The Impact of a Temporary Recurrent Street Closure on Physical Activity in New York City

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ABSTRACT *At least 70 US cities have now introduced ciclovías—large-scale street closures to promote physical activity—joining numerous other cities worldwide that have implemented ciclovías in efforts to improve population health. We assessed the impact of Summer Streets, a New York City program in which 6.9 contiguous miles of urban streets were closed to traffic and opened for walking, cycling, and group activities, such as dancing and yoga, on population physical activity levels. Screen line counts were used to estimate attendance, and a street intercept survey was conducted to assess demographic characteristics of participants, baseline adherence to physical activity recommendations, and type and duration of physical activity at Summer Streets. In addition, a traffic study was used to determine if there were vehicular traffic delays as a result of the program. About 50,000 people participated in Summer Streets; among participating New Yorkers, bicyclists averaged 6.7 miles, runners 4.3 miles, and walkers 3.6 miles, equivalent to 72–86 min of moderate physical activity. Among New Yorkers attending Summer Streets, 24 % reported that they did not routinely engage in moderate- or vigorous-intensity physical activity. These non-routine exercisers engaged in the equivalent of 26–68 min of moderate-intensity physical activity at Summer Streets. Summer Streets served as an enticement for New Yorkers, including those who did not ordinarily meet physical activity recommendations, to engage in physical activity. There were no significant vehicular traffic delays during the program.*

KEYWORDS *Active design, Ciclovía, Active transportation, Physical activity, Built environment, Street closure, Open streets, Summer streets*

INTRODUCTION

As modern lives have become less physically demanding, engaging in regular physical activity has become difficult.¹ Just half of American adults reported meeting 2008 Department of Health and Human Services (HHS) weekly recommendations of 75 min of vigorous-intensity physical activity or 150 min of moderate-intensity physical activity.^{2,3} In New York City (NYC), 60 % of adults reported meeting those recommendations in 2010.⁴ Strikingly, a national study utilizing accelerometers to measure physical activity found that less than 5 % of US adults meet recommendations.⁵ Physical inactivity is now the fourth leading cause of preventable death in the USA and also contributes significantly to the second and third causes—high blood pressure and obesity, respectively.⁶

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The US Centers for Disease Control and Prevention (CDC)'s Task Force for Community Preventive Services recommends that communities create or enhance access to places for physical activity⁷ and implement street- and community-scale measures to improve environmental conditions for physical activity.⁸ Toward this end, cities have been working to improve neighborhood, street, and sidewalk conditions for pedestrians and cyclists^{9–11} and expand areas for recreational physical activity by creating and enhancing parks, playgrounds, and fitness centers.^{12,13} Increasingly, cities are also implementing large-scale street closures, or *ciclovías*, to promote recreational walking, cycling, and skating. Building on the example of Bogotá, Colombia, which first introduced *ciclovías* in the 1960s as a venue for free health- and community-oriented events,¹⁴ 70 US cities have now introduced *ciclovías*.¹⁵

While *ciclovías* have been embraced by cities seeking to increase population-level physical activity, they are less well studied for their physical activity and health impacts than other built environment initiatives. In one of the few outcome studies available, over 50 % of adult participants surveyed at a 2010 *ciclovía* program in St. Louis, MO, reported achieving 75 min or more of physical activity at the event.¹⁵ Another study of four *ciclovía* programs in Colombia, Mexico, and the USA found that from a public health perspective, the programs were cost beneficial.¹⁶

To provide space for active recreation and to encourage New Yorkers to employ sustainable forms of transportation, the NYC Department of Transportation (DOT) launched the *Summer Streets* program in 2008. Summer Streets is an urban *ciclovía* encompassing a 6.9-mile continuous traffic-free street closure from Brooklyn Bridge in downtown Manhattan to Park Avenue at 72nd Street on the Upper East Side, where there is a connection into Central Park's 6-mile, car-free loop. In 2008, the program operated from 7 a.m.–1 p.m. for three consecutive Saturdays on August 9, 16, and 23. The NYC Department of Health and Mental Hygiene (DOHMH) partnered with DOT to assess the initiative's potential for promoting physical activity among New Yorkers. Our objectives were threefold: (1) to describe the participants in the program, including their demographic characteristics and their usual physical activity levels; (2) to report the amount of physical activity participants engaged in through the Summer Streets program; and (3) to assess the program within the NYC context and suggest future directions for this work. The study results reported in this paper add needed evidence to the scientific literature on *ciclovías* as a strategy for increasing population physical activity levels.

METHODS

Our evaluation consisted of three methodologies. First, we conducted screen line counts to estimate the number of Summer Streets participants. Second, we conducted a street intercept survey (SIS) to assess participant characteristics and levels of physical activity. Third, we conducted a traffic study to understand the impact of Summer Streets on vehicular traffic.

Screen Line Counts

DOT staff conducted screen line counts of participants at three locations along the route, determining the number of pedestrians, cyclists, and skaters in both northbound and southbound directions. Screen lines were done on Lafayette Street between Spring and Broome Streets, on Park Avenue between 23rd and 24th Streets, and on Park Avenue between 49th and 50th Streets. Data from the intercept surveys

(mode of travel and length of trip) were used to adjust these screen line counts and tally an estimate of daily total participants. The screen line counts were conducted during the second Saturday of the program (August 16, 2008).

Street Intercept Survey

The SIS instrument was developed by DOHMH in partnership with DOT. The instrument included 28 items that addressed participant demographics, usual level of physical activity, mode of transportation to Summer Streets, activity along the Summer Streets route, and length of travel along the Summer Streets route. Vigorous physical activity was described as activity that causes strenuous breathing, like running or aerobics, whereas moderate physical activity was described as activity that causes increased, but not too strenuous, breathing, like brisk walking.² Questions also assessed participants' attitudes toward the Summer Streets program. We piloted the survey on the first Saturday of the program, then implemented it on the second Saturday of the program (August 16, 2008).

DOHMH-trained interviewers were staff members of NYC DOHMH and DOT, and volunteer graduate students. To conduct the survey, interviewers were stationed at three traffic-light intersections where participants traveling along the route periodically came to a stop in order to allow for cross-town motor vehicle traffic. This method permitted recruitment of pedestrians as well as cyclists and skaters. In order to reduce selection bias, the person in closest physical proximity to the interviewer when the traffic stopped was asked to participate in the survey. If that person refused, the next closest person would be asked to participate and so on. The survey took about 5 min to complete, after which time the interviewer would wait for traffic to stop at the light and would again approach the closest person.

Vehicular Traffic Study

DOT conducted a traffic study to determine any changes in vehicular traffic due to the event. Baseline data was collected on Saturday, August 2, 2008, 1 week prior to the program, between 7 a.m. and 1 p.m., counting southbound vehicles crossing East 63rd Street on Park Avenue (the event route) and on the other southbound routes in the study area (5th Avenue, Park Avenue, Lexington Avenue, 2nd Avenue, and FDR Drive). Southbound vehicle traffic data was again collected on the first Saturday of the program (August 9, 2008) on 5th Avenue, Park Avenue, Lexington Avenue, 2nd Avenue, and FDR Drive.

Analysis

All data analyses were performed using SPSS version 17.0 (SPSS, Inc., Chicago IL). The mean miles were translated into estimated minutes of moderate physical activity, by applying equivalent speeds published by CDC to the mean miles traveled.¹⁷ For pedestrian activity, a walking speed of 3–4.5 miles per hour (mph) is considered moderate physical activity, and for bicycling, a speed of 5–9 mph is moderate physical activity.¹⁷

RESULTS

An estimated 50,000 people participated in the Summer Streets program on Saturday, August 16, 2008, including 33,000 pedestrians (walkers and runners), 15,000 cyclists and 2000 skaters. The total number of Summer Streets participants approached to complete a survey was 403; of those, 331 agreed to do the survey and

completed all or part of the survey, for a response rate of 82 %. Of the 331 participants surveyed, 274 (83 %) were from NYC, 38 (11 %) were from outside NYC, and 19 (6 %) did not indicate their residency (Table 1). For Summer Streets participants from NYC, over half (56 %) were aged 25–44, followed by 34 % aged 45–64. Older New Yorkers (aged 65 and older) and younger New Yorkers (aged 18–24) made up 5 and 4 % of the participants, respectively, with data missing on 1 %. Participation in Summer Streets among New Yorkers was almost evenly split between males (43 %) and females (45 %), with data missing on 11 %. In terms of racial/ethnic composition of New Yorker attendees, whites comprised 58 % of participants, followed by Asians (14 %), Hispanics (9 %), blacks (5 %), and other groups (6 %).¹⁸

Nearly all NYC participants considered their health status to be good or better: 38 % reported that their health status was very good, while 31 % considered themselves to be in excellent health and 23 % reported good health. Only 6 % reported being in fair or poor health. When asked about their usual level of physical activity, 73 % of participants reported that they met weekly physical activity recommendations, 22 % reported that they engaged in some physical activity but did not meet recommendations, and 2 % said that they engaged in no moderate or vigorous physical activity. Fourteen percent reported that they sometimes ride a bicycle to work, whereas 9 % often ride a bicycle to work. To reach the Summer Streets program on that day, the vast majority (87 %) of participants reported using active and sustainable transportation modes: about half (53 %) rode a bicycle; 17 % walked; 5 % used other active modes, such as skating or running; and 17 % used public transportation (subway or bus). Three percent used a car or taxi to reach Summer Streets.

Table 2 compares the demographic characteristics and self-reported health status of Summer Streets participants from NYC to the general NYC population, using data from US 2010 Census¹⁸ and NYC 2006 Community Health Survey (CHS).¹⁹ When compared with NYC residents overall, Summer Streets participants from NYC were more likely to be white; be between 25 and 64 years old; report good, very good, or excellent health; and report meeting weekly physical activity recommendations (Table 2). Six percent of participants reported living in the South Bronx, East/Central Harlem, or North/Central Brooklyn, NYC neighborhoods disproportionately affected by illness and where the DOHMH has District Public Health Offices (DPHOs) to better serve these communities.²⁰ The majority (70 %) of Summer Streets participants from NYC were from Manhattan, followed by Brooklyn (14 %), Queens (13 %), the Bronx (3 %), and Staten Island (1 %). Based on reported home zip codes, the majority of NYC participants resided close to the Summer Streets route. Figure 1 displays a visual map of the home zip codes of NYC residents participating in Summer Streets, the event route, and the DPHO boundary lines.

The average duration of physical activity for participating New Yorkers was estimated to be between 72 and 86 min of moderate activity (Table 3). Bicyclists averaged 6.7 miles, runners 4.3 miles, and walkers 3.6 miles on the Summer Streets route. Among the 24 % of NYC residents who reported either doing no regular moderate- or vigorous-intensity physical activity or not meeting physical activity recommendations, the average amount of physical activity during Summer Streets was the equivalent of 26–68 min of moderate physical activity.

More than one third (35 %) of NYC participants reported that they had attended Summer Streets the previous week (Saturday, August 9), and more than two thirds (69 %) indicated they planned to attend the following week (Saturday, August 23) (data not shown). More than 9 out of 10 (93 %) NYC participants indicated they

TABLE 1 Summer Streets participants, New York City, 2008

	NYC resident participants (%)			All participants (%)		p value ^a
	n=274	n=38	n=331			
Age category						
18–24	4		3			0.07
25–44	56	40	54			
45–64	34	52	37			
65+	5	6	5			
Missing	1	2	1			
Gender						
Female	45	29	43			0.11
Male	43	56	45			
Missing	11	15	12			
Race/ethnicity						
Hispanic	9	2	8			0.07
White	58	79	61			
Black	5	6	5			
Asian	14	4	13			
Other	6	2	5			
missing	8	6	7			
Self-reported health status						
Poor/fair	6	6	6			0.74
Good	23	19	22			
Very good	38	48	39			
Excellent	31	25	30			
Missing	3	2	3			
Weekly physical activity						
No moderate or vigorous physical activity	2	4	2			0.61
Some physical activity but less than recommendations	22	21	21			
Meets physical activity recommendations	73	73	73			
Missing	4	2	4			
Bike to work						
Never	72	77	73			0.72
Often	9	10	9			
Sometimes	14	10	13			

TABLE 1 Continued

	NYC resident participants (%)			All participants (%)			p value ^a
	n=274	Non-NYC participants (%)	n=38	n=331			
Transport mode ^b	Missing	5	2	4			<0.01
	Bike	53	19	48			
	Walk	17	4	15			
	Public transit	17	13	16			
	Car/taxi	3	46	10			
	Other	7	15	8			
Activity at Summer Streets	Missing	3	4	3			0.31
	Bike	60	65	61			
	Run	7	4	7			
	Walk	17	6	15			
	Class	1	2	1			
	Other	11	19	12			
	Missing	4	4	4			

^aPearson correlation test
^bTransport mode to Summer Streets program

TABLE 2 Demographic and behavioral characteristics of New Yorkers participating in Summer Streets compared to the general New York City population

		NYC resident participants <i>n</i> =274	Census 2010	CHS 2006
Age category	18–24	4 %	14 % ^a	
	25–44	56 %	44 % ^a	
	45–64	34 %	28 % ^a	
	65+	5 %	15 % ^a	
	Missing	1 %		
Gender	Female	45 %	53 %	
	Male	43 %	47 %	
	Missing	11 %		
Race/ethnicity	Hispanic	9 %	29 %	
	White	58 %	33 %	
	Black	5 %	23 %	
	Asian	14 %	13 %	
	Other	6 %	20 %	
	Missing	8 %		
Place of residence				
Live in DPHO neighborhood	Yes	6 %	16 %	
	No	94 %	84 %	
Borough	Bronx	3 %	17 %	
	Brooklyn	14 %	31 %	
	Manhattan	70 %	19 %	
	Queens	13 %	28 %	
	Staten Island	1 %	6 %	
Self-reported health status	Poor/fair	6 %		22 %
	Good	23 %		35 %
	Very good	38 %		26 %
	Excellent	31 %		18 %
	Missing	3 %		
Weekly physical activity (PA)	No moderate or vigorous PA	2 %		14 %
	Some PA but less than recommendations	22 %		42 %
	Meets PA recommendations	73 %		44 %
	Missing	4 %		
	Never	72 %		
Bike to work	Often	9 %		(<1 %) ^c
	Sometimes	14 %		
	Missing	5 %		
	Bike	53 % ^b		(<1 %) ^c
	Walk	17 % ^b		(14 %) ^c
Transport mode	Public transit	17 % ^b		(55 %) ^c
	Car/taxi	3 % ^b		(33 %) ^c
	Other	7 % ^b		
	Missing	3 % ^b		

^aAdjusted to match age of survey sample (18 years and older)

^bTransport mode to Summer Streets program

^cUsual transport mode to get to work/school on weekdays

FIG. 1 Summer Streets attendees: residence by home zip code, New York City, 2008.

would attend Summer Streets two or more times per month if it were held every week during the summer. More than one third (43 %) of walkers who lived in NYC said that traffic prevents them from walking more outside of Summer Streets, and 8 out of 10 cyclists (81 %) who lived in NYC said that concerns about safety, traffic, and cars and lack of bike lanes limit their biking outside of this program.

On the baseline data collection day (August 2nd), between 7 a.m. and 1 p.m., 3361 southbound vehicles were counted on Park Avenue, the event route, and 37,404 southbound vehicles were counted on other routes in the study area, which comprised 5th Avenue, Park Avenue, Lexington Avenue, 2nd Avenue, and FDR Drive. During the August 9th Summer Streets, traffic on all routes decreased by 2.5 % (940 fewer vehicles). Most of the traffic diverted from Park Avenue was absorbed on 5th Avenue (1165 vehicles, a 24 % increase). Small increases in traffic volumes were seen on other routes as well; however, in no case did the increase in traffic cross a threshold that generated significant vehicular congestion or delay.

TABLE 3 Mean minutes of moderate-equivalent physical activity and distance traveled by New York City residents and all participants in Summer Streets, by activity, New York City, 2008

	NYC Residents		All participants	
	Mean miles traveled on Summer Streets route ^a	Duration of moderate-equivalent physical activity ^b (min)	Mean miles traveled on Summer Streets route ^a	Duration of moderate-equivalent physical activity ^b (min)
Walkers	3.6	72	3.6	72
Runners	4.3	86	4.2	84
Cyclists	6.7	80	6.6	79

^aMean distance estimated from responses to street intercept survey
^bCalculated based on distance traveled, using Centers for Disease Control and Prevention published estimates of 3 miles per hour walking or running speed as moderate-equivalent physical activity and 5 miles per hour biking speed as moderate-equivalent physical activity.¹⁷

DISCUSSION

Summer Streets provided nearly seven continuous miles of car-free street space in a dense urban area for people to engage in many forms of physical activity, such as running, skating, and cycling. We estimate that 44,000 New Yorkers and 6000 non-New Yorkers participated in the program on a single day in the first year of the initiative, rendering Summer Streets one of the best-attended *ciclovía* programs in the USA.¹⁴ Participants from NYC engaged in the equivalent of 72–86 min of moderate-level physical activity, about half of the total minutes of weekly physical activity recommended by the HHS.² The event also mobilized many New Yorkers who do not usually get enough physical activity. About one quarter (24 %) of participants were those who reported not usually meeting physical activity recommendations. These participants engaged in the equivalent of 26–68 min of moderate-level physical activity. However, this may be an underestimate of minutes of physical activity since people who do not usually meet physical activity recommendations may travel at a slower speed than the absolute-intensity metabolic equivalents (METs) provided by the CDC.² A more precise measure would have been relative-intensity METs, which takes into account the individual’s fitness level; however, such resource-intensive measurements were not feasible for this evaluation. Additionally, 87 % of all participants used an active mode of transportation to the event, increasing their accumulated physical activity minutes for the day.

The majority of Summer Streets participants were white, resided in Manhattan, were between the ages of 25 and 64, usually met weekly physical activity recommendations, and considered themselves to be in good, very good, or excellent health. This participant profile differs from that of the NYC population overall (Table 2) and indicates that those at greatest risk of obesity and other health conditions were underrepresented at Summer Streets. These findings were similar to the results of Hipp et al.’s¹⁵ study of the St. Louis *ciclovía* program, which also documented a gap between program participants and the demographic groups at greatest risk of obesity in that city.¹⁵

The location of the Summer Streets event route likely impacted the geographic distribution of participants. The event ran through Manhattan’s East Side where many of NYC’s highest-income neighborhoods are located.²¹ Planning similar

events or initiatives in higher-need areas, such as neighborhoods where the DOHMH has DPHOs, may be an effective way of attracting participants from demographic groups that are at highest risk of obesity. In light of results from this study, NYC DOHMH and DOT have partnered to expand street closures in high-need neighborhoods. For example, since 2010, more than 55 community *Play Streets* have operated in the Bronx, Brooklyn, upper Manhattan (including East and Central Harlem), and Queens. Community Play Streets are single street blocks that are closed to cars and opened up for active recreation for children and families. Some Play Streets operate daily and others weekly, during many weeks of the summer. Community groups are responsible for their operation. Informal observations indicate children engage in various physical activities, such as running, bicycling, scootering, and active games, at these events. In addition, each summer since 2009, about 20 small multi-block street closures, dubbed *Weekend Walks*, have been held along commercial corridors throughout the five boroughs of NYC. During these events, streets are closed to traffic. Although the Weekend Walks program is not promoted exclusively as an active recreation event, physical activities, such as dance classes, are included. Still, it should be noted that walking, running, or cycling distances long enough to achieve significant amounts of physical activity may not be feasible for adults at either the Play Streets or Weekend Walks events.

NYC residents who participated in Summer Streets had overwhelmingly positive attitudes toward the event. While more than one third of respondents had attended the previous week, more than two thirds planned on attending the following week, and 9 out of 10 predicted that they would attend Summer Streets at least twice a month if it were held regularly in the summer months. These findings are consistent with similar surveys carried out in other cities that have implemented *ciclovía* programs. In Bogotá, Colombia, where *ciclovías* originated, one study found that among adult participants, 86 % planned to return the following Sunday; more broadly, a systematic review of the literature on *ciclovía* programs found that most events were characterized by low opposition and high support within the community.¹⁴

Finally, to understand the impact of Summer Streets on vehicular traffic, DOT conducted a traffic study prior to and during the event date. Compared to the baseline date, traffic on all routes decreased by 2.5 % during the August 9th Summer Streets. Most of the traffic diverted from Park Avenue was absorbed on 5th Avenue (a 24 % increase). Small increases in traffic volumes were seen on other routes as well; however, in no case did the increase in traffic cross a threshold that generated significant vehicular congestion or delay. This analysis showed that Summer Streets did not generate significant vehicular congestion or delay in the area of the event.

Limitations

Our work is subject to several limitations. First, our screen line counts are best estimates of participation in the event; we could not confirm exact numbers of participants or the types of activity in which they engaged. Second, our street intercept survey relied upon self-reported data, the accuracy of which could not be confirmed. Third, there were substantial missing data related to gender. We attribute this missing data to surveyor error, indicating a need to better train volunteers and staff in data collection. Fourth, our sample differs from the general NYC population,

limiting our ability to generalize results to all NYC residents. Finally, this survey is cross sectional in design, thus impeding our ability to make causal inferences.

Future Directions

Summer Streets has been held on the first three Saturdays in August since 2008. The number of attendees has increased sixfold since 2008, with an estimated 300,000 participants in the summer of 2013. *Ciclovías* offer cities a feasible strategy for increasing population-level physical activity. A systematic review of 38 *ciclovía* programs in 11 countries in the Americas found that *ciclovías* merit study as relatively low-cost, high-benefit programs that effectively promote physical activity among families and individuals of all ages.¹⁴ A study of four *ciclovía* programs implemented in Colombia, Mexico, and the USA found that from a public health perspective, the programs were cost beneficial.¹⁶ A cost-benefit analysis for the Summer Streets program in NYC is recommended, and further study is needed to determine how Summer Streets can be implemented more frequently and expanded geographically to provide greater access to residents of higher-need neighborhoods.

CONCLUSION

The study presented here is one of few to assess the impact of a *ciclovía* program on population health. The closure of about 80 NYC blocks to motor vehicles on three Saturdays in August 2008 provided an opportunity for tens of thousands of NYC pedestrians, cyclists, and others to engage in leisure-time physical activity, as well as to use active transportation to arrive at the event, without causing significant vehicular delay. Because street closures do not require capital construction, *ciclovía* programs like Summer Streets should be explored as a relatively low-cost and easily implemented strategy for increasing opportunities for physical activity in urban neighborhoods throughout the world.

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