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Associations of park use with physical activity in renovated parks serving low-income communities in New York City: Insights from the Community Parks Initiative

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Abstract

Parks have the potential to encourage physical activity among urban communities. However, existing research on the link between park use and physical activity has produced inconsistent results. Mixed findings in the past may be due in part to differences in park quality across studies. The aim of this study was to explore the association between park use and physical activity among New York City adults in low-income communities that recently received city-sponsored park renovation as part of the Community Parks Initiative (CPI). Using population-weighted survey data from eight neighborhoods with recent park renovation (n=2,000), we measured associations between park use frequency ($\geq$ once/week vs. $<$ once/week) and self-reported physical activity (high vs. low-moderate based on the International Physical Activity Questionnaire). We adjusted models for age, sex, education, race/ethnicity, income, study site, and use of other (non-CPI) parks, and conducted stratified analysis for demographic variables with significant interactions with park use. After adjusting for covariates, we observed a positive association between park use and physical activity (Prevalence Ratio [PR]=1.30, 95% CI=1.16–1.46). Greater frequency of park use was more strongly associated with high physical activity among adults ≤ 50 y (PR=1.39, 95% CI=1.14–1.69), individuals with annual household income $<$ \$25,000 (PR=1.54, 95% CI=1.13–2.08), and Latinos (PR=1.77, 95% CI=1.44–2.18). Our findings suggest that high-quality parks might be particularly beneficial for promoting physical activity among those with a lower

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Author Contributions

The study was conceived and designed by Terry T.-K. Huang and Katarzyna E. Wyka. Rachel L. Thompson and Luis David Olivera León performed data analysis and interpretation. The first draft of the manuscript was written by Luis David Olivera León and Rachel L. Thompson and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics Approval

The research received ethical approval from Institutional Review Board #2022–0549-PHHP at the City University of New York.

Consent to Participate

Passive informed consent was obtained from participants prior to their engagement in the study.

socioeconomic background and in younger and Latino adults, emphasizing the importance of continued investment in park revitalization among urban communities of color.

Keywords

Built environment; parks; physical activity; community health; health equity; Community Parks Initiative (CPI)

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INTRODUCTION

There is compelling evidence indicating that physical inactivity elevates the risk of chronic health conditions and leads to a shortened life expectancy [1,2]. Globally, more than a quarter of the adult population, totaling 1.4 billion adults, engages in insufficient physical activity [3]. Levels of inactivity are twice as prevalent in high-income countries compared to their low-income counterparts [3]. The decline in physical activity is attributable to sedentary behaviors during leisure time and employment, along with increased use of passive transportation modes [3]. In 2020, the Centers for Disease Control and Prevention (CDC) reported that only 24.2% of U.S. adults adhered to the 2018 Physical Activity Guidelines for Americans [4]. The prevalence of low levels of physical activity is a worldwide concern, prompting current public health initiatives to prioritize interventions, including those leveraging the built environment, to increase physical activity [5].

In New York City (NYC), physical inactivity exacerbates health inequities, disproportionately affecting certain demographic groups [6,7]. This includes Black and Latino adults, older adults, individuals with lower educational attainment, and those residing at or near the poverty line [6,7]. These groups are less likely to meet established physical activity guidelines compared to other segments of the population [6]. This underscores a concerning trend where health disparities are intertwined with patterns of physical inactivity, necessitating targeted interventions to address these disparities and promote equitable health outcomes.

Urban parks, as integral components of the community landscape, have demonstrated positive effects on various health outcomes [8–11]. Revitalized urban parks have the potential to increase physical activity, ranging from casual walking to more vigorous activities [12]. However, the existing body of evidence concerning the connection between parks and physical activity remains inconclusive. Numerous reviews have yielded varied results, encompassing both positive and negative outcomes, as well as instances where no discernible effect was observed [13–15]. Differences in park quality both across and within studies may be one contributing factor to the mixed findings, as studies have shown that the public health benefits of parks are closely tied to the perceived safety and quality of parks [16,17].

Low-income minority communities face significant barriers in access to safe, quality parks [18,19]. In NYC, home to over 2,000 parks, high-poverty neighborhoods have access to 21% less park space compared to high-income neighborhoods, and majority non-White neighborhoods have access to 33% less park space compared to majority White neighborhoods [20]. Racial/ethnic minorities have also reported more barriers to using community parks compared to Whites, including safety concerns and inadequate or poorly-maintained facilities [21]. Parks perceived as poor quality or unsafe may not be supportive environments for physical activity behaviors, which may be one reason why previous studies have not shown a high prevalence of park-related physical activity among minority communities [22,23]. Nevertheless, there is a gap in the research regarding how high-quality parks with amenities that promote physical activity could enhance opportunities for exercise in low-income urban minority communities.

In NYC, the equity-based Community Parks Initiative (CPI) was launched in 2014, which led to the redesign and renovation of 67 neighborhood parks in low-income ($\geq 20\%$ of population below poverty line), densely populated (≥ 110 people per acre), and rapidly growing communities ($\geq 25\%$ growth from 2000 to 2010) [24]. In addition, eligible parks must not have received more than \$250,000 in capital funding in the prior 2 decades. Park redesign as a component of CPI included: making parks friendly to all age groups (e.g., more adult fitness equipment or space in playgrounds); making parks more accessible by lowering fencing and improving seating and shading; improving aesthetics and lighting; and increasing greening to support resiliency [24] (Figure 1). Renovated parks re-opened between 2017 and 2022 and we previously showed that CPI led to greater park use among adults [25]. As such, CPI presented a unique opportunity to examine the association between park use and physical activity in the context of high-quality parks, effectively controlling for meaningful differences in park quality between study parks, in previously underserved communities. Therefore, the purpose of this study was to explore the association between park use frequency and physical activity level among NYC adults in low-income, predominantly Latino and Black communities following city-sponsored park redesign and renovation as part of the CPI.

METHODS

This study follows the STROBE guidelines for reporting cross-sectional observational studies [26].

Setting

This study utilized cross-sectional baseline data collected by the Supporting Parks and Revitalizing Communities Study (SPARCS), providing a snapshot of the post-CPI condition in study neighborhoods. SPARCS is an ongoing community engagement intervention study in eight NYC neighborhoods (two each in Manhattan, Brooklyn, The Bronx, and Queens) that received park redesign and renovation as part of the CPI. These eight parks were purposefully selected based on adequate park neighborhood population sizes ($n \geq 20,000$ adult contacts in each neighborhood) in the master CPI sampling frame (given that polling

research generally expects a 1–2% response rate), strength of existing park partnerships, and representation of the four largest boroughs in New York City.

Sample and Data Collection

Adults ≥ 18 y living within a 0.5-mile radius of the eight study parks were recruited by a polling firm (Consensus Strategies, Waltham, MA) using email ($n=130,436$) and text message ($n=148,427$) solicitation. Study neighborhoods were defined as the 0.5-mile Euclidian distance radius around the perimeter of each of the eight selected parks, given that most New Yorkers report walking up to 5 blocks to a park [27]. A random stratified approach to sampling was utilized, with strata established for age, sex, race/ethnicity, and education, and a minimum of 25 participants set for each stratum. Target enrollment was calculated to reflect the distribution of each subgroup in the general population residing within each study neighborhood.

Survey data were collected between 8 June and 22 June 2023 from 2,067 respondents. The survey was administered online in English ($n=1,852$), Spanish ($n=61$), and Chinese ($n=87$). A verified translation service that followed a standardized translation protocol was used to translate the survey into Spanish and Chinese. Native Spanish and Chinese speakers from the SPARCS research team confirmed the accuracy of the translations. A table summarizing the characteristics of the survey respondents is available in the Supplemental File (Online Resource 1.1). To achieve a population-representative design with a balanced (equal) sample size across the eight study sites, raked weights were applied to survey samples from each of the 8 study sites to achieve a final $n=2,000$, with $n=250$ observations for each study site.

Ethical Considerations

The study was approved by the City University of New York Institutional Review Board #2022–0549-PHHP. Passive informed consent was used before participants proceeded to the survey. Respondents received a \$25 Amazon gift card as an incentive for completing the survey.

Measures

Park Use: Park use frequency was measured using previously validated survey items by Veitch et al. [28]. The survey asked participants about how frequently they visited the CPI-renovated study park in the preceding 30 days. Response options were: (1) daily, (2) 4–6 times per week, (3) 2–3 times per week, (4) once per week, (5) 2–3 times per month, (6) once per month, (7) less than once per month, or (8) no visit in the past 30 days. Studies have shown that experiencing health benefits from urban parks requires frequent park visitation [29–31]. Previous dose-response studies have shown that frequent exposure to green spaces of at least 30 minutes [29] to 120 minutes [30] or more per week can improve physical health, mental health, and well-being. Frequent visits to urban parks can also have greater impacts on physical activity behaviors. In a sample of adults visiting nearby parks on average 2.3 times per week, Evenson et al. found that those who visited the parks at least once engaged in higher moderate and moderate-to-vigorous physical activity on days when a park was visited compared to days when a park was not visited [31]. In line with the findings from these studies, we recoded park use from the original 8-item scale

into two categories: low frequency of CPI-renovated park use (less than once per week) and high frequency of CPI-renovated park use (once per week or more). This dichotomization allowed us to better differentiate between frequent and infrequent park use on the basis of health-benefitting potential.

Physical Activity: Physical activity levels were assessed using the seven-item International Physical Activity Questionnaire (IPAQ) [32]. IPAQ assesses physical activity in the past seven days across various dimensions, including frequency, duration, and type of activity, such as walking, exercise, work-related activities, and transportation [33]. Following criteria for IPAQ scoring [33], reported activities were converted to metabolic equivalent of task (MET) minutes, which gives greater weight to higher-intensity activities such as vigorous exercise. Using both the total volume of physical activity (in MET-minutes) and frequency of activity, participants were further categorized into one of three groups [33]:

- High Activity, defined as:
 - Vigorous-intensity activity on at least 3 days and accumulating at least 1,500 MET-minutes per week OR
 - 7 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 3,000 MET-minutes per week
- Moderate Activity, defined as:
 - 3 or more days of vigorous-intensity activity of at least 20 minutes per day OR
 - 5 or more days of moderate-intensity activity or walking of at least 30 minutes per day OR
 - 5 or more days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum of at least 600 MET-minutes per week
- Low Activity, defined as:
 - Not meeting any of the criteria for high or moderate activity

Prior research indicates that the IPAQ substantially overestimates physical activity levels, with difficulty distinguishing between health-benefitting moderate- and vigorous-intensity activities [34,35]. The US Department of Health and Human Services 2018 guidelines for physical activity among adults suggest that at least 150–300 minutes per week of moderate-intensity activity, 75–150 minutes per week of vigorous-intensity activity, or an equivalent combination of moderate- and vigorous-intensity aerobic activity is required to achieve substantial health benefits from physical activity [36]. To better align interpretation of our study outcome with adherence to current public health guidelines for physical activity among adults, we combined the moderate and low activity IPAQ categories into a single group. Considering significant probable overestimation of self-reported physical activity using the IPAQ, this recategorization allowed us to draw a clearer distinction between individuals who were more likely to be meeting weekly physical activity guidelines (i.e.,

those classified as “High Activity” using the IPAQ) to those who were less likely to be meeting the guidelines (i.e., those classified as “Low Activity” or “Moderate Activity” using the IPAQ).

Sociodemographic Characteristics and Other Covariates: Variables thought to be associated with both park use frequency and physical activity level were selected to be used as covariates in statistical analyses. These included: sex [37, 38], age [38], race/ethnicity [23], annual household income [39,40], education [39], and use of other neighborhood parks (besides the study park). Age was categorized as “≤50 years” or “>50 years”. Race/ethnicity was categorized as “Latino”, “Non-Latino Black”, “Non-Latino White”, or “Other or multiracial”, where the “Other or multiracial” category included individuals who identified as American Indian/Alaskan Native, Asian/Pacific Islander, Middle Eastern/North African, or having two or more races. Annual household income was categorized as “<\$25,000” or “≥\$25,000”, and education was categorized as “Some college or less” or “College graduate”. Frequency of use of other parks in the neighborhood was categorized similarly to the CPI-renovated park use variable, with values “Less than once per week” and “Once per week or more”.

Statistical Analysis

All descriptive analyses and modeling results were reported following the application of raked weights to ensure the sample reflected the broader study population. Alpha for all significance testing was set at $p < 0.05$. Descriptive statistics (n, %) were generated for all variables in the overall sample and stratified by frequency of CPI-renovated park use and level of physical activity. Chi-squared tests to examine independence between covariates and frequency of CPI-renovated park use were performed using Rao & Scott’s second-order correction for complex survey-weighted designs [41].

Log-binomial regression models were fit to characterize the association between frequency of CPI-renovated park use and physical activity. Model A included only the independent (frequency of CPI-renovated park use) and dependent (physical activity) variables. The dependent variable was modeled as the probability of reporting high physical activity, and the reference group for the independent variable was low (less than once per week) frequency of CPI-renovated park use. Model B included adjustments for sex, age, race/ethnicity, annual household income, education, use of other neighborhood parks, and study site.

A third log-binomial regression model was created to identify and characterize potential interactions between sociodemographic variables (sex, age, race/ethnicity, annual household income, and education) and frequency of CPI-renovated park use. The reported Model C includes only interactions which screened statistically significant. Model C was also adjusted for remaining covariates which did not exhibit significant interactions with frequency of CPI-renovated park use. Since both park use and physical activity have been shown to uniquely differ across these sociodemographic groups [6, 23, 37–40], treating them as simple covariates would mask the unique relationships between park use and physical activity experienced within each group. By screening for interactions between each

sociodemographic variable and park use and producing stratified models across levels of variables with significant interactions, we were able to characterize differential associations between park use and physical activity which would have otherwise been missed in the overall adjusted model.

In the results, we report prevalence ratios (PRs) and 95% confidence intervals (CIs) for the association between (high) frequency of CPI-renovated park use and (high) physical activity. For models A and B, we report PRs for the association between frequency of CPI-renovated park use and physical activity in the overall study sample. For model C we report PRs by levels of covariates showing significant interaction effects with frequency of CPI-renovated park use.

Data cleaning, descriptive analyses, and data visualization were performed using R software, Version 4.3.2 (<https://www.R-project.org/>) and log-binomial regression models were fit using PROC GENMOD in SAS software, Version 9.4 (SAS Institute Inc., Cary, NC, USA).

RESULTS

Sample Characteristics

The survey-weighted sample (n=2,000) was predominantly non-White, with 40% of participants identifying as Latino, 29% as non-Latino Black, 11% as non-Latino White, and 20% as other or multiracial (Table 1). The sample predominantly consisted of women (53%), people aged ≤50y (62%), and individuals with some college education or less (72%). Thirty percent of the sample had an annual household income of <\$25,000, falling below 100% of the federal poverty level for a family of 3 [42]. Most participants (67%) had moderate-to-low levels of physical activity as reported by the IPAQ.

Younger and less educated participants had greater frequency of CPI-renovated park use compared to their older and higher educated counterparts. Nearly half (46%) of individuals ≤50y reported visiting the park once per week or more compared to 35% of individuals >50y (p=0.016, Table 1). Only 36% of college graduates reported visiting the park once per week or more compared to 44% of individuals with some college or less (p=0.041). Individuals with high self-reported physical activity (IPAQ) also had significantly higher frequency of CPI-renovated park use compared to individuals with moderate-to-low physical activity levels (49% vs. 39% visiting once per week or more, p=0.033). Over half (53%) of individuals who reported frequently visiting other neighborhood parks also reported visiting the CPI-renovated park once per week or more (p<0.001). Latinos and other/multiracial individuals reported higher CPI-renovated park use (46% and 45% visiting once per week or more, respectively) compared to non-Latino Blacks (37%) and non-Latino Whites (36%), although these differences were not significant (p=0.200). Males and individuals with lower income also reported more frequent CPI-renovated park use (with 45% of males and 47% of individuals with annual household income <\$25,000 visiting once per week or more compared to 39% of females and 40% with income ≥\$25,000), but these differences were also non-significant (p=0.200 for both sex and income).

We found significant differences in physical activity across levels of most covariates, including sex, age, race/ethnicity, annual household income, education, and use of other neighborhood parks (Table 2). Males were more likely to report high physical activity (39%) compared to females (28%) ($p = 0.006$), as were adults ≤ 50 y (37%) compared to adults > 50 y (26%) ($p = 0.014$). High physical activity was also more prevalent among non-Latino Whites (42%) compared to Latinos (35%), non-Latino Blacks (35%), and individuals with other/multiracial identities (21%) ($p = 0.018$). Adults with higher annual income ($\geq \$25,000$) were more likely to report high physical activity (37%) compared to those with lower annual income ($< \$25,000$) (23%) ($p = 0.002$), as were college graduates (41%) compared to adults with some college or less (30%) ($p = 0.004$). Furthermore, 43% of individuals who reported using other neighborhood parks once per week or more also reported high levels of physical activity, compared to only 27% of individuals who reported less frequent use of other neighborhood parks ($p < 0.001$).

Associations Between CPI-Renovated Park Use and Physical Activity Level

Estimated using log-binomial regression, the crude association (PR) between frequency of CPI-renovated park use and physical activity level was 1.32 (95% CI 1.16 – 1.49, Figure 2, **Model A**). After adjusting for sex, age, race/ethnicity, annual household income, education, use of other neighborhood parks, and study site, the positive association remained statistically significant (PR = 1.30, 95% CI 1.16 – 1.46, Figure 2, **Model B**).

Significant interactions were found between frequency of CPI-renovated park use and three sociodemographic variables: age, income and race/ethnicity. Figure 2, **Model C** shows the results of stratified analysis by levels of these sociodemographic variables. Greater frequency of park use was more strongly associated with high physical activity among adults age ≤ 50 y (PR = 1.39, 95% CI = 1.14 – 1.69) compared to adults age > 50 y (PR = 1.08, 95% CI = 0.83 – 1.42). Individuals with lower household income ($< \$25,000$ /year) also exhibited a stronger association between CPI-renovated park use and physical activity (PR = 1.54, 95% CI = 1.13 – 2.08) compared to those with higher household income ($\geq \$25,000$ /year), (PR = 0.98, 95% CI = 0.83 – 1.16). Across the four racial/ethnic groups considered, Latinos (PR = 1.77, 95% CI = 1.44 – 2.18) and non-Latino Whites (PR = 1.39, 95% CI = 1.04 – 1.86) were the only two groups to show a significant positive association between CPI-renovated park use and physical activity. The association for non-Latino Blacks was positive, but non-significant (PR = 1.20, 95% CI = 0.94 – 1.55), and the association for individuals with other or multiracial identities was negative, but non-significant (PR = 0.76, 95% CI = 0.50 – 1.16). More detailed model outputs for Models A-C are available in Online Resource 1.

DISCUSSION

In the context of recently renovated urban parks serving low-income communities in NYC, we found that greater frequency of renovated park use was positively associated with higher self-reported physical activity. Given that past studies have shown mixed results, in part due to variations in park quality across studies, this paper is a unique contribution to the literature and adds to our understanding of the role of neighborhood parks in health and wellbeing when park quality is high.

Renovated parks offer spaces that can promote both increased park use and increased physical activity by providing high-quality amenities that support active behaviors and enhancing safety and accessibility. The eight recently revitalized urban parks included in our study experienced substantial infrastructure improvements as a part of CPI, including enhanced accessibility, expanded shaded areas and greenspaces, and improved lighting and aesthetics. As a part of CPI, study parks also added or improved amenities that encourage physical activity, such as walking tracks, ball courts, fitness equipment, and multipurpose fields. Moreover, previous studies have found that park renovations can increase park safety perceptions in some communities, which may be another reason why renovated parks may foster more park-related physical activity [8].

The CDC has found that low-income adults in the US have lower compliance with physical activity guidelines compared to those with higher income (above 200% of the federal poverty level) [4]. Environmental barriers, such as limited access to quality parks and recreational facilities pose significant hurdles to physical activity in low-income areas [18]. Safety concerns, encompassing issues like crime and traffic, further impede participation in exercise within these communities [19]. In light of these barriers, our findings showing a strong positive association between renovated park use and physical activity among low-income NYC residents making less than \$25,000 in annual household income provides further evidence for the potential positive impact of quality neighborhood parks situated within low-income communities. Our findings suggest that further investment in the renovation and redesign of neighborhood parks may be particularly impactful on the health and well-being of neighborhood residents in the lowest income category.

Among the racial/ethnic groups considered in this analysis, we found the association between renovated park use frequency and physical activity to be the strongest among Latinos and non-Latino Whites. This finding is consistent with two other studies examining racial/ethnic variation in park-related physical activity. Derosé et al. found that Spanish-speaking Latinos in Los Angeles were equally as likely as Whites to report using a park for exercise (although English-speaking Latinos were less likely to do so) [23]. Spanish-speaking Latinos in the study were also the most likely racial/ethnic group to report walking to get to a park [23]. In a national sample of US adults, Carlson et al. found that non-Hispanic Blacks were less likely to report active park use (e.g., walking, playing sports, biking) compared to Latinos and non-Latino Whites, who were equally likely to report active park use [21].

Studies have shown Latino park users perceive parks as spaces for socialization and leisure with family and friends, providing spaces for large families without large backyards to get together outside [43]. Spending time outdoors is seen by some Latino cultures as an important component of leisure life for immigrants outside their home country (for example, as a substitute for Mexican *plazas*, integral components of social life and community in Mexico) [43]. Latinos frequently report visiting parks in groups of three or more people [44,45], engaging in a variety of activities at parks, including passive leisure, barbecuing/picnicking, socializing, walking, and playing group sports like soccer (although Latina women report participating in less physically active behaviors in parks than Latino men) [46]. In our sample, Latinos reported higher park use frequency than any other racial/ethnic

group. A higher prevalence of frequent park use, combined with the variety of activities Latinos tend to engage in at parks, might be one explanation why we have observed a stronger association between park use and physical activity among Latinos in our sample compared to other groups, although further research is needed to clarify the mechanisms by which renovated urban parks might promote physical activity among Latino communities specifically.

We found no significant association between renovated park use frequency and physical activity level among non-Latino Black and other/multiracial groups. In our sample, Black and other/multiracial adults visited study parks less frequently than Latino adults. At the same time, Black and other/multiracial adults in our sample also reported low rates of engaging in high levels of physical activity (35% and 21%, respectively), which may be one explanation why no significant positive association between renovated park use and physical activity was observed for these groups. Our physical activity findings are in line with data on Blacks in the general US population, which suggest that only 29.7% of non-Latino Black men and 16.5% of non-Latino Black women met the national physical activity guidelines in 2020, compared to 30.5% of their White male and 24.3% of their White female counterparts [4]. Among Asians (a large component of the other/multiracial category), 30.2% of Asian-American men and only 16.7% of Asian-American women met the national guidelines for physical activity in 2020 [4].

We also found no significant association between renovated park use frequency and physical activity level among older (>50y) adults. Adults >50y in our sample visited study parks less frequently and reported lower physical activity levels overall compared to younger (≤50y) adults, suggesting that NYC residents over 50y are possibly engaging in less park-related physical activity than their younger counterparts. This finding is in line with other studies that have shown that aging adults tend to visit community parks less than their younger counterparts [38,47]. Studies have also shown that older adults visiting community parks tend to participate in more sedentary behaviors during park visits compared to younger adults [38,47].

Park renovations alone may not be enough to engage all populations in participation in physical activity at neighborhood parks [9,25]. Shores and West propose that a combination of infrastructure improvements and social support is essential to promote physical activity among Black park visitors [48]. Similar to Latinos, Black and Asian park visitors also tend to report visiting parks in large family groups more frequently than White park visitors [44,45], so group exercise activities may be another possible means of promoting park-related physical activity among racial minority groups [23]. Cohen et al. have argued for the necessity of social programming or special incentives to encourage park use and physical activity among those over 50y [47].

The equity-driven CPI provides an example of a successful citywide built environment policy initiative whereby park redesign and renovation have demonstrated tangible impacts on the health of disadvantaged urban communities. CPI is an ongoing initiative, whereby NYC Parks reports the completion of targeted physical improvements in 110 priority parks and playgrounds serving underserved neighborhoods to-date (including fully redesigned

and renovated parks like the ones in this study and others that received partial updates), with plans to expand the project to incorporate further physical improvements, as well as enhanced public programming, across dozens more sites across the city [24]. Similar initiatives may be undertaken in other cities with a history of disinvestment in neighborhoods of color as a means of promoting health equity through access to high quality health-promoting park space. These steps can ensure that more communities benefit from improved park quality and access, thereby supporting broader public health goals.

Limitations

This study has several limitations. First, the cross-sectional nature of the study limits causal interpretation. While we did find that more frequent park users were more likely to exhibit high levels of physical activity, the reverse is also plausible (individuals who are more physically active may be more frequent visitors of parks). Second, all study measures were derived from self-reported survey data, which may have led to biased measurement of the exposure, outcome, and/or covariates. To minimize risk of bias in the measurement of park use and physical activity, we used validated questionnaires previously tested for reliability and validity across a variety of populations [28,34]. The IPAQ and the Veitch et al. park use questionnaire ask about past-week and past-month behaviors, respectively, and thus may be open to recall bias. Furthermore, the IPAQ does not differentiate park-specific physical activity, meaning physical activity taking place outside the park was also captured. Finally, the unique contexts of the neighborhoods surrounding the eight study parks participating in the SPARCS study may limit the generalizability of our findings to other populations. Nevertheless, our large, population-representative study sample and our focus on predominantly lower income Latino and Black adults is an important addition to the literature on the built environment and health disparities.

As stated previously, the IPAQ as a self-reported measure of physical activity has been shown to overestimate physical activity levels, with difficulty distinguishing between moderate- and vigorous-intensity activities [35]. One systematic review concluded that the IPAQ overestimates physical activity level by 84% on average compared to accelerometry and other objective physical activity criteria [34]. Studies among the general population and low-income Blacks have repeatedly shown weak-to-moderate correlations between self-reported physical activity on the IPAQ and accelerometer data [49,50]. To address limitations of using the IPAQ as an accurate indicator of individual physical activity, we chose to dichotomize IPAQ categories into “High Activity” vs. “Moderate-to-Low Activity”. This categorization yields a breakdown within our sample (33% “High Activity” vs. 67% “Moderate to Low Activity”) more closely resembling the distribution of individuals meeting (and not meeting) physical activity guidelines in the general US population (with 24.2% meeting the guidelines vs. 75.8% not meeting the guidelines in 2020) [4]. While this breakdown may still be overestimating the proportion of our sample meeting public health guidelines for physical activity, we believe our interpretation is reasonable considering that NYC residents tend to be more physically active on average than the general US population [7].

CONCLUSION

In this study, we demonstrated a significant positive association between frequent use of renovated urban parks and increased physical activity among adults in low-income, predominantly Latino and Black communities in New York City. We observed stronger positive associations between frequent renovated park use and high physical activity among younger adults, those with the lowest income, and Latino residents. Older adults, and individuals with Black and other/multiracial identities, did not exhibit an association between park use and physical activity, suggesting the potential need for tailored programming and social support to engage these populations in physical activity at neighborhood parks.

Renovations under the CPI have made parks more appealing and accessible, benefiting low-income communities of color by providing not only spaces for physical exercise but also for social and cultural activities. Our findings emphasize the significance of quality park spaces in enhancing community health and addressing physical activity-related health disparities. This study supports further investment in park improvements to promote physical well-being across diverse urban populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

1. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Impact of physical inactivity on the world's major non-communicable diseases. *Lancet*. 2012;380(9838):219–229. doi:10.1016/S0140-6736(12)61031-9 [PubMed: 22818936]
2. Bartley KF, Eisenhower DL, Harris TG, Lee KK. Accelerometer and survey data on patterns of physical inactivity in New York City and the United States. *Public Health Rep*. 2019;134(3):293–299. doi:10.1177/0033354919841855 [PubMed: 30951644]
3. World Health Organization. Physical activity. World Health Organization. Published 2022. <https://www.who.int/news-room/fact-sheets/detail/physical-activity>. Accessed March 13, 2024.
4. Elgaddal N, Kramarow EA, Reuben C. Physical activity among adults aged 18 and over: United States, 2020. NCHS Data Brief, no. 443. Hyattsville, MD: National Center for Health Statistics; 2022. Available from: 10.15620/cdc:120213.
5. Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJ, Martin BW. Correlates of physical activity: why are some people physically active and others not? *The Lancet*. 2012;380(9838):258–271. doi:10.1016/S0140-6736(12)60735-1.
6. Center for Disease Control and Prevention. Physical activity data & statistics. Centers for Disease Control and Prevention. Published August 31, 2022. <https://www.cdc.gov/physicalactivity/data/index.html>. Accessed March 13, 2024.
7. New York City Department of Health and Mental Hygiene. Physical activity measured by accelerometer: A comparison of New York City and the nation. <https://www1.nyc.gov/assets/doh/downloads/pdf/epi/databrief22.pdf>. Accessed March 13, 2024.

8. Cohen DA, Han B, Nagel C, et al. The first national study of neighborhood parks. *Am J Prev Med.* 2016;51(4):419–426. doi:10.1016/j.amepre.2016.03.021 [PubMed: 27209496]
9. Otero Peña JE, Kodali H, Ferris E, et al. The role of the physical and social environment in observed and self-reported park use in low-income neighborhoods in New York City. *Front Public Health.* 2021;9. doi:10.3389/fpubh.2021.656988
10. Hartig T, Mitchell R, de Vries S, Frumkin H. Nature and Health. *Annu Rev Public Health.* 2014;35(1):207–228. doi:10.1146/annurev-publhealth-032013-182443 [PubMed: 24387090]
11. Richardson EA, Pearce J, Mitchell R, Kingham S. Role of physical activity in the relationship between urban green space and health. *Public Health.* 2013 Apr;127(4):318–324. doi: 10.1016/j.puhe.2013.01.004. [PubMed: 23587672]
12. Veitch J, Ball K, Crawford D, Abbott GR, Salmon J. Park improvements and park activity: a natural experiment. *Am J Prev Med.* 2012;42(6):616–619. doi:10.1016/j.amepre.2012.02.015 [PubMed: 22608379]
13. Kaczynski AT, Henderson KA. Parks and recreation settings and active living: a review of associations with physical activity function and intensity. *J Phys Act Health.* 2008;5(4):619–632. doi:10.1123/jpah.5.4.619 [PubMed: 18648125]
14. Bancroft C, Joshi S, Rundle A, et al. Association of proximity and density of parks and objectively measured physical activity in the United States: A systematic review. *Soc Sci Med* 1982. 2015;138:22–30. doi:10.1016/j.socscimed.2015.05.034
15. O. Ferdinand A, Sen B, Rahurkar S, Engler S, Menachemi N. The relationship between built environments and physical activity: a systematic review. *Am J Public Health.* 2012;102(10):e7–e13. doi:10.2105/AJPH.2012.300740
16. Cohen DA, Inagami S, Finch B. The built environment and collective efficacy. *Health Place.* 2008;14(2):198–208. doi:10.1016/j.healthplace.2007.06.001 [PubMed: 17644395]
17. Kodali HP, Ferris EB, Wyka K, et al. The association of park use and park perception with quality of life using structural equation modeling. *Front Public Health.* 2023;11. doi:10.3389/fpubh.2023.1038288
18. Sallis JF, Cerin E, Conway TL, et al. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. *Lancet Lond Engl.* 2016;387(10034):2207–2217. doi:10.1016/S0140-6736(15)01284-2
19. Kim J, Liu J, Colabianchi N, Pate RR. The effect of perceived and structural neighborhood conditions on adolescents' physical activity and sedentary behaviors. *Arch Pediatr Adolesc Med.* 2010;164(10):935–942. doi:10.1001/archpediatrics.2010.167 [PubMed: 20921351]
20. Parks and an Equitable Recovery. Trust for Public Land. <https://www.tpl.org/parks-and-an-equitable-recovery-parkscore-report>. Accessed June 30, 2024.
21. Carlson SA, Brooks JD, Brown DR, Buchner DM. Racial/Ethnic differences in perceived access, environmental barriers to use, and use of community parks. *Prev Chronic Dis.* 2010;7(3):A49. [PubMed: 20394688]
22. Knapp M, Gustat J, Darensbourg R, Myers L, Johnson C. The Relationships between Park Quality, Park Usage, and Levels of Physical Activity in Low-Income, African American Neighborhoods. *Int J Environ Res Public Health.* 2019;16(1):85. doi:10.3390/ijerph16010085
23. Deroose KP, Han B, Williamson S, Cohen DA. Racial-ethnic variation in park use and physical activity in the city of Los Angeles. *J Urban Health Bull N Y Acad Med.* 2015;92(6):1011–1023. doi:10.1007/s11524-015-9994-8
24. New York City Parks. Community Parks Initiative. New York City Department of Parks & Recreation. <https://www.nycgovparks.org/about/framework-for-an-equitable-future/community-parks-initiative>. Accessed March 13, 2024.
25. Kodali H, Wyka E, Costa S, Evenson K, Huang TK, Thorpe L. Association of park renovation with park use in New York City. *JAMA Netw Open.* 2024;7(4). doi:doi:10.1001/jamanetworkopen.2024.1429
26. Cuschieri S. The STROBE guidelines. *Saudi J Anaesth.* 2019;13(Suppl 1):S31–S34. doi:10.4103/sja.SJA_543_18 [PubMed: 30930717]
27. Huang TTK, Wyka KE, Ferris EB, et al. The Physical Activity and Redesigned Community Spaces (PARCS) Study: Protocol of a natural experiment to investigate the impact of citywide

- park redesign and renovation. *BMC Public Health*. 2016;16:1160. doi:10.1186/s12889-016-3822-2 [PubMed: 27842531]
28. Veitch J, Salmon J, Carver A, et al. A natural experiment to examine the impact of park renewal on park-use and park-based physical activity in a disadvantaged neighbourhood: the REVAMP study methods. *BMC Public Health*. 2014;14(1):600. doi:10.1186/1471-2458-14-600 [PubMed: 24924919]
 29. Shanahan DF, Bush R, Gaston KJ, et al. Health benefits from nature experiences depend on dose. *Sci Rep*. 2016;6(1):28551. doi:10.1038/srep28551 [PubMed: 27334040]
 30. White MP, Alcock I, Grellier J, et al. Spending at least 120 minutes a week in nature is associated with good health and wellbeing. *Sci Rep*. 2019;9(1):7730. doi:10.1038/s41598-019-44097-3 [PubMed: 31197192]
 31. Evenson KR, Wen F, Hillier A, Cohen DA. Assessing the contribution of parks to physical activity using global positioning system and accelerometry. *Med Sci Sports Exerc*. 2013;45(10):1981. doi:10.1249/MSS.0b013e318293330e [PubMed: 23531716]
 32. Hagströmer M, Oja P, Sjöström M. The International Physical Activity Questionnaire (IPAQ): a study of concurrent and construct validity. *Public Health Nutr*. 2006;9(6):755–762. doi:10.1079/phn2005898 [PubMed: 16925881]
 33. Sjostrom M, Ainsworth B, Bauman A, Bull F, Hamilton-Craig C, Sallis J. Guidelines for data processing analysis of the International Physical Activity Questionnaire (IPAQ) - Short and long forms. In: 2005. <https://www.semanticscholar.org/paper/Guidelines-for-data-processing-analysis-of-the-and-Sjostrom-Ainsworth/efb9575f5c957b73c640f00950982e618e31a7be>. Accessed March 14, 2024.
 34. Lee PH, Macfarlane DJ, Lam T, Stewart SM. Validity of the international physical activity questionnaire short form (IPAQ-SF): A systematic review. *Int J Behav Nutr Phys Act*. 2011;8(1):115. doi:10.1186/1479-5868-8-115 [PubMed: 22018588]
 35. Bauman A, Bull F, Chey T, et al. The international prevalence study on physical activity: results from 20 countries. *Int J Behav Nutr Phys Act*. 2009;6(1):21. doi:10.1186/1479-5868-6-21 [PubMed: 19335883]
 36. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans, 2nd edition. Washington, DC: U.S. Department of Health and Human Services; 2018. https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf. Accessed March 13, 2024.
 37. Cohen DA, Williamson S, Han B. Gender differences in physical activity associated with urban neighborhood parks: findings from the national study of neighborhood parks. *Womens Health Issues*. 2021;31(3):236–244. doi:10.1016/j.whi.2020.11.007 [PubMed: 33358644]
 38. Evenson KR, Williamson S, Han B, McKenzie TL, Cohen DA. United States' neighborhood park use and physical activity over two years: The National Study of Neighborhood Parks. *Prev Med*. 2019;123:117–122. doi:10.1016/j.ypmed.2019.03.027 [PubMed: 30898586]
 39. National Recreation and park association by: Andrew J. Mowen et al. Americans' Use and Perceptions of Local Recreation and Park Services: A Nationwide Reassessment. 2016 https://www.nrpa.org/uploadedFiles/nrpa.org/Publications_and_Research/Research/Park-Perception-Study-NRPA-Full-Report.pdf. Accessed June 29, 2024.
 40. Cohen DA, Han B, Derosé KP, et al. Neighborhood poverty, park use, and park-based physical activity in a Southern California city. *Soc Sci Med*. 2012;75(12):2317–2325. doi:10.1016/j.socscimed.2012.08.036 [PubMed: 23010338]
 41. Rao JNK, Scott AJ. The analysis of categorical data from complex sample surveys: chi-squared tests for goodness of fit and independence in two-way tables. *J Am Stat Assoc*. 1981;76(374):221–230. doi:10.1080/01621459.1981.10477633
 42. United States Department of Health and Human Services. Poverty guidelines. The office of the assistant secretary for planning and evaluation. Published January 17, 2024. <https://aspe.hhs.gov/topics/poverty-economic-mobility/poverty-guidelines>. Accessed March 13, 2024.

43. Stodolska M, Shinew KJ, Acevedo JC, Izenstark D. Perceptions of urban parks as havens and contested terrains by mexican-americans in Chicago neighborhoods. *Leis Sci.* 2011;33(2):103–126. doi:10.1080/01490400.2011.550220
44. Sasidharan V, And FW, Godbey G. Cultural differences in urban recreation patterns: An examination of park usage and activity participation across six population subgroups. *Manag Leis.* 2005;10(1):19–38. doi:10.1080/13606710500086710
45. Gobster PH. Managing Urban Parks for a Racially and Ethnically Diverse Clientele. *Leis Sci.* 2002;24(2):143–159. doi:10.1080/01490400252900121
46. Stodolska M, Shinew KJ, Li MZ. Recreation participation patterns and physical activity among Latino visitors to three urban outdoor recreation environments. *J Park Recreat Adm.* 2010;28:36–56.
47. Cohen DA, McKenzie TL, Sehgal A, Williamson S, Golinelli D, Lurie N. Contribution of public parks to physical activity. *Am J Public Health.* 2007;97(3):509–514. doi:10.2105/AJPH.2005.072447 [PubMed: 17267728]
48. Shores KA, West ST. Physical activity outcomes associated with african american park visitation in four community parks. *J Park Recreat Adm.* 2008;26(3)
49. Wolin KY, Heil DP, Askew S, Matthews CE, Bennett GG. Validation of the international physical activity questionnaire-short among blacks. *J Phys Act Health.* 2008;5(5):746–760. doi:10.1123/jpah.5.5.746 [PubMed: 18820348]
50. Cerin Es, Cain K l, Oyeyemi AL, et al. Correlates of agreement between accelerometry and self-reported physical activity. *Med Sci Sports Exerc.* 2016;48(6):1075–1084. doi:10.1249/MSS.0000000000000870 [PubMed: 26784274]



Figure 1.
Examples of amenities installed at study sites as a part of Community Parks Initiative renovation

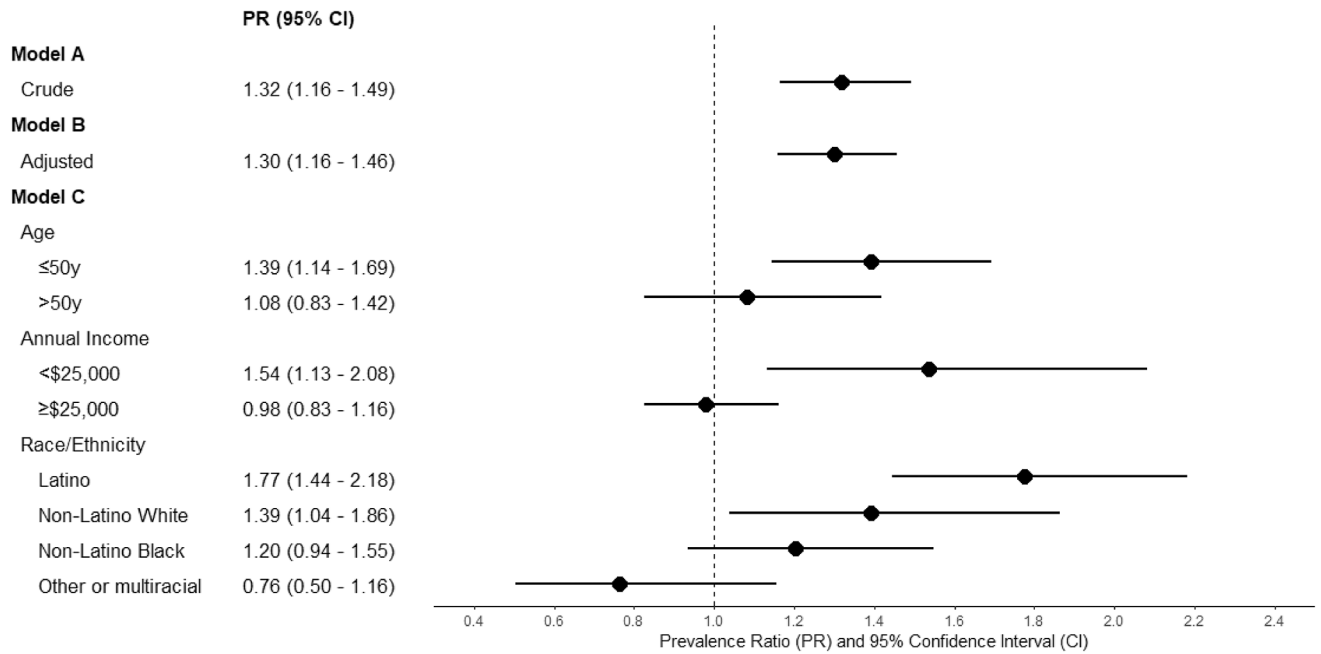


Figure 2.

Prevalence ratios for high physical activity level, comparing frequent users of renovated parks (once per week or more) to infrequent users of renovated parks (less than once per week): Model A = unadjusted log-binomial model, Model B = log-binomial model adjusted for sex, age, race/ethnicity, annual household income, education, use of other neighborhood parks, and study site, Model C = log-binomial model with interactions between age*study park use, annual household income*study park use, and race/ethnicity*study park use, also adjusted for sex, education, use of other neighborhood parks, and study site

Table 1
Sample characteristics stratified by frequency of CPI-renovated park use

	Frequency of CPI-Renovated Park Use			p-value ^b
	Overall, N = 2,000 ^a	Low (Less than once per week), N = 1,159 ^a	High (Once per week or more), N = 841 ^a	
Sex				0.200
Female	1,057 (53%)	640 (61%)	417 (39%)	
Male	943 (47%)	519 (55%)	424 (45%)	
Age				0.016
≤50 Years	1,249 (62%)	671 (54%)	578 (46%)	
>50 Years	751 (38%)	489 (65%)	262 (35%)	
Race/Ethnicity				0.200
Latino	801 (40%)	433 (54%)	368 (46%)	
Non-Latino Black	572 (29%)	362 (63%)	210 (37%)	
Non-Latino White	230 (11%)	146 (64%)	83 (36%)	
Other or multiracial	398 (20%)	218 (55%)	180 (45%)	
Annual Household Income				0.200
<\$25,000	604 (30%)	320 (53%)	284 (47%)	
≥\$25,000	1,396 (70%)	839 (60%)	557 (40%)	
Education				0.041
Some college or less	1,444 (72%)	805 (56%)	640 (44%)	
College graduate	556 (28%)	355 (64%)	201 (36%)	
Use of Other Neighborhood Parks				<0.001
Less than once per week	1,202 (60%)	781 (65%)	422 (35%)	
Once per week or more	798 (40%)	379 (47%)	419 (53%)	
Level of Physical Activity (IPAQ)				0.033
Moderate-to-low	1,337 (67%)	820 (61%)	517 (39%)	
High	663 (33%)	339 (51%)	324 (49%)	

^a n (%), weighted

^b chi-squared test with Rao & Scott's second-order correction [28]

Table 2
Sample characteristics stratified by level of physical activity

	Level of Physical Activity (IPAQ Category)		p-value ^b
	High, N = 663 ^a	Moderate to Low, N = 1,337 ^a	
Sex			0.006
Female	292 (28%)	764 (72%)	
Male	370 (39%)	573 (61%)	
Age			0.014
≤50 Years	464 (37%)	785 (63%)	
>50 Years	199 (26%)	552 (74%)	
Race/Ethnicity			0.018
Latino	283 (35%)	518 (65%)	
Non-Latino Black	200 (35%)	371 (65%)	
Non-Latino White	96 (42%)	134 (58%)	
Other or multiracial	83 (21%)	315 (79%)	
Annual Household Income			0.002
<\$25,000	140 (23%)	464 (77%)	
≥\$25,000	523 (37%)	873 (63%)	
Education			0.004
Some college or less	432 (30%)	1,012 (70%)	
College graduate	230 (41%)	325 (59%)	
Use of Other Neighborhood Parks			<0.001
Less than once per week	319 (27%)	883 (73%)	
Once per week or more	344 (43%)	454 (57%)	

^a n (%), weighted

^b chi-squared test with Rao & Scott's second-order correction [28]