
Assessment of Bicycle Use Among Residents in Affordable Housing in New York City

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To cite this article:

Sadie Sanchez, Erin Thanik, Ganga Bey, Demetrios Papazaharias, Lynn Onyebeke, Jessica Oh, Moses Syldort, Sarah Wolf, Elizabeth Garland. Assessment of Bicycle Use Among Residents in Affordable Housing in New York City. *Science Journal of Public Health*.

Vol. 6, No. 5, 2018, pp. 127-132. doi: 10.11648/j.sjph.20180605.12

Received: September 12, 2018; **Accepted:** October 4, 2018; **Published:** November 7, 2018

Abstract: Inadequate physical activity is associated with an increased risk of obesity. But most U.S. adults do not meet the Centers for Disease Control and Prevention recommendations for physical activity. Active transportation, such as bicycling to a destination, is associated with increased physical activity levels, but little research has been conducted regarding bicycle use in urban environments like New York City (NYC). A cross-sectional, self-administered survey was given to residents of two low-income neighborhoods in NYC to determine the prevalence of bicycle ownership and usage, and to assess potential community improvements to increase bicycle use. More than 80% of the 119 participants endorsed knowing how to ride a bicycle and nearly half of all participants reported that they or someone in their household own a bicycle. Of those who own a bicycle, the vast majority stored it in their apartment. More participants with a bicycle in their household reported better health status and moderate to high activity levels than those without a bicycle in their household. Those with a bicycle in their household were significantly more likely than those without a bicycle in their household to have used it for work or leisure in the last 30 days. The most commonly reported reason for not bicycling more frequently was lack of safe and secure designated bicycle storage areas in their apartment buildings. Other commonly reported reasons for not bicycling more frequently included perceived crime and lack of traffic safety. Participants suggested that clearly marked bicycle lanes and car-free bicycle paths may increase bicycle use in their neighborhoods.

Keywords: Active Transportation, Physical Activity, Bicycle Use, Built Environment, Bicycle Storage, Community Improvements, Active Design

1. Introduction

Inadequate physical activity is associated with an increased risk of obesity with consequences including development of many chronic diseases leading to significant morbidity, premature mortality and economic loss [1-5]. The Centers for Disease Control and Prevention (CDC) recommend that adults meet the goal of 150 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous aerobic activity per week [6]. Almost half (48%) of adults in the United States (U.S.) in 2008, and 60% of New York City (NYC) residents in 2010, reported meeting these

recommendations [7, 8]. However, when measured by accelerometers, these self-reported statistics were grossly over-estimated, with less than 5% of U.S. adults meeting the CDC recommendations in 2008 and 29% of New Yorkers meeting the recommendations in 2011 [9-11]. While vigorous physical activity achieves the highest level of fitness, the greatest health effects are seen in those individuals who progress from being sedentary to completing moderate physical activity regularly [5].

While obesity is a growing epidemic throughout the U.S., certain populations are disproportionately affected [12]. Specifically, a correlation between lower socioeconomic

status, notably in minority communities, reduced physical activity and increased risk of obesity has been well established [13-15]. NYC exhibits a similar pattern; residents of low-income neighborhoods spend less time in recreational exercise and have higher rates of obesity and diabetes compared to NYC as a whole [16, 17]. Many studies have shown an association between these disparities and a lower number of physical activity resources within these communities, such as sidewalks, parks, community centers, and walking/biking trails [15, 18-21]. In addition to fewer amenities in the built environment, many communities with lower socioeconomic status may have safety and crime disparities, further hindering physical activity [22]. This research team previously found that low income residents living in housing that incorporated active design elements found perceived safety encouraged physical activity [23].

Active transportation, such as bicycling or walking to a destination, can contribute to total physical activity levels and has been inversely correlated with body mass index (BMI) [5, 24-26]. A cross-sectional study reported large differences between nations in their use of active transportation and obesity rates. For example, Latvia's active transportation rate was 67% with a corresponding 13.7% obesity rate compared to the U.S. with rates of 8% and 34.3%, respectively [24]. Conversely, more time spent in a car was associated with an increased likelihood of obesity [27, 28]. Perceived and objective differences in the built environment (e.g., traffic patterns, thoroughfares with many lanes, serpentine roads, lack of secure bicycle parking) can influence whether people ride their bicycles for daily travel or for leisure [28-30]. Active transportation levels often differ by income, as well. In NYC, the neighborhoods with higher poverty levels are about less likely to have used a bicycle compared to the lower poverty neighborhoods [31].

The NYC Department of Health and Mental Hygiene (DOHMH) supports bicycling as a convenient, cost-effective and environmentally responsible way to incorporate physical activity into daily life [32]. The NYC Department of Transportation reports over 1,000 miles of bicycle lanes throughout all five boroughs where over half a million residents of NYC ride bicycles. Since 2005, NYC commuter bicycling has more than doubled and rose by more than 25% between 2008 and 2009 alone [33]. However, there is a paucity of research regarding bicycle use in urban, low-income neighborhoods. Our aim was to determine the prevalence of bicycle ownership and use and to identify potential community improvements which might increase bicycle use among residents of two low-income neighborhoods in NYC.

2. Methods

A cross-sectional survey was conducted in June 2014 at affordable housing buildings in two low-income neighborhoods in Central Harlem (Manhattan) and East New York (Brooklyn). All participating locations were selected to receive secure bicycle storage in the future. The Manhattan

locations consisted of eight buildings totaling 240 units; the Brooklyn locations consisted of four buildings totaling 100 units.

In collaboration with the NYC DOHMH and two participating community development corporations, Harlem Congregation for Community Improvement (HCCI) and Cypress Hills Local Development (CHLDC) that own and manage the participating housing locations, flyers were distributed in the buildings notifying residents of the study. Research assistants, along with representatives from DOHMH, HCCI, and CHLDC, were present to determine participant eligibility and verify completion of the survey. A Spanish-speaking representative was present at each study site. Recruitment tables were set up at each location and eligible residents were given a self-administered survey. No identifying information was recorded. Demographic information and number of years living in current apartment unit were collected as well as information on physical activity and general health, and bicycle ownership and use.

Eligible participants had to be at least eighteen years of age, reside in one of the included buildings, and speak English or Spanish. Participants received ten-dollar NYC mass transit cards (MetroCards), as well as other items including water bottles, cookbooks, and jump ropes supplied by the DOHMH as compensation for their time. This study received exemption from the Icahn School of Medicine at Mount Sinai and the DOHMH Institutional Review Boards.

Survey questions were adapted from two validated sources, the 2005-2006 National Health and Nutrition Examination Survey (NHANES) and the 2012 NYC Community Health Survey (CHS) [34, 35], and from the 2009 Nashville Area Metropolitan Planning Organization Bicycle and Pedestrian Study (Nashville Area MPO) [36]. The questions adapted from NHANES asked about bicycle use in the last 30 days while the NYC CHS-adapted questions focused on general health and physical activity. Questions regarding attitudes and community improvements to increase bicycle use were adapted from the Nashville Area MPO survey. The survey that was developed for this study was available in both English and Spanish.

Using IBM SPSS Statistics for Windows, Version 20.0 (2011, Armonk, NY), frequencies for demographics and all study questions were determined for households where someone owned a bicycle ("bicycle owners"), households without a bicycle ("non-owners"), and the total study population. Pearson's chi-squared test and Fisher's exact test were used to evaluate whether there was a difference in reported bicycle use in the last 30 days between bicycle owners and non-owners ($p < 0.05$).

3. Results

Table 1 describes demographics of the population and prevalence of bicycle use in the previous 30 days. The mean age of the study population ($n=119$) was 38.9 years with participants living in their apartments for an average of 5.9 years. The study population was 58% female overall; among

bicycle owners (n=54), 62.9% were female and, among non-owners (n=65), 53.8% were female. More bicycle owners reported being moderately or very active (96.3%) compared to non-owners (81.5%). Similarly, bicycle owners tended to more often rate their health as very good or excellent compared to 49.2% of non-owners (66.7% vs. 49.2%).

Overall, 45.4% of participants reported that someone in their household owned a bicycle. Among bicycle owners, the majority (77.8%) stored it in their apartments. Bicycle owners were significantly more likely to have bicycled to work in the last 30 days (48.1%), compared with non-owners (4.6%). Similarly, bicycle owners (68.5%) were significantly more likely to ride their bicycle for fun or leisure in the last 30 days compared to non-owners (16.9%).

Table 1. Demographics and Bicycle Use.

	Total n=136
Mean Age (S.D)	39.5 (14.9)
Mean years living in apartment (S.D.)	6.3 (7.3)
Female (%)	74 (54.4)
Rate activity level as moderately or very (%)	118 (86.8)
Rate health as very good or excellent (%)	79 (58.1)
Someone in household owns bicycle (%)	58 (42.6)
Bicycled to work, school, or errands in last 30 days (%) ^a	36 (26.5)
Bicycled for fun or leisure in last 30 days (%) ^a	56 (41.2)

Participants were asked to rate their agreement with a list of potential reasons for not bicycling more frequently (Table 2). A minority of participants agreed or strongly agreed that they do not know how to ride a bicycle (18.3%) and they do not like bicycling (18.6%). Most participants strongly endorsed that lack of secure and safe designated bicycle storage areas in their apartment buildings (66.1%) was a reason for not bicycling more frequently. Other common reasons why participants reported not bicycling more frequently included not feeling safe bicycling in traffic (41.7%), concerns regarding the weather (36.8%) and not feeling safe because of crime in the neighborhood (32.4%). There were no significant differences in responses between owners and non-owners.

Table 2. Reasons Participants Do Not Bicycle More Frequently.

	Total who agree / strongly agree
I don't know how to ride a bicycle	24 (17.6%)
I don't feel safe bicycling in traffic	53 (39.0%)
I don't feel safe bicycling because of crime	41 (30.1%)
There is no secure / safe bicycle storage in my building	80 (58.8%)
I don't like bicycling	26 (19.1%)
Weather	49 (36.0%)
There is no shower facilities at my destination	38 (27.9%)
I cannot wear appropriate bicycling clothing	26 (19.1%)

Participants were also asked how important potential improvements in their neighborhood would be to increase bicycling within the community (Table 3). Commonly endorsed potential improvements included clearly marked bicycle lanes (83.6%), car-free bicycle paths and / or bicycle

destinations (76.3%), and reduced traffic speeds (71.4%). Participants endorsed more frequently that low-cost bicycle purchase programs (74.6%) would increase bicycling versus Citi Bike (NYC's fee-based bicycle-sharing program) in their neighborhood (59.6%). Lastly, most participants (73.3%) agreed or strongly agreed that more designated bicycle storage areas in apartment buildings would encourage more bicycling in their neighborhood; with a tendency for more bicycle owners (82.4%) versus non-owners (66.2%) agreeing with this potential improvement.

Table 3. Importance of Improvements to Increase Bicycling in Participants' Neighborhoods.

	Total who agree / strongly agree
Clearly marked bicycle lanes	109 (80.1%)
Reduced traffic speeds	95 (69.8%)
More bicyclists in streets	80 (58.8%)
More bicycle storage in apartment buildings	96 (70.6%)
Citi-Bike in the neighborhood	79 (58.1%)
Low cost bicycle purchase programs	100 (73.5%)
Less crime in the neighborhood	94 (69.1%)
Car-free bicycle paths and / or bicycle destinations	101 (74.3%)

4. Discussion

Most participants in this study endorsed knowing how to ride a bicycle and nearly half of all participants reported that they or someone in their household owns a bicycle. More participants with a bicycle in their household reported a better health status and being more active. Furthermore, those with a bicycle were significantly more likely to have bicycled for work or leisure in the last 30 days, suggesting an advantage for these participants in time engaged in physical activity.

The most commonly reported reason for not bicycling more frequently among the participants in our study was the lack of safe and secure bicycle storage. This finding is consistent with the 2007 NYC Bicycle Survey, which found limited bicycle storage to be one of the most common reasons for not commuting by bicycle [37]. Other studies have evaluated the positive impact of public bicycle parking availability, but to our knowledge, no studies have evaluated the impact of residential bicycle storage [38, 39]. The majority of participants, including those who do not own bicycles, reported that dedicated bicycle storage in apartment buildings was a potential community improvement that may lead to increased bicycle use. In the future, this barrier may be mitigated by a law passed in NYC in 2009 that mandates new multi-family residential and commercial buildings provide bicycle storage [40]. However, there are no such laws for existing residential buildings and many do not have adequate bicycle storage.

Perceived lack of traffic safety was also cited in this study as a reason for not bicycling more frequently. This is also consistent with the 2007 NYC Bicycle Survey, where participants noted that car driver behavior and traffic were among the most common reasons for not commuting by

bicycle [37]. In addition, a cross-sectional study conducted in Manhattan, Kansas evaluated adults who actively commute and found that 64.2% of those surveyed reported traffic safety as a barrier to bicycling [41].

Participants in this study agreed that installation of bicycle lanes and paths could increase bicycle use in their communities, perhaps also improving bicycle safety. Sallis et al. projected increases in bicycle use if safety from cars was improved, and that the greatest impact on bicycle use would be among minority groups and those living in the least safe neighborhoods for bicycling [42]. A study conducted after installation of bicycle lanes in NYC found no increase in the number of bicycle-car collisions, even with an increased number of cyclists, suggesting a decreased rate of collisions [43]. Several other studies found as the number of bicyclists and pedestrians in streets increased, injury rates declined, further strengthening the endorsement for active commuting [44-46].

Our findings must be interpreted with caution. Our study population was relatively young and had self-reported high levels of activity and good health; our results may not be generalizable to an older or a less healthy population. Although participants reported their physical activity level, they did not report on other forms of active transportation or exercise (e.g. walking, jogging). Since our definition of a "bicycle owner" included anyone in the participant's household owning bicycle, some of the estimates among bicycle owners may be under-estimated as these individuals themselves may not ride a bicycle. Finally, as this study population is a convenience sample and surveys were retrospective, selection and recall bias cannot be excluded.

5. Conclusion

Increasing bicycle use is an important public health intervention given the reported health benefits of bicycling and active transportation, such as decreased BMI and improved cardiovascular health [47-49]. Despite the known benefits of active transportation, the National Household Transportation Survey found that the prevalence of bicycling remained unchanged between 2001 and 2009 [50]. Enhancing infrastructure for active transportation may be a way to help address the obesity epidemic in the U.S. and barriers to physical activity, especially in low-income urban communities.

Future urban infrastructure enhancements to promote bicycling should prioritize low-income neighborhoods and engage individuals through community-based participatory research. Efforts to promote physical activity are most effective when community-specific education addresses perceptions and attitudes toward physical activity [51, 52]. The CDC Task Force for Community Preventive Services offers strategies aimed at increasing physical activity and, specifically, addresses potential improvements in urban design [53]. These improvements may have the most significant impact in neighborhoods where residents appear to be already inclined towards bicycling and other forms of

active transport [27]. NYC has instituted some of these policies, such as the creation of dedicated bicycle paths and installation of bicycle storage to encourage physical activity among its residents.

In conclusion, this study represents a pioneer effort to elicit community opinion regarding interventions that may lead to increased bicycle use. There is a desire and ability among individuals living in low-income urban neighborhoods to ride bicycles, stressing the need to remove barriers/promote facilitators to promote bicycle riding. Further studies should evaluate whether community improvements or changes in urban design actually increase bicycle use and to what extent.

Acknowledgements

The authors thank the Cypress Hills Local Development Corporation and the Harlem Congregation for Community Improvement for their collaboration in collecting survey data. The authors also thank the men and women who participated in the study. All other individuals who contributed to this research are listed above as named authors.

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