4. Discussion

Post-construction, the quality of the greenway streetscape/sidewalk improved. The greenway was well-utilized and users were almost exclusively neighborhood residents. Transportation was the most common use (walking to/from destinations including bus/trolley stops). Systematic observations at the greenway found a slight increase in non-walking MVPA after construction (running or bicycling rose from 4% to 9%) and MVPA that included walking (rose from 16% to 18%). However, the magnitude of the increase was virtually the same as the increase observed at the comparison site which indicated that intensity of physical activity did not change as a result of the greenway (adjusted results confirmed no treatment effect). The slight increases in MVPA we observed aligns with small increases (2-percent point) noted in federal physical activity surveillance reports (CDC-NCHS et al., 2018) and may, in part, be motivated by physical activity and obesity prevention campaigns (White House, 2018; PDPH, 2018).

We are aware of only one pre-post and control-adjusted greenway evaluation in a disadvantaged community to which our results can be compared. Systematic observations collected in a disadvantaged community in New Orleans found a statistically significant increase in moderate or vigorous activity two years after a 6-block greenway was built (Gustat et al., 2012). Despite greenway MVPA only showing a small increase (≤4-percent point increase) there was a decrease in MVPA activity at the comparison site, thus widening the difference-in-difference between the greenway and comparison site. Substantive differences between the New Orleans study and the new Philadelphia greenway evaluation include study design, the surrounding environment (the Philadelphia greenway has much more commercial activity and heavier traffic), and greenway design/quality (the Philadelphia greenway was narrower and much longer and had more segments that were lower-quality).

There are a few possible explanations for why the current study's greenway did not dramatically increase intensity of outdoor physical activity. First, while favorable environmental features increased post-construction, parts of the greenway still had unsafe intersections, heavy traffic, industrial/commercial activity/driveways, and on-road sharrow (online photos (Carroll, 2015). Markers of neighborhood disorder persisted (including excess litter and boarded-up houses) which – in the context of parks – have been found to deter aerobic physical activity (Hamilton, 2017). The greenway was an amenity on one street but improvements were absent on neighboring streetscapes. We conjecture that the greenway may have required much higher-level infrastructure on the greenway itself and neighboring streets in order to overcome low baseline conditions and motivate substantial increases in MVPA. In addition, the greenway was relatively isolated. It connected residents to a park and local services (a mini-mall with a supermarket, a ball field, a recreation center), but not to Philadelphia's central business district.

Some research has found that park maintenance (McCormack et al., 2010; SRSNP and APHA, 2012) and the presence of supervised or organized activities (Cohen et al., 2013) results in much higher park use and higher intensity of physical activity. Greenway contexts are not the same as parks, nevertheless, it is possible that greenway maintenance/ongoing enhancements (SRSNP and APHA, 2012) and long-term, context-appropriate physical activity programming could have resulted in higher intensity physical activity on the greenway. A short term physical activity program was intended to coincide with the launch of the greenway (PP, 2012); but due to a 10-month delay in finishing the greenway, the program was delivered before the trail was finished (Trent and uGO, 2012).

Perception of crime is known to be negatively correlated with

outdoor leisure MVPA (Harrison et al., 2007) and with greenways in particular (Keith et al., 2018). While the novel design of the greenway on an existing sidewalk directly in front of homes likely increased users' perception of the greenway as relatively safe from crime during the day, users confirmed nighttime safety concerns. Throughout the study period, objective crime rates remained very high in the study area. Post-construction, violent crimes at the greenway were much higher than the city average, and Philadelphia is a high-crime city. For example, in 2014, the homicide rate per 100,000 persons was 32.1 at the greenway, 17.8 in Philadelphia (OpenDataPhilly, 2018), and 4.5 in U.S. (FBI, 2014).

During the planning phase, the community had concerns and opposition to the greenway (Knowles and Pennsylvania Environmental Council, 2015; Luong and Pennsylvania Environmental Council, 2011). Community opposition to active travel infrastructure is quite common (often from automobile owners) and in some cases has halted infrastructure or curtailed the design (Palardy et al., 2018; Melamed, 2017; Specht, 2017). The greenway's proximity to residents' homes heightened some residents' concerns about maintenance of the greenway (the need to water trees, pick up litter, issue violations to vehicles that may park on the greenway, etc. (Fischer, 2012)). Additionally, community members questioned who would use the greenway especially since bicycling was not a common activity in the community, and advocated for anti-crime and pro-business/housing/youth interventions rather than active travel infrastructure (Lee, 2013). Nevertheless, despite community concerns prior to greenway construction, after the greenway was built, neighborhood residents were the primary users and most agreed that the greenway was an improvement to the neighborhood.

Limitations of the study include a single assessment of greenway impact (1.5 years after construction finished) and only one control site. It is unknown if results would generalize to other types of communities and other types of greenways. This study was focused primarily on greenway impacts on physical activity levels. Greenways can potentially influence neighborhood residents and the broader community in many other ways that were not discussed in this paper (Lindsey et al., 2017; Gobster et al., 2017). There are well-known limitations with systematic observations and survey data for collecting information about physical activity levels (vs. a direct measures like accelerometry) which may have resulted in measurement error (Baranowski and Simons-Morton, 1991). Nevertheless, temporal trends in our systematic observations were consistent with automated counts of pedestrians and bicycles, thus providing cross-validity for results regarding changes in physical activity. Furthermore, systematic observations of the community are an appropriate means of assessing group/community level use of the new amenity and allowed us to assess physical activity in the context within which it occurs (McKenzie et al., 2006) as well as assess changes over time.

Design strengths of the study are a pre-post control group study design, collection of objective measure of physical activity (systematic observations), and use of supplementary data that provided information on the broader context including why the greenway did not have a larger impact on physical activity levels.

5. Conclusion

A new greenway on arterial streets in a very disadvantaged area did not significantly increase physical activity, relative to a comparison area. While greenways can connect residents to destinations, provide transportation infrastructure, and improve the aesthetic value of a neighborhood (Walmsley, 2006), this case study illustrates a number of substantive challenges that must be addressed in future built environment interventions if planners want to see increases in intensity of physical activity levels in disadvantaged communities. 1. In general, poorer neighborhoods have fewer safe/high-quality facilities for physical activity relative to better-off neighborhoods (Hamilton, 2017). Given low sidewalk/streetscape quality at baseline, the construction of

the greenway improved the environment, however, conditions remained sub-optimal. Incremental improvements may have been insufficient to motivate substantial increases in MVPA. 2. Long-term, context-appropriate physical activity programming may be required to engage community members in moderate or high intensity physical activity on new greenways (Cohen et al., 2013). 3. Low perception of safety from crime can deter outdoor aerobic activity, particularly among women and older-aged adults (Harrison et al., 2007; Foster and Giles-Corti, 2008); thus, enhanced crime prevention strategies will likely be needed to activate communities in high-crime areas. More longitudinal research studies (with appropriate comparison groups) are needed to provide local and regional urban/environmental policy-makers with evidence on the physical activity impacts of their greenspace and transportation investments in high risk disadvantaged communities.

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Declaration of Competing Interest

No potential conflicts of interest relevant to this article were reported.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2019.100941.

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