The mediating role of perceived crime in gender and built environment associations with park use and park-based physical activity among park users in high poverty neighborhoods

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ABSTRACT

Women use parks less for physical activity than men, and explanations include gendered concerns regarding personal safety and access to walking paths. This study conducted mediation analyses to examine the effects of gender and presence of park walking path on park use, participation in park programs, and park-based physical activity through the hypothesized mediator (perception of crime). The sample included 3213 park users from 48 parks in high poverty neighborhoods in Los Angeles surveyed between 2013 and 2015; park-level factors were assessed through systematic observations of study parks. Women reported fewer park visits than men in the last 7 days ($\beta = -0.17$, $p = 0.02$) and had significantly higher perceived crime ($\beta = 0.12$, $p < 0.0001$) and perceived crime partially mediated the gender association with park visits ($\beta_{gender, \, direct} = -0.09$, $p = 0.19$; $\beta_{gender, \, indirect} = -0.07$, $p < 0.0001$). Similarly, the existence of a walking path in the park was significantly related to increased park use ($\beta = 0.27$, $p = 0.006$) and a lower level of perceived crime ($\beta = -0.25$, $p = 0.0034$) and perceived crime partially mediated the association of walking path with park visits ($\beta_{walking \, path, \, direct} = 0.18$, $p = 0.10$; $\beta_{walking \, path, \, indirect} = 0.15$, $p = 0.005$). The associations between gender, walking path, and park-based exercise and program participation were not meaningfully mediated by perceived crime. Among park users in majority Latino, high poverty neighborhoods, addressing crime concerns are likely necessary to increase park use among women and adults whose parks do not have a walking path. For park-based exercise and participation in park programs, gendered preferences regarding park-based physical activity should be explored.

1. Introduction

Engaging in regular physical activity (PA) contributes to many positive health outcomes, including longevity, improved quality of life, and reduced incidence of cardiovascular diseases, diabetes, depression, certain cancers, and the prevention of obesity (U.S. Department of Health and Human Services, 1996). However, accelerometer-based estimates suggest that fewer than 10% of American adults meet the minimum level of recommended PA (Physical Activity Guidelines Advisory Committee, 2008), and the time in moderate to vigorous PA (MVPA) declines with age and is lower among women than men (Tucker et al., 2011).

Public parks offer great promise to help community members be physically active, and there is increasing enthusiasm about parks' role in promoting PA, along with a significant movement to create more parks and enhance their infrastructures, facilities, amenities, and aesthetics (Godbey et al., 2005; Kaczynski and Henderson, 2008; Kruger et al., 2007). An estimated 70% of persons in the U.S. live within walking distance of a park (Godbey et al., 1992); further, parks have been found to facilitate PA in minority communities (Godbey et al., 2005; Reed et al., 2012; Tinsley et al., 2002).

Despite the promise of parks for population PA, there are several challenges to achieving their potential across all socio-demographic groups. For example, women have been found to be less likely than men to use parks overall and for PA (Derose et al., 2018). Explanations for these gender disparities are varied, but two consistent ones are that: 1) women are deterred from park use and park-based PA out of concerns for personal safety (Foster and Giles-Corti, 2008) and 2) access to walking paths and other neighborhood characteristics that facilitate walking (e.g., sidewalks, streetlights, etc.) influence PA among women more so than among men (Brownson et al., 2001; Richardson et al., 2017b).

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Nevertheless, the precise relationships between gender, crime or safety concerns, built environment, and population PA and health have been inconsistent (Foster and Giles-Corti, 2008) and remain "elusive" (Bracy et al., 2014). Higher perceived crime has been found to be associated with higher risks of obesity and higher levels of body mass index (BMI), and this relationship was partially mediated by levels of PA (Brown et al., 2014). Higher perceived neighborhood crime has also been found to mediate the pathway between objective crime and BMI (Richardson et al., 2017a). In a longitudinal analysis, lower perceived crime was associated with a 7 min/week increase in recreational walking (Foster et al., 2016). Multiple studies have found that perceived crime or safety concerns are more important than objective crime measures for predicting PA in general, especially among Latinos (van Bakergem et al., 2017) and women in low-income areas (Timperio et al., 2015), as well as for predicting park use and PA (Lapham et al., 2016). Research has also suggested that environmental and social cues interact significantly with gender to influence park use and PA (Jorgensen et al., 2013).

Here we explore the relationships among gender, the built environment, and perceptions of crime in relation to park use and park-based PA among adult park users in high poverty neighborhoods. Previously, we found that among neighborhood residents (park users and non-users), gender and perceptions of safety were significantly associated with park use and park-based PA (Derose et al., 2018). We complement these analyses by focusing on park users – those who have made the decision to use the park – to explore the extent to which crime perceptions mediate the relationships between gender and the built environment and park use and park-based PA, using data from a large study of urban parks in Los Angeles to answer the following two research questions:

1. To what extent do crime perceptions mediate the relationship between gender and park use, park-based PA, and park program participation among park users in high poverty neighborhoods?
2. To what extent do crime perceptions mediate the relationship between park-level structural factors (having a walking path) and park use, park-based PA, and park program participation among park users in high poverty neighborhoods?

2. Methods

2.1. Study sample

The primary data come from a cluster randomized controlled trial of 48 parks in high-poverty neighborhoods in Los Angeles that tested whether park-based interventions could increase park use and PA (Cohen et al., 2016a). Specifically, a 4-arm cluster randomized trial with 3 different interventions offered at parks were compared to a control condition: free adult exercise classes, a frequent user program, and free classes plus a frequent user program. Because we found no differences among study arms in park-level use and PA between two data collection waves on all primary outcomes (Cohen et al., 2017a), we combined the overall study arms for the present study to increase power.

For this sub-study two data sources are used: 1) **individual factors** were obtained through intercept surveys with 3213 park users, half at baseline and half during the intervention period. [park users were selected based on a quota system in which we specifically sought respondents based on gender (50% male) and observed activity level (1/3 of whom were seen engaged in MVPA prior to being asked to participate in the survey)]; 2) **park-level factors** were obtained through systematic observations of study parks (n = 48). The participation rate was 41.5% among park users. Trained, bilingual community health promoters (*promotoras*) conducted the intercept surveys with park users using a structured electronic questionnaire about use of the subject park, frequency of exercise, socio-demographics, health-related factors,

perceptions of park safety and estimated screen time. These same *promotoras* conducted systematic observations in study parks using SOPARC, a validated method using momentary time sampling to assess the characteristics of parks and their users, including their PA levels (McKenzie et al., 2006). Observations were conducted in each park 3 times on one day per month over a 6-month period at baseline and follow-up (12 days total, 6 weekend days and 6 weekdays, or 36 one-hour observation periods per park). Relevant measures collected through the surveys and observations are specified below.

The RAND Human Subjects Protection Committee approved the study and an oral consent procedure for the park user survey.

2.2. Measures

2.2.1. Dependent variables
2.2.1.1. Park use. Park use was defined as the number of times residents stated visiting their neighborhood park in the previous 7 days, which has been validated with global positioning system monitoring in a racially and ethnically diverse sample (Evenson et al., 2013).

2.2.1.2. Use of parks for exercise. Use of parks for exercise was determined by asking participants: "Where do you usually exercise?" with response options of "I do not usually exercise, park, home, private health club, streets or sidewalks, or other." For this analysis, we created two groups: 1) those who exercise in a park; and 2) those who do not exercise in a park (for those who usually exercised but not in a park, we set this outcome as missing).

2.2.1.3. Participates in park programs. Participates in park programs was determined by a single question, "Have you ever participated in a program sponsored at this park?" (yes/no).

2.2.2. Independent variables
Our primary independent variables of interest were 1) *gender* (male, female) as self-reported by participants; and 2) whether the park had a walking path or loop (determined through SOPARC structured observations, where there was a distinct path for continuous walking that was not intended to merely connect different park areas). We focused on walking paths because a national study had found that the park facility that generated the most MVPA among adults and seniors was a walking loop (Cohen et al., 2017b; Cohen et al., 2016b). Our hypothesized mediator was perceived crime in neighborhood derived from responses to 3 items from the Neighborhood Environment Walkability Scale (Saelens et al., 2003): 1) There is a high crime rate in this neighborhood; 2) The crime rate in this neighborhood makes it unsafe to go on walks at night; 3) The crime rate in this neighborhood makes it unsafe to go on walks during the day. (Participants were asked to answer these questions based on the neighborhood surrounding the park where they were surveyed.) Items were scaled from 1 (*strongly disagree*) to 4 (*strongly agree*). Higher values on the crime index indicated higher neighborhood crime perceptions.

We controlled for other **individual characteristics** that have been associated with park use and PA in previous studies (Cohen et al., 2012; Derose et al., 2015; Paxton et al., 2005): *age, gender, race-ethnicity* (African American, Asian/Pacific Islander, Latino, white, or other), *having a child under 18 years old, proximity to park* (within 1/4 mile, 1/2 mile, and 1 mile and more than a mile), *meeting others at parks, PA status at time of interview* (sedentary vs. active), *health status* (fair/poor vs. good to excellent), *body mass index ≥ 30 (obese)* based on self-reported height and weight, *time spent watching television, using computers, and other screen-time*, and *educational status* (< high school, high school graduate or GED, some college or college graduate). We also controlled for **park-level factors** that have been found to correlate with park use and PA (Cohen et al., 2012) (e.g., *park size* (acres) and *number of observed organized activity sessions*, determined through SOPARC
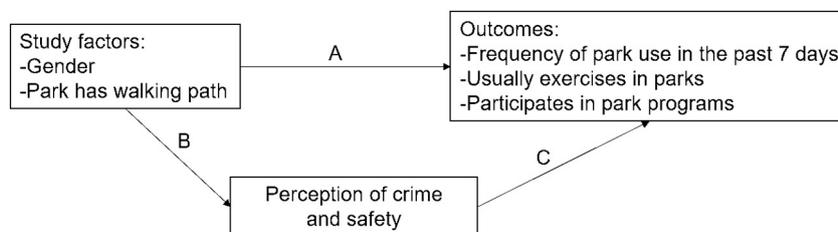
Fig. 1. Illustration of the rationale for mediation analysis.

structured observations).

2.3. Statistical analysis

We first examined descriptive statistics of individual-level characteristics and park-level variables and a simple bivariate analysis of all variables by gender. Next, we conducted mediation analyses (MacKinnon, 2012) to examine the effect of two independent variables – one at the level of the individual (gender of respondent) and the other at the level of the park (whether there was a walking path) – on three outcomes (self-reported park use frequency, participation in park programs, and park-based PA) through the hypothesized mediator (the respondent's perception of crime and safety in the neighborhood surrounding the park). Fig. 1 illustrates the rationale of the mediation analysis. A study factor's total effect on an outcome is broken down to two pathways: link A is the direct effect from the study factor to the outcome independent of the mediator, and links B and C are the indirect effect of the study factor through the mediator.

The classic mediation analysis for a single outcome consists of three regression models: 1) a regression between the outcome and the study factor(s) to confirm the overall effect of the study factor(s); 2) a regression between the mediator and the study factor(s) to confirm link B in Fig. 1; and 3) a regression between the outcome and both the study factor(s) and the mediator simultaneously to estimate the relative effect sizes between links A and C. The direct effect is estimated by model 3) alone, and the indirect effect is estimated by multiplying estimates from models 2) and 3). If the effect of a study factor is entirely through links B and C, the mediator is considered to fully mediate the study factor's effect, and otherwise is considered to partially mediate the study factor's effect.

We conducted three sets of mediation analyses for the three outcomes separately by linear regressions. The three mediation analyses shared the same step 2), i.e., a linear regression between the mediator (perceived crime index) and the study factors (gender and walking path). The same set of covariates were controlled for in all linear regression models, including survey waves, park acreage, number of organized activities in the park, and respondents' race/ethnicity, age, education, obesity status, self-rated health status, having children under 18 years old or not, weekly screen time at home, distance between home and parks (discretized to 0–1/4, 1/4–1/2, and 1/2–1, and > 1 mile), meeting others at parks or not, and the PA status before the interview (sedentary versus active). A random park effect was applied to account for potential clustering among respondents in the same park. Direct effects were directly estimated by the three models. Indirect effects were estimated by combining links B and C where standard errors were calculated by the delta method. Regression coefficients are unstandardized.

3. Results

3.1. Descriptive statistics

Table 1 provides an overview of the characteristics of our sample and the associations between gender and all study variables, including individual-level predictors and the park use and PA outcomes. Among

Table 1
Park user characteristics by gender.

Characteristic	Total (n = 3213)	Women (n = 1631)	Men (n = 1582)	p value
Participant socio-demographics				
Mean age (years)	40.39	39.59	41.21	0.0002
Race-ethnicity (%)				
Latino	84.89%	86.67%	83.06%	0.0043
African American	7.21%	5.84%	8.63%	0.0022
White	3.68%	3.56%	3.81%	0.7134
Asian	2.28%	2.03%	2.54%	0.3325
Other race-ethnicity	0.03%	0.00%	0.06%	
Education level (%)				
< High school	36.48%	33.70%	39.36%	0.0009
High school graduate	39.72%	44.34%	34.94%	< 0.0001
Some college	13.25%	12.93%	13.59%	0.5807
College graduate	10.54%	9.03%	12.12%	0.0046
Has child under the age of 18 (%)	65.92%	76.89%	54.57%	< 0.0001
Distance lives from park (%)				
0–1/4 mile	34.08%	36.62%	31.46%	0.0021
1/4–1/2 mile	29.64%	30.54%	28.71%	0.2585
1/2–1 mile	20.03%	18.87%	21.23%	0.0971
> 1 mile	16.25%	13.97%	18.61%	0.0004
High crime in neighborhood (3 items, scale 1–4)	2.2423	2.303	2.1796	< 0.0001
Sees people they know often/sometimes (%)	68.70%	65.47%	72.04%	< 0.0001
Poor or fair health (%)	21.06%	19.63%	22.54%	0.0436
Obese (BMI ≥ 30, %)	21.67%	22.95%	20.38%	0.0868
Mean screen time (minutes per week)	149.0	159.7	138.0	< 0.0001
Park use and physical activity				
Average # of visits in past 7 days	2.7408	2.6677	2.7155	0.0299
Ever participated in park programs (%)	11.79%	15.30%	8.17%	< 0.0001
Usually exercises at park (%)	40.39%	34.46%	46.51%	< 0.0001

our sample of park users, median age was 40; 85% were Latino; 36% had less than a high school education and 40% were high school graduates; 84% lived within 1 mile of the park; and 66% had children under the age of 18. Statistically significant differences between men and women were found for all three PA outcomes. On average, women visited the park 2.667 days vs. 2.716 days for men (p = 0.0299). Just over 15% of women reported ever participating in a park program vs. 8% of men (p < 0.0001). Nearly half (46%) of men reported exercising at the park vs. a third (35%) of women (p < 0.0001). Among covariates, the only factors that were not statistically significant different between men and women were: white and Asian race; college education; living between ¼ mile and 1 mile of the park; and obesity status.

3.2. Mediation analysis

Results of the mediation analyses for all outcomes and study factors are presented in Table 2. The results suggest a heterogeneous mediation

Table 2
Results of mediation analyses.[a]

Outcome	1) Model between outcome and study factors			2) Model between mediator and study factors	3) Model between outcome and both study factors and mediator			Indirect effect of study factors through mediators: model 2) × model 3)		
	# of days visited park in past 7 days	Usually exercises in park	Participates in park programs	Crime index	# of days visited park in past 7 days	Usually exercises in park	Participates in park programs	# of days visited park in past 7 days	Usually exercises in park	Participates in park programs
Study factor	Estimate (se)	Estimate (se)	Estimate (se)	Estimate (se)	Estimate (se)	Estimate (se)	Estimate (se)	Estimate (se)	Estimate (se)	Estimate (se)
Female gender	−0.17 (0.07)*	−0.12 (0.02)***	0.08 (0.01)***	0.12 (0.03)***	−0.09 (0.07)	−0.11 (0.02)***	0.08 (0.01)***	−0.07 (0.02)***	−0.01 (0.003)*	0.004 (0.002)*
Walking path in park	0.27 (0.10)**	0.11 (0.03)***	−0.03 (0.02)	−0.25 (0.09)**	0.18 (0.10)	0.11 (0.03)***	−0.03 (0.02)	0.15 (0.05)**	0.01 (0.006)	−0.01 (0.006)
Mediator										
Crime index	–	–	–	–	−0.60 (0.05)***	−0.04 (0.02)***	0.04 (0.01)***	–	–	–

Significant p-values are marked with * < 0.05, ** < 0.01, *** < 0.001. All coefficients are unstandardized.
[a] All regressions accounted for nested design by park random effects and controlled for: survey wave, park acreage, number of organized activities in the park, and respondents' race/ethnicity, age, education, obesity status, self-rated health status, having children under 18 years old or not, weekly screen time at home, distance between home and parks (discretized to 0–1/4, 1/4–1/2, and 1/2–1, and > 1 mile), meeting others at parks or not, and physical activity status before the interview (sedentary versus active).

effect of the perceived crime index for different outcomes and study factors.

First, both study factors had mostly significant overall associations with the three outcomes (the first column in Table 2). Women reported fewer park visits than men in the last 7 days (β = −0.17, p = 0.02), and were less likely to exercise in parks (β = −0.12, p = 0.02). However, women were more likely to participate in park programs (β = 0.08, p < 0.0001). The existence of a walking path in the park was significantly related to increased park use (β = 0.27, p = 0.006), and more usual exercise in parks (β = 0.11, p = 0.0006). However, a walking path was not significantly related to program participation (β = −0.03, p = 0.10).

Next, the mediator perceived crime index was significantly related to the two study factors (the second column in Table 2). Women had significantly higher perceived crime than men (β = 0.12, p < 0.0001). The existence of a walking path in park was associated with a lower level of perceived crime (β = −0.25, p = 0.0034).

Lastly, the crime index had different levels of mediation for different outcomes and study factors (the last two columns in Table 2). For park visits in the last 7 days, perceived crime partially mediated the gender association ($\beta_{gender,\ direct}$ = −0.09, p = 0.19; $\beta_{gender,\ indirect}$ = −0.07, p < 0.0001) and that of the walking path ($\beta_{walking\ path,\ direct}$ = 0.18, p = 0.10; $\beta_{walking\ path,\ indirect}$ = 0.15, p = 0.005), where indirect associations were large and significant and direct associations were not significant. This result suggests that gender and the existence of a walking path influenced park visits partially through perceived crime.

In contrast, perceived crime did not meaningfully mediate park-based PA and program participation, although statistically significant. For usual exercise in parks, the direct effects of gender and walking path were significant ($\beta_{gender,\ direct}$ = −0.11, p < 0.0001; $\beta_{walking\ path,\ direct}$ = 0.11, p = 0.0007), and their indirect effects were an order of magnitude smaller ($\beta_{gender,\ indirect}$ = −0.01, p = 0.03; $\beta_{walking\ path,\ indirect}$ = 0.01, p = 0.06). For program participation, the direct gender association was significant ($\beta_{gender,\ direct}$ = 0.08, p < 0.0001), and the indirect association of gender with program participation was statistically significant but very small ($\beta_{gender,\ indirect}$ = 0.004, p = 0.01). The other study factor, walking path, lacked an overall association with program participation. In other words, the associations between gender and program participation were not meaningfully mediated by perceived crime.

4. Discussion

In this study of park users across 48 parks in high poverty neighborhoods in Los Angeles, we find evidence that the effects of gender and aspects of the built environment on park use are mediated by perceptions of crime in the neighborhood surrounding the park. However, we did not find that perceptions of crime mediated the effects of gender and the built environment on exercising in the park and park program participation. These findings have important implications for park-based interventions that aim to increase park use to increase population PA.

First, we found that even among people who visit the park, women report fewer park visits a week than men overall, which confirms earlier findings among population-based samples (Derose et al., 2018) and park observational studies (Evenson et al., 2016). Although the absolute difference was small, over time these add up (e.g., adjusted results of −0.2 fewer visits among women add up to 10 fewer visits in a year). Further, our mediation analysis still holds and demonstrated that perceptions of crime in the neighborhood surrounding the park partially mediated this association between gender and park visits. Women reported higher crime perceptions, and this partially accounted for their reduced use of the park. Thus, to reduce gender disparities in park use, interventions will need to address women's concerns about crime.

Similarly, we also found that the presence of a walking path in the park was associated with more park visits among park users, and that

this, too, was partially mediated by perceptions of crime. Users of parks with walking paths reported lower perceived crime, and this partially accounted for their greater use of the park. A national study found that parks with walking loops had 80% more users than parks without walking loops and that the largest impact of walking loops was for seniors, noting walking loops' potential physical and psychological advantages (Cohen et al., 2017b). It could be that park walking paths create a greater sense of safety, since these generally attract many users. Having more people in a park has been found to be particularly important for women's park use (Jorgensen et al., 2013). Seeing other people engaging in the activity also increases social support for using the park for walking and makes it normative. Greater use could also further discourage crime.

Our findings for the other two outcomes – exercising in parks and program participation – were not partially mediated by crime perceptions, but still provide important implications for park-based interventions. Among park users, women were less likely to exercise in parks than men, which again confirms previous studies among population-based samples that include park users and non-users (Derose et al., 2018) and park observational studies (Joseph and Maddock, 2016). Our findings suggest that addressing crime perceptions will not result in women being more physically active when they visit the park. Instead, other interventions are likely needed. Our sample was largely Latino and most had children under 18 years of age. Previous research among similar populations has found that women's park visits are largely centered around their children (Cohen et al., 2018) and providing childcare may be necessary to facilitate these women's park-based PA (Casper et al., 2013; Cronan et al., 2008). Other ways to address this concern would be scheduling adult PA classes around children's park activities (classes, leagues, etc.) and placing exercise equipment around playgrounds.

Another finding was that the existence of a walking path was associated with higher levels of park-based PA, which again confirms a national study that found that parks users accrued 90% more metabolic equivalent of task (MET) hours when there was a walking loop as compared to users of parks without a loop (Cohen et al., 2017b). Our mediation analyses suggest that addressing crime perceptions will not result in more park-based exercise among park users where there is no walking path. Instead, other interventions to enhance the likelihood of park-based PA (i.e., beyond addressing crime perceptions) are likely necessary. Walking paths can be much less expensive additions as compared to other park facilities that support PA (Cohen et al., 2017b). In addition, walking paths can be used by all ages simultaneously and are generally open at all hours the park is.

The findings for our third outcome, program participation, are also worth mentioning. We did not find that the presence of a walking path was associated with program participation among park users, which is expected. However, we did find that gender played an important role, with women being more likely than men to have participated in a park program, and this gender association was not meaningfully mediated by perceived crime. This suggests that among park users, women are more universally attracted to park programs. For adults, these programs usually consist of non-sports league programming such as yoga, dance, and exercise classes. Such programming appears to encourage park-based PA among women, who are more likely to be sitting and watching children on the playground at the park, compared to men who are more likely to play in sports leagues or pickup games (Cohen et al., 2018).

4.1. Limitations

Our data come from two cross-sectional surveys, and thus the directions of the relationships are unclear, and causality cannot be inferred. In addition, most of our measures, at least the individual-level and outcome measures, are based on self-report and therefore subject to various kinds of bias including recall and social desirability. However, reports of park use have been validated as reliable (Evenson et al., 2013). Finally, we surveyed park users only in high poverty areas of a single metropolitan area, thus the results may not generalize to higher income and other metropolitan areas.

4.2. Conclusion

Among park users in high poverty neighborhoods, most of whom were Latino, addressing crime concerns are likely necessary to increase park use among women and adults whose parks do not have a walking path. For park-based exercise and participation in park programs, crime concerns do not appear to be the main driver. Thus, it may be necessary to explore gendered preferences regarding park-based PA (e.g., types of activities, programs, opportunities for combining with childcare responsibilities) and aspects of the built environment (e.g., walking paths) that facilitate park-based PA. More park programming that focuses on PA would be a reasonable way to increase park-based PA among women.

Declaration of competing interest

None.

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