

Applied Research Brief: Health-Promoting Community Design

The Effect of Objectively Measured Crime on Walking in Minority Adults

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Abstract

Purpose. Evaluate the relationship between neighborhood crime and the amount of daily walking by minority adults.

Design. This was a cross-sectional study of minority adult walking behavior and crime.

Setting. Oakland, California was chosen as the study area because of the substantial spatial variation in levels of criminal activity combined with detailed information on walking trips.

Participants. The study was restricted to minority adults who responded to the 2000 Bay Area Travel Survey and lived in Oakland, California ($n = 359$).

Method. Data on leisure and utilitarian walking were collected through the 2000 Bay Area Travel Survey and combined with crime data from the Oakland Police Department. A negative binomial model was used to test if violent, property, or quality of life crimes had significant associations with daily minutes walked, controlling for individual and neighborhood covariates.

Results. The model showed a significant negative association between violent crime and minutes walked per day ($b = -.07$; $p = .016$). Neither property nor quality of life crimes were correlated with amount of walking.

Conclusions. Reductions in violent crime may increase opportunities for minority residents in urban areas to participate in physical activity such as walking, thereby providing another reason to pursue anticrime measures. Urban designers' efforts to increase physical activity by improving neighborhood walkability may consider violent crime prevention in their designs. (*Am J Health Promot* 2008;22[6]:433-436.)

Key Words: Crime; Walking; Adult; Minority. Manuscript format: research; Research purpose: relationship testing; Study design: cross-sectional; Outcome measure: behavioral; Setting: local community; Health focus: physical activity; Strategy: environment; Target population age: adults; Target population circumstances: minority

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This manuscript was submitted November 16, 2006; revisions were requested April 16, and June 14, 2007; the manuscript was accepted for publication June 15, 2007.

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0890-1171/08/\$5.00 + 0

INTRODUCTION

Concern about rising levels of obesity in the American population has prompted a focus on people's opportunities to engage in physical activities such as walking.^{1,2} The U.S. Department of Health and Human Services'

Healthy People 2010 guidelines recommend at least a 50% increase in walking for short trips (<1 mile).³ With the goal of increasing walking, policy makers and researchers have begun to consider how neighborhoods may affect pedestrianism.⁴

One critical characteristic affecting neighborhood walkability is safety. Re-

searchers considering the impact of crime on walking have found mixed associations.⁵⁻⁹ Doyle et al.⁶ found that living in counties with lower crime rates was associated with walking more and that the effect was stronger for women than men. Similarly, Weinstein et al.,⁷ using data from the 1996 Behavioral Risk Factor Surveillance System, found that living in neighborhoods perceived as unsafe was associated with higher levels of physical inactivity. In contrast, King et al.⁸ in a large sample of women over 40 years and Brownson et al.⁹ in a sample of U.S. adults found no relationship between activity levels and perceived safety. The inconsistent findings in the research may result from varying definitions of crime, i.e., objective vs. perceived, as well as differences in definition and measurement of physical activity.⁵

Whereas prior work has addressed the association between walking and crime, this is one of a few studies to focus on minority populations who, importantly, often live in higher crime areas^{10,11} and have higher rates of obesity.¹² In addition, this study addresses weaknesses of earlier work by using detailed, objective measures of crime. Using a social ecology framework,¹³ we hypothesized that neighborhood crime is associated with lower levels of walking after accounting for individual, household, and built environment factors.

METHODS

Design

The study employed a cross-sectional research design to assess the association between crime and the amount of daily walking by minority adults in Oakland, California. We controlled for

individual and neighborhood covariates in the model.

Data Sources and Sample

Data were taken from three publicly available sources: the 2000 San Francisco Bay Area Travel Survey (BATS), Census 2000 Topologically Integrated Geographic Encoding and Referencing system files, and 2000 Oakland, California crime records. Analyses were performed in 2006 with approval from the University of Virginia institutional review board. Information on leisure and utilitarian walking and sociodemographic data were available from BATS, which is a random-digit dial activity diary survey of 15,064 households in the nine-county Bay Area, commissioned by the Metropolitan Transportation Commission. The survey collected detailed activity and travel information for assigned 2-day periods and sociodemographic characteristics. The overall survey response rate was 15.6% with a completion rate of 48.2%; households with incomes below \$40,000 or more than four people had lower response rates (exact figures are not available).¹⁴

General studies of travel survey methods have shown that the activity-based approach used in the BATS survey captures more trips than traditional trip diary methods.¹⁵ BATS, in particular, was designed to improve reporting of trip chains (e.g., stopping at the grocery store on the way home from work).¹⁶ Although BATS uses a more advanced survey methodology than most regional travel surveys, it is still clear that the instrument does not capture all trips. In particular, comparisons of global positioning system (GPS)-based surveys with diaries have shown that diaries may miss 20% to 30% of trips.¹⁵ A study of misreporting of vehicle trips within Alameda County (where the study area was located) found that 22% of vehicle trips were missed by the travel diary.¹⁷ However, the cost of wearable GPS technology and the need for respondents to keep the device with them at all times have resulted in little validation of walk trip reporting being conducted for travel surveys. Nevertheless, the BATS data provide the most comprehensive assessment of both utilitarian and leisure walking, and the data have been used

in previous studies of active travel in planning and public health.^{18,19}

The sample was limited to nonwhite adult residents (≥ 19 years) of Oakland, California to match the geographic availability of detailed crime data. Respondents missing geocoded residential location ($n = 8$) and those who did not report the number of household vehicles ($n = 10$) were eliminated from the sample, resulting in a final sample size of 359 adults. *t*-tests showed significant differences in walking, household income, and crime rates between white and nonwhite respondents, supporting the decision to model minority behavior separately.

Measures

Outcome Measure. Utilitarian and recreational walking trips were extracted from the BATS survey and used to calculate the number of minutes walked per day for each minority respondent. The activity diaries completed by respondents asked about type of activity (e.g., traveling, chores, meals, recreation, sleep, work, school, shopping); location; and duration for all activities undertaken on the survey days. For trips involving travel, respondents were asked to indicate the mode of transportation (e.g., car, rail, walk). This framework captured walking when (1) it was the primary purpose (e.g., recreational walk trip) or (2) the respondent walked to a destination (i.e., utilitarian walking). It did not capture walking undertaken as part of another activity. For example, if a respondent walked to the grocery store, shopped, and then walked home, the instrument only captured the walks to and from the grocery store and not any walking done inside the grocery store while shopping.

Crime. The Oakland Police Department provided summary records of all law enforcement reports for 2000. Researchers grouped crime into three categories: property (arson, burglary, theft, and vandalism), violent (murder, robbery, assault, and battery [rape and attempted rape were not included because addresses could not be released for these crimes]), and quality of life (weapons offenses, prostitution, drug arrest, liquor law violations, and disorderly conduct). The address of

each crime was geocoded to the census block group using ArcGIS (ESRI Corp, Redlands, Calif) and converted to indices of crimes per 1000 block group residents.

Individual Covariates. Multivariate models were controlled for sociodemographic factors such as age, sex, household auto ownership (household vehicles per licensed driver), race/ethnicity (African-American [reference category], Latino, Asian, other nonwhite), disability status, and whether the walking occurred on a weekday or weekend. Household income was tested as a control variable (due to concerns about response rate variation by income) but was not significant in the model.

Neighborhood Covariates. The study also controlled for variation in the built environment by including measures that previous research had shown to be significant.²⁰ Three such built environment measures were significant and were included in the final models: population density (persons per km²), Cervero and Duncan's¹⁸ "residential index" calculated as housing units as a percent of housing and employment, and a composite measure of the street network. This composite measure was generated using factor analysis on the number of intersections per km² and the percentage of one-, three-, four-, and five-way intersections within a 0.8-km radius of respondent's home.

Analysis

Minutes walked was modeled with a negative binomial model to account for significant overdispersion of zeroes ($G^2 = 6130.54$; $p < .01$) caused by the large proportion of respondents who made no walking trips.²¹ Negative binomial analyses used the *nbreg* command in Stata 9.2 (Stata Corp, College Station, Tex). Robust standard errors which account for correlations among household members are reported and were calculated using the *cluster* command.

RESULTS

The mean age (\pm SD) of adults in the sample was 44 years (± 16). Forty-nine percent of the sample was African-American, 26% Asian, 20% Latino, and

Table 1
Multivariate Negative Binomial Model of Minutes Walked: Crime Factors†

| | Coefficient, <i>b</i> | Factor Change for One-Unit Increase, e^b | Factor Change for SD Increase, $e^{b\sigma}$ | Significance, <i>p</i> |
|-----------------------|--------------------------------|--------------------------------------------------|----------------------------------------------------|---------------------------|
| Violent crime | -0.069 | 0.933 | 0.324 | 0.016 |
| Property crime | 0.006 | 1.006 | 1.297 | 0.427 |
| Quality of life crime | 0.012 | 1.012 | 1.427 | 0.229 |
| N | 359 | | | |
| LL (full) | -351.45 | | | |
| LL (intercept only) | -358.50 | | | |
| Wald test | $\chi^2(13) = 59.59, p < 0.01$ | | | |

LL indicates log likelihood.

† Model has been adjusted for age, race, gender, disability status, auto ownership, survey day, population density, residential index, and street network factor.

5% other nonwhite. These numbers are comparable to the Census 2000 data for Oakland, which show that the minority population is 47% African-American, 22% Asian, and 26% Latino. Households averaged 1.0 (± 0.4) cars per driver. Fifty-two percent of respondents were female; 5% reported a disability affecting their abilities to walk. Seventy-four percent of respondents were surveyed on weekdays.

Adults walked 4.2 (95% confidence intervals [CI] = 2.4, 6.0) minutes per day on average. A large portion (88%) of respondents reported no walking trips during the survey period. Among respondents who reported at least one walking trip, the average minutes walked were 34.4 (95% CI = 22.9, 45.9). Respondents from zero-vehicle households walked 10.6 (95% CI = 3.2, 18.0) minutes per day compared with 3.9 (95% CI = 2.1, 5.7) minutes for individuals with at least one household vehicle. Respondents encountered wide variations in crime with an aver-

age of 67.0 property crimes per 1000 residents (interquartile range [IQR] = 47.3, 76.4; coefficient of variation [CV] = 0.91), 17.9 violent crimes (IQR = 7.0, 23.8; CV = 1.43), and 20.3 quality of life crimes (IQR = 2.9, 29.3; CV = 0.67). The urban study location was reflected by an average population density of 5518 per km² [IQR = 3152, 7301, CV = 0.67].

Negative Binomial Model

The model results showed that an SD increase in violent crime (16.3 crimes per 1000 block group residents) is associated with a decrease in walking rates by a factor of 0.32 (CI = 0.13, 0.81) (Table 1). For the reference person with no vehicle access, this translates to 14.1 more minutes of walking per day based on living in a very low crime neighborhood (fifth percentile) compared with a very high crime neighborhood (95th percentile) (Table 2). The model predicts a difference of 4.4 minutes of walking per day

Table 2

Predicted Minutes of Walking per Day by Violent Crime Level and Vehicle Access for the Reference Person†

| | Violent Crime Percentile | | | |
|-------------------------------|--------------------------|-----|-----|-----|
| | 5% | 25% | 75% | 95% |
| Zero-vehicle households | 14.7 | 9.2 | 2.7 | 0.6 |
| One car per driver households | 4.6 | 2.9 | 0.9 | 0.2 |

† Reference person is a nondisabled 44-year-old African-American male who lives in the average neighborhood for all environmental characteristics.

for individuals with access to a vehicle depending on whether they live in a high- or low-crime area. Quality of life and property crimes had no statistically significant effect on walking rates.

DISCUSSION

Two policy implications emerge from the finding that violent crimes—murder, robbery, assault, and battery—are associated with less walking for minority residents of an urban area. First, it suggests that policies intended to lessen crime may have the ancillary benefit of increasing physical activity for minorities by making it possible for them to make longer and more walking trips. This is important because it is a method for increasing opportunities for physical activity that does not require any changes to the physical environment to be effective. Policing strategies based on the broken windows theory emerged during the 1990s^{22,23} (see Harcourt²⁴ for a critique) and focus on enforcing quality of life infractions to decrease more serious crime.

The second policy implication is that initiatives which aim to increase physical activity by changing neighborhood design should also address crime, particularly violent crime. Urban design plays a critical role in this by providing spaces that can deter crime through the use of lighting and other features.⁵ By designing spaces that facilitate having “eyes on the street,” designers can minimize opportunities for crime.^{25,26}

There are a number of study limitations. The cross-sectional nature of this study makes it impossible to assess the causal relationships among crime, the built environment, and walking. As the literature on self-selection bias has documented,^{4,27} cross-sectional studies cannot distinguish between an environment's influence on behavior and the behavioral preferences of people that cause them to choose particular neighborhoods. In addition, the analysis showed relatively low levels of walking among the study population. This result may reflect behavior or may be an artifact of the survey method. For example, self-reported travel data are likely to systematically underreport

short trips and are not designed to capture walking undertaken as part of other activities (e.g., house cleaning or shopping).¹⁷ Finally, this study only measured crime objectively rather than also incorporating individuals' perceptions; a more robust study would include both of these measures of crime, which may influence behavior differently. The limited geographic scope and the focus on walking suggest the need for further studies which would look at a larger area with a wider range of land use types and crime levels and use objective measures of physical activity (e.g., accelerometers).

CONCLUSIONS

Results from this study suggest that violent crime suppresses the opportunities for physical activity that minority residents obtain from walking. This finding is useful to practitioners because it suggests that crime reduction efforts may have an ancillary benefit of improving physical activity levels in minority adults, a group that is at risk for obesity and its associated health issues.

Acknowledgments

The author gratefully acknowledges Chuck Purvis and Rachel Gossen of the Metropolitan Transportation Commission and Marie Mason of the Oakland Police Department for their assistance in data assembly.

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