

Homicides, Public Goods, and Population Health in the Context of High Urban Violence Rates in Cali, Colombia

Lina Martínez · Sergio Prada · Daniela Estrada 

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Abstract Obesity and frequent mental and physical distress are often associated with major health problems. The characteristics of the urban environment, such as homicide rates and public goods provision, play an important role in influencing participation in physical activity and in overall mental health. This study aimed to determine whether there was a relationship between homicide rates and public goods provision on the health outcomes of the citizens of Cali, Colombia, a city known for its high urban violence rate and low municipal investment in public goods. We used a linear probability model to relate homicide rates and public goods provision (lighted parks, effective public space per inhabitant, and bus stations) at the district level to health outcomes (obesity and frequent mental and physical distress). Individual data were obtained from the 2014 CaliBRANDO survey, and urban context characteristics were obtained from official government statistics. After controlling for individual covariates, results showed that

homicide rates were a risk factor in all examined outcomes. An increase in 1.0 m² of public space per inhabitant reduced the probability of an individual being obese or overweight by 0.2% (95% confidence interval (CI) = - 0.004 to - 0.001) and the probability of frequent physical distress by 0.1% (95% CI = - 0.002 to - 0.001). On average, the presence of one additional bus station increased the probability of being obese or overweight by 1.1%, the probability of frequent mental distress by 0.3% (95% CI = 0.001–0.004), and the probability of frequent physical distress by 0.02% (95% CI = 0.000–0.003). Living in districts with adequate public space and lighted parks lowers the probability of being obese and high homicide rates, which are correlated with poor health outcomes in Cali, Colombia. Investments in public goods provision and urban safety to reduce obesity rates may contribute to a better quality of life for the population.

Keywords Obesity · Health outcomes · Homicide rates · Public goods · Cali

L. Martínez
School of Business and Economic Studies, Universidad Icesi & POLIS, Cali, Colombia
e-mail: lmmartinez@icesi.edu.co

S. Prada
School of Business and Economic Studies, Universidad Icesi & PROESA, Cali, Colombia
e-mail: siprada@proesa.org.co

D. Estrada 
School of Business and Economic Studies, Universidad Icesi & CIENFI, Cali, Colombia
e-mail: destrada@icesi.edu.co

Introduction

Urbanization is a rapidly occurring phenomenon, particularly in developing countries [1]. Cities attract a large number of inhabitants because urban areas provide better access to markets and public goods. Cities have to deal with problems associated with urbanization (such as transportation, public goods provision and

maintenance, safety and security, and affordable housing) to make them livable and attractive to the population [2].

Major challenges that urban areas have to deal with are health hazards, with obesity being one of the most studied. The literature on obesity in developing countries has shown that the prevalence of this condition is increasing in urban settings and that the poor and females are affected the most [3]. Recent studies in developed countries have shown how health outcomes may be related to environmental factors that facilitate healthy behaviors. For example, Heinrich et al. [4] found that 71.0% of the variance in the prevalence of obesity in a mid-sized US Midwestern city was related to environmental variables such as physical activities (e.g., soccer fields), amenities (e.g., benches), resources (e.g., parks), and incivilities (e.g., vandalism). In addition, the study found that environments with low socioeconomic conditions showed higher rates of obesity prevalence, which might be related to the higher rates of incivilities that discourage residents from walking or participating in other activities at available neighborhood physical activity resources [4]. McAlexander et al. [5] obtained similar results.

Other studies have addressed issues such as how urban contextual and neighborhood factors relate to individual health including coronary heart diseases [6, 7], obesity [8–11], and mental and physical health [12]. Others have analyzed how the mode of transportation (motor vehicles) has a positive correlation with obesity [13, 14].

Most of these studies have shown that the availability of adequate public space incentivizes physical activity and improves the health outcomes of individuals by reducing the prevalence of obesity [15, 16]. However, if people are concerned about their safety, they may underuse the available public space, which would limit their physical activity [17–19]. It has also been reported that unsafe conditions are related to depression and anxiety [20]. Confirming the correlation between these aspects (homicides, public good provision, and health outcomes) and then modifying these environmental conditions can help policymakers increase the quality of life of the citizens [21, 22].

In this paper, we provide evidence to the scarce literature available on how crime rates and public goods provision (lighted parks, adequate public space per inhabitant, and bus stations) are associated with health outcomes (obesity and frequent mental and physical

distress) in Cali, the most violent city in Colombia and one of the top 10 in the world. In 2014, Cali experienced more than 60 homicides per 100,000 inhabitants compared to Bogota (17/100,000), which is the capital and largest city in Colombia, and Medellin (20/100,000), which is the second largest city [12]. In addition, Cali has a different pattern of municipal investment per capita compared to Bogota and Medellin. Municipal investment refers to socioeconomic investment, including health, education, and basic public goods and services as well as road infrastructure. For example, Cali's investment in 2011 was approximately only 30% of Bogota's and 50% of Medellin's [23].

Methods

Sources of Data

Data for this analysis came from two sources. Cross-sectional data were obtained from 2014 CaliBRANDO, a survey conducted annually in Cali by the Observatory of Public Policy at Universidad Icesi among adults aged ≥ 18 years. The survey is conducted such that the probability sample is representative of the sex and socioeconomic strata of the city. On average, 1200 individuals are randomly selected and surveyed in person. The survey asks about life satisfaction, income, employment, education, and health conditions including weight and height to estimate the body mass index (BMI) and the number of days feeling physically or mentally ill. The latter are adopted from a set of questions from the Centers for Disease Control and Prevention (CDC) (2000) entitled "Healthy Days Measures," which are included in the National Health and Nutrition Examination Survey since 2000 and in the Behavioral Risk Factor Surveillance System since 1993 [24].

The second source of data was obtained from government reports on public space and homicide rates in 2013. Data from 2014 CaliBRANDO survey were paired with official information, using the district of residence as the matching variable. All 22 districts were included. Variation at the district level was used to identify the association between homicides, public goods provision, and self-reported health outcomes because these are not equally distributed geographically.

Independent Variables

Two crime measures were used. First, the homicide rate per 10,000 inhabitants was used as an objective measure for safety in each district. Second, a subjective measure of perceived safety was taken from the 2014 CaliBRANDO survey in which respondents were asked to rate on a scale of 1 to 10 their satisfaction with the mayor's management of city security, where 1 was completely unsatisfied and 10 was completely satisfied.

For public goods provision, the number of lighted parks per 10,000 inhabitants, number of square meters of adequate public space (parks, green areas, main squares, and small squares) per inhabitant, and number of bus stations per district were used.

Confounders

We accounted for individual characteristics that affected health outcomes according to the literature. For example, age, being female, belonging to a racial minority group, and low education levels have been shown to be related to weight gain and the probability of being obese [25, 26], as well as being married [26–28] and having children [26]. Weight satisfaction was included because some studies have found it to be a predictor of weight loss and positive health behavior [29, 30]. Owning a car was also included because there is a strong and positive relationship between the means of transportation and obesity [31, 32].

Outcome Variables

Three variables were used to measure health outcomes. First, BMI was used based on the following categories: underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$), normal ($18.5 \text{ kg/m}^2 \leq \text{BMI} \leq 24.9 \text{ kg/m}^2$), overweight ($25 \text{ kg/m}^2 \leq \text{BMI} \leq 29.9 \text{ kg/m}^2$), and obese ($\text{BMI} \geq 30 \text{ kg/m}^2$). Second, it was determined whether the respondent had felt physically ill ≥ 14 days during the previous 30-day period. Third, it was determined whether the respondent had felt mentally ill for ≥ 14 days during the previous 30-day period. The latter corresponds to the definition of frequent mental distress [24]. A 14-day threshold was chosen because practitioners use a similar timeframe to diagnose mood disorders [33, 34].

Statistical Analyses

Given the multilevel framework of the study, that is, individual-level and district-level variables, a multilevel regression was first estimated to account for the fact that individual-level factors may have differential effects on outcomes depending on the context. However, interclass correlation of the empty model approximated to zero and showed that grouping by districts was not statistically different from a linear multivariate model (results are available upon request). Therefore, linear fixed-effects models were used to estimate the association between homicide rates and public goods provision at the district level with each health outcome at the individual level after controlling for individual covariates. This econometric technique makes use of within-subject within-district variation only to identify the effects of included regressors in each health outcome (obesity and frequent mental and physical distress). Fixed effects are included at the district level; consequently, the effects of all unobserved characteristics that did not vary over time and were specific to the district were controlled in the analysis (i.e., poverty and availability of police patrols).

As reported in the literature review, men and women are not similarly vulnerable to the effects of individual as well as higher level factors on their psychological distress and obesity. To account for the full interaction of these variables and sex, a separate regression model is estimated by sex. Each regression model was adjusted for age, marital status (reference category: married), number of years of education, number of children, ownership of a vehicle, satisfaction with the mayor's management of parks and public space, satisfaction with the mayor's management of city security, satisfaction with individual life, and satisfaction with current weight.

The three specifications differed in some ways. The obesity model included the number of days without good physical health and the number of days without good mental health, while the unhealthy mental days model includes only the number of days without good physical health, and the unhealthy physical days model includes only the number of days without good mental health. All analyses were conducted using Stata 14 (StataCorp., College Station, TX).

Results

Population and City Characteristics

Cali's 22 districts can be grouped according to their socioeconomic characteristics (Table 1) [35]. On average, rich districts (2, 17, 19, and 22) have eight times more areas of adequate public space than poor districts. For example, district 22 has the highest number of square meters of public space per inhabitant and the lowest rate of obese and overweight people. In contrast, poorer districts (1, 8, 13, 15, and 20) have higher rates of obese and overweight people. This phenomenon is observed even in districts with a higher number of lighted parks per 10,000 inhabitants. Both rich and poor districts have high homicide rates, with an average of 7.1 homicides per 10,000 inhabitants. The lowest rates are

observed in richer districts, with the exception of district 22, which has a high homicide rate, not because of the number of deaths but because of the small number of inhabitants.

Table 2 presents demographics and other characteristics at the individual level. The sample was equally distributed by sex; average age was 38 years, and nearly 46% of those interviewed were either married or living in common law. One third of the population owned a car, and 42% were obese or overweight. One in ten individuals felt physically or mentally ill for ≥ 14 days in the last 30 days.

Multivariate Analysis

Tables 3, 4, and 5 present the results for each outcome by sex. Homicide rates were associated with a positive

Table 1 Overall characteristics in Cali's districts

District	Habitants ^a , no. (%)	Effective public space ^b , no. of square meters per inhabitant	Massive transportation system stations ^c , no. (%)	Lighted parks ^b , no. per 10,000 habitants	Homicide rate ^b , no. per 10,000 habitants
1	88,432 (3.8)	2.4	0 (0.0)	0.9	4.4
2	114,651 (5.0)	6.5	7 (12.3)	4.7	2.9
3	46,400 (2.0)	5.0	10 (17.5)	1.9	8.2
4	53,369 (2.3)	1.9	5 (8.8)	4.3	6.0
5	112,089 (4.9)	3.2	1 (1.8)	4.9	1.8
6	189,837 (8.2)	1.1	0 (0.0)	2.6	4.7
7	71,334 (3.1)	1.3	2 (3.5)	2.7	7.3
8	102,388 (4.4)	0.6	6 (10.5)	2.5	4.4
9	44,994 (2.0)	0.5	5 (8.8)	1.8	13.8
10	110,854 (4.8)	1.6	0 (0.0)	3.4	4.5
11	107,339 (4.7)	1.4	2 (3.5)	5.4	3.4
12	66,881 (2.9)	0.9	1 (1.8)	2.1	6.4
13	177,641 (7.7)	1.6	3 (5.3)	2.5	9.7
14	172,696 (7.5)	1.3	0 (0.0)	1.7	10.8
15	159,369 (6.9)	1.8	0 (0.0)	3.1	8.9
16	107,170 (4.7)	2.1	0 (0.0)	1.6	8.3
17	139,665 (6.1)	9.9	1 (1.8)	4.1	1.8
18	131,453 (5.7)	0.7	2 (3.5)	2.1	4.6
19	112,947 (4.9)	2.7	9 (15.8)	2.7	3.5
20	69,331 (3.0)	0.2	0 (0.0)	0.7	17.9
21	112,336 (4.9)	3.4	0 (0.0)	4.5	11.2
22	11,160 (0.5)	45.2	3 (5.3)	2.7	11.7

^a Cali en Cifras 2013

^b Cali Cómo Vamos 2014

^c MIO 2015

probability of being obese for men but not for women. Homicide rates were associated with a positive probability of feeling mentally unhealthy for women and a negative probability for men. Similarly, homicide rates were associated with a positive probability of feeling

Table 2 Overall characteristics of the study sample, Cali: CaliBRANDO (2014)

Characteristic	Year 2014 (<i>n</i> = 1206)
Demographics and income (%)	
Men	50.2
Women	49.8
Mean age (SE) (years)	38.1 (0.4)
Mean schooling (SE) (years)	11.4 (0.1)
High score in life satisfaction ^b	47.3
Owns vehicle	31.3
More than 1 and less than 2 minimum wages of monthly income ^a	42.9
Marital status (%)	
Married	21.8
Living in common law	25.0
Single	41.9
Divorce	6.1
Widower	2.6
Children (%)	
Parent	65.4
Mean number of children (SE)	1.3 (0.4)
Health (%)	
Health insurance	92.0
Satisfied with weight	56.8
Felt physically ill 14 days or more	9.7
Felt mentally ill 14 days or more	8.1
Mean days per month felt physically ill (SE)	2.4 (0.2)
Mean days per month felt mentally ill (SE)	2.7 (0.2)
Mean height (SE) (m)	1.7 (0.0)
BMI (%)	
Obese (≥ 30 kg/m ²)	8.8
Overweight (25–29.9 kg/m ²)	33.3
Normal (18.5–24.9 kg/m ²)	55.2
Underweight (< 18.5 kg/m ²)	2.8

BMI body mass index

^a The minimum wage was USD308 in 2014, with an exchange rate of 2000 pesos per dollar

^b Respondents were asked: “On a scale from 1 to 10, how satisfied are with your life?” where 1 is very dissatisfied and 10 is very satisfied. On this scale, 9 and 10 are considered a high score in life satisfaction

physically unhealthy for women and a negative probability for men. These estimates show the existence of an association between crime and unsafe environments and health outcomes and that there are differential effects by sex. While these coefficients seem pretty small at first sight, for instance 0.003 for males, when the probabilities are evaluated at the mean (7.1 homicides/10,000 inhabitants), it translates to males being 2.3% more likely to be obese or overweight as a consequence of increased violence, and at the most violent district (17.9 homicides/10,000 inhabitants), the effect translates to 5.4%.

An increase in 1.0 m² of adequate public space per inhabitant reduced the probability of being obese or overweight by 0.2% [95% confidence interval (CI) = – 0.004 to – 0.001]. In addition, adequate public space reduced the probability of frequent physical distress by 0.1% (95% CI = – 0.002 to – 0.001). In both of these outcomes, results differ by sex in magnitude, with women benefitting more than men. Regarding mental distress, results differ by sex, benefitting men and affecting women.

The number of lighted parks was negatively associated (at a 1% level of statistical significance) with the probability of being obese, suggesting that one additional lighted park per 10,000 inhabitants can reduce the probability of being obese by 0.8%; however, it was counterintuitive that there was a positive association between the number of lighted parks and a higher probability of feeling mentally or physically ill at 0.3% (95% CI = 0.002–0.003) and 0.2% (95% CI = 0.002–0.002), respectively. Results differ by sex in magnitude but not in sign.

Lastly, on the average, one additional bus station increased the probability of being obese or overweight by 1.1% (95% CI = 0.008–0.013), the probability of frequent mental distress by 0.3% (95% CI = 0.001–0.004), and the probability of frequent physical distress by 0.02% (95% CI = 0.000–0.003). Results differ by sex in magnitude but not in sign for weight problems and physical distress. However, for mental distress, women are less likely to report such problems and men are more likely to do it, with better availability of massive transportation stations.

Discussion

Despite Latin America being a region having some of most violent cities in the world, we are not aware of any

Table 3 Results of linear regression analysis of CalIBRANDO survey data for obesity: Cali, 2014

Variable	Obese or overweight Total, <i>b</i> (SE, 95% CI)	Obese or overweight Men, <i>b</i> (SE, 95% CI)	Obese or overweight Women, <i>b</i> (SE, 95% CI)
Crime and public space			
Homicide rate per inhabitant	0.002*** (- 0.001 ; 0.001 , 0.003)	0.003** (- 0.001 ; 0.001 , 0.005)	0.002 (- 0.001 ; - 0.001 , 0.004)
Effective public space per inhabitant (m ²)	- 0.002*** (- 0.001 ; - 0.004 , - 0.001)	- 0.002* (- 0.001 ; - 0.004 , 0.000)	- 0.003** (- 0.002 ; - 0.007 , - 0.000)
Lighted parks per inhabitant	- 0.008* (- 0.004 ; - 0.016 , 0.000)	- 0.021*** (- 0.005 ; - 0.032 , - 0.011)	0.004 (- 0.009 ; - 0.015 , 0.023)
Transportation system (MIO) stations	0.011*** (- 0.001 ; 0.008 , 0.013)	0.002 (- 0.003 ; - 0.004 , 0.008)	0.018*** (- 0.002 ; 0.015 , 0.022)
Health status			
Did not have good physical health? (days)	0.002 (- 0.002 ; - 0.003 , 0.007)	0.004 (- 0.004 ; - 0.005 , 0.013)	0.001 (- 0.003 ; - 0.005 , 0.007)
Did not have good mental health? (days)	0.002 (- 0.002 ; - 0.003 , 0.007)	- 0.001 (- 0.003 ; - 0.008 , 0.006)	0.005 (- 0.003 ; - 0.002 , 0.011)
Satisfied with current weight	- 0.297*** (- 0.032 ; - 0.363 , - 0.231)	- 0.238*** (- 0.063 ; - 0.370 , - 0.106)	- 0.349*** (- 0.033 ; - 0.418 , - 0.280)
Height (m)	- 0.770*** (- 0.216 ; - 1.220 , - 0.320)	- 0.670** (- 0.278 ; - 1.249 , - 0.091)	- 0.935*** (- 0.257 ; - 1.469 , - 0.400)
Demographic			
Men	0.198*** (- 0.031 ; 0.134 , 0.262)		
Age	0.003** (- 0.001 ; 0.000 , 0.005)	0.002 (- 0.001 ; - 0.000 , 0.004)	0.002 (- 0.002 ; - 0.002 , 0.006)
Living in common law	- 0.079* (- 0.039 ; - 0.159 , 0.002)	- 0.088 (- 0.057 ; - 0.207 , 0.030)	- 0.079 (- 0.068 ; - 0.221 , 0.063)
Divorce	- 0.115** (- 0.046 ; - 0.211 , - 0.019)	- 0.078 (- 0.088 ; - 0.261 , 0.104)	- 0.161** (- 0.066 ; - 0.299 , - 0.023)
Single	- 0.176*** (- 0.039 ; - 0.256 , - 0.095)	- 0.199*** (- 0.051 ; - 0.306 , - 0.092)	- 0.176** (- 0.077 ; - 0.336 , - 0.015)
Widower	- 0.089 (- 0.079 ; - 0.255 , 0.076)	- 0.083 (- 0.299 ; - 0.705 , 0.539)	- 0.073 (- 0.086 ; - 0.252 , 0.107)
Years of education	0.000 (- 0.005 ; - 0.009 , 0.010)	0.007 (- 0.007 ; 0.008 , 0.021)	- 0.009 (- 0.008 ; - 0.025 , 0.006)
Number of children	0.008 (- 0.010 ; - 0.013 , 0.030)	0.008 (- 0.018 ; - 0.029 , 0.045)	- 0.008 (- 0.02 ; - 0.048 , 0.033)
Own vehicle	0.089*** (- 0.025 ; 0.037 , 0.141)	0.122*** (- 0.039 ; 0.041 , 0.202)	0.036 (- 0.049 ; - 0.067 , 0.139)
Satisfaction			
Life satisfaction from 1 to 10	0.017* (- 0.008 ; - 0.000 , 0.034)	0.020 (- 0.015 ; - 0.010 , 0.051)	0.014 (- 0.011 ; - 0.009 , 0.037)
Satisfaction with mayor's management of parks and public space (1-10)	- 0.019** (- 0.008 ; - 0.036 , - 0.002)	- 0.022* (- 0.011 ; - 0.046 , 0.001)	- 0.014 (- 0.009 ; - 0.034 , 0.006)
Satisfaction with mayor's management of city security (1-10)	0.003 (- 0.008 ; - 0.015 , 0.020)	- 0.001 (- 0.012 ; - 0.026 , 0.023)	0.002 (- 0.01 ; - 0.019 , 0.023)
Constant	1.722*** (- 0.388 ; 0.916 , 2.528)	1.760*** (- 0.491 ; 0.739 , 2.781)	2.113*** (- 0.436 ; 1.207 , 3.020)
District dummies included	Yes	Yes	Yes
<i>N</i>	1057	535	522
Adjusted <i>R</i> ²	0.15	0.12	0.19

Table 4 Results of linear regression analysis of CaliBRANDO survey data for 14 or more unhealthy mental days: Cali, 2014

Variable	14 or more unhealthy mental days Total, <i>b</i> (SE; 95% CI)	14 or more unhealthy mental days Men, <i>b</i> (SE; 95% CI)	14 or more unhealthy mental days Women, <i>b</i> (SE; 95% CI)
Crime and public space			
Homicide rate per inhabitant	0.001*** (0.000 ; 0.001 ; 0.002)	- 0.002** (- 0.001 ; - 0.003 , - 0.000)	0.004*** (- 0.001 ; 0.002 , 0.006)
Effective public space per inhabitant (m ²)	0.000 (0.000 ; - 0.001 , 0.001)	- 0.002* (- 0.001 ; - 0.003 , 0.000)	0.003*** (- 0.001 ; 0.002 , 0.005)
Lighted parks per inhabitant	0.027*** (- 0.002 ; 0.023 , 0.030)	0.000 (- 0.002 ; - 0.004 , 0.005)	0.045*** (- 0.005 ; 0.036 , 0.054)
Transportation system (MIO) stations	0.003*** (- 0.001 ; 0.001 , 0.004)	0.010*** (- 0.001 ; 0.009 , 0.012)	- 0.004*** (- 0.001 ; - 0.006 , - 0.002)
Health status			
Did not have good physical health? (days)	0.005*** (- 0.002 ; 0.002 , 0.009)	0.004 (- 0.003 ; - 0.002 , 0.009)	0.007** (- 0.003 ; 0.002 , 0.013)
Satisfied with current weight	- 0.051*** (- 0.014 ; - 0.079 , - 0.022)	- 0.066*** (- 0.018 ; - 0.103 , - 0.028)	- 0.035* (- 0.019 ; - 0.074 , 0.004)
Demographic			
Men	- 0.010 (- 0.017 ; - 0.046 , 0.026)		
Age	0.000 (- 0.001 ; - 0.002 , 0.002)	0.000 (- 0.001 ; - 0.002 , 0.002)	0.001 (- 0.002 ; - 0.003 , 0.005)
Living in common law	0.042** (- 0.020 ; 0.000 , 0.084)	0.041** (- 0.019 ; 0.001 , 0.081)	0.050 (- 0.031 ; - 0.014 , 0.114)
Divorce	0.047 (- 0.039 ; - 0.035 , 0.129)	- 0.022 (- 0.046 ; - 0.117 , 0.074)	0.095** (- 0.045 ; 0.002 , 0.189)
Single	0.071** (- 0.032 ; 0.004 , 0.139)	0.042 (- 0.037 ; - 0.035 , 0.119)	0.103** (- 0.040 ; 0.019 , 0.187)
Widower	0.088* (- 0.043 ; - 0.002 , 0.178)	- 0.053 (- 0.039 ; - 0.134 , 0.028)	0.098 (- 0.062 ; - 0.032 , 0.228)
Years of education	- 0.001 (- 0.002 ; - 0.006 , 0.004)	- 0.005 (- 0.003 ; - 0.012 , 0.002)	0.003 (- 0.005 ; - 0.006 , 0.013)
Number of children	0.008 (- 0.012 ; - 0.018 , 0.033)	0.003 (- 0.012 ; - 0.023 , 0.029)	0.009 (- 0.017 ; - 0.027 , 0.044)
Own vehicle	0.030 (- 0.019 ; - 0.010 , 0.070)	0.008 (- 0.026 ; - 0.046 , 0.063)	0.064** (- 0.003 ; 0.002 , 0.126)
Satisfaction			
Life satisfaction from 1 to 10	- 0.014** (- 0.006 ; - 0.027 , - 0.001)	- 0.008 (- 0.006 ; - 0.020 , 0.004)	- 0.021** (- 0.01 ; - 0.041 , - 0.002)
Satisfaction with mayor's management of parks and public space (1-10)	0.001 (- 0.004 ; - 0.006 , 0.009)	0.002 (- 0.005 ; - 0.007 , 0.012)	- 0.001 (- 0.005 ; - 0.011 , 0.010)
Satisfaction with mayor's management of city security (1-10)	- 0.007** (- 0.003 ; - 0.014 , - 0.000)	- 0.011* (- 0.005 ; - 0.022 , 0.001)	0.000 (- 0.007 ; - 0.015 , 0.016)
Constant	0.121* (- 0.061 ; - 0.005 , 0.248)	0.254*** (- 0.072 ; 0.105 , 0.403)	- 0.031 (- 0.128 ; - 0.298 , 0.235)
District dummies included	Yes	Yes	Yes
<i>N</i>	1084	544	540
Adjusted <i>R</i> ²	0.04	- 0.003	0.088

CI confidence interval

p* < 0.10; *p* < 0.05; ****p* < 0.010

Table 5 Results of linear regression analysis of CaliBRANDO survey data for 14 or more unhealthy physical days: Cali, 2014

Variable	14 or more unhealthy physical days Total, <i>b</i> (SE; 95% CI)	14 or more unhealthy physical days Men, <i>b</i> (SE; 95% CI)	14 or more unhealthy physical days Women, <i>b</i> (SE; 95% CI)
Crime and public space			
Homicide rate per inhabitant	0.001*** (0.000 ; 0.001 ; 0.002)	- 0.002*** (- 0.001 ; - 0.003 ; - 0.001)	0.003*** (- 0.001 ; 0.001 ; 0.005)
Effective public space per inhabitant (m ²)	- 0.001*** (0.000 ; - 0.002 ; - 0.001)	- 0.001* (- 0.001 ; - 0.002 ; 0.000)	- 0.003*** (- 0.001 ; - 0.004 ; - 0.001)
Lighted parks per inhabitant	0.021*** (- 0.001 ; 0.018 ; 0.023)	0.006** (- 0.002 ; 0.001 ; 0.011)	0.028*** (- 0.004 ; 0.019 ; 0.036)
Transportation system (MIO) stations	0.002* (- 0.001 ; - 0.000 ; 0.003)	0.002 (- 0.001 ; - 0.001 ; 0.005)	0.001 (- 0.001 ; - 0.002 ; 0.003)
Health status			
Did not have good mental health? (days)	0.004** (- 0.002 ; 0.001 ; 0.007)	0.003 (- 0.002 ; - 0.002 ; 0.007)	0.006*** (- 0.002 ; 0.002 ; 0.010)
Satisfied with current weight	- 0.016 (- 0.016 ; - 0.050 ; 0.018)	- 0.002 (- 0.020 ; - 0.044 ; 0.040)	- 0.039 (- 0.025 ; - 0.091 ; 0.013)
Demographic			
Men	- 0.027 (- 0.018 ; - 0.065 ; 0.011)		
Age	0.002** (- 0.001 ; 0.000 ; 0.005)	0.003** (- 0.001 ; 0.000 ; 0.005)	0.002 (- 0.001 ; - 0.001 ; 0.005)
Living in common law	0.004 (- 0.023 ; - 0.044 ; 0.051)	0.028 (- 0.032 ; - 0.039 ; 0.095)	- 0.017 (- 0.037 ; - 0.094 ; 0.061)
Divorce	- 0.048** (- 0.023 ; - 0.096 ; - 0.001)	- 0.066** (- 0.029 ; - 0.127 ; - 0.006)	- 0.036 (- 0.04 ; - 0.120 ; 0.049)
Single	0.032* (- 0.018 ; - 0.005 ; 0.068)	0.029 (- 0.029 ; - 0.032 ; 0.089)	0.036 (- 0.032 ; - 0.030 ; 0.102)
Widower	0.024 (- 0.065 ; - 0.112 ; 0.160)	0.136 (- 0.188 ; - 0.254 ; 0.526)	0.009 (- 0.084 ; - 0.166 ; 0.184)
Years of education	- 0.005* (- 0.002 ; - 0.010 ; 0.000)	- 0.007** (- 0.003 ; - 0.013 ; - 0.001)	- 0.001 (- 0.005 ; - 0.011 ; 0.009)
Number of children	- 0.006 (- 0.01 ; - 0.026 ; 0.014)	- 0.01 (- 0.011 ; - 0.033 ; 0.014)	0.004 (- 0.018 ; - 0.032 ; 0.040)
Own vehicle	- 0.01 (- 0.019 ; - 0.050 ; 0.030)	- 0.007 (- 0.023 ; - 0.054 ; 0.041)	- 0.024 (- 0.036 ; - 0.098 ; 0.050)
Satisfaction			
Life satisfaction from 1 to 10	- 0.009* (- 0.005 ; - 0.019 ; 0.001)	- 0.017*** (- 0.006 ; - 0.030 ; - 0.005)	0.002 (- 0.006 ; - 0.011 ; 0.015)
Satisfaction with mayor's management of parks and public space (1-10)	0.002 (- 0.004 ; - 0.006 ; 0.009)	- 0.004 (- 0.005 ; - 0.015 ; 0.007)	0.008* (- 0.005 ; - 0.001 ; 0.018)
Satisfaction with mayor's management of city security (1-10)	- 0.003 (- 0.005 ; - 0.013 ; 0.006)	0.001 (- 0.005 ; - 0.008 ; 0.011)	- 0.011 (- 0.008 ; - 0.027 ; 0.004)
Constant	0.061 (- 0.079 ; - 0.102 ; 0.225)	0.205** (- 0.084 ; 0.031 ; 0.379)	- 0.101 (- 0.132 ; - 0.375 ; 0.173)
District dummies included	Yes	Yes	Yes
<i>N</i>	1084	544	540
Adjusted <i>R</i> ²	0.03	0.04	0.03
CI confidence interval			

p* < 0.10; *p* < 0.05; ****p* < 0.010

study whether population health, as measured by obesity rates and subjective mental and physical health conditions, is affected by homicide rates and lack of public goods provision such as lighted parks and adequate public space. There is evidence of this relationship, but most studies on this subject have been conducted in cities in developed countries where crime rates are significantly lower and public goods are higher in number and quality. Cali, which remains one of the most violent cities in the world, offers a unique opportunity to test the direction, significance, and magnitude of these environmental effects.

The study was possible because of a unique dataset available on Cali and, to our knowledge, on any city in Latin America. The dataset comprises a population survey that includes CDC five questions on the self-reported health status and measures of weight and height. It is the only survey in the country for population health outcomes with city-level representativeness.

Our analysis found a robust and statistically significant negative association between homicide rates, public goods provision, and health outcomes after controlling for observed and unobserved time-invariant factors at both the individual and district levels in 2014, a year with the lowest observed rate since 1994 (homicide rate was 120 in 1994, 91 in 2004, and 60 in 2014). Assuming that those higher homicide rates seen > 20 years ago were even more harmful to population health, our results show that several generations of Cali inhabitants suffered from the lack of government control over crime and its lack of investment in public goods provision.

Our results also showed that men and women are not similarly vulnerable to the effects of individual and district-level factors on their psychological or physical distress and obesity. The literature had shown that fear of neighborhood violence during adolescence predicts obesity in African American female adults [36, 37]. In our study, the effects of homicide rates on obesity were statistically significant for men but not for women, showing that in this context, contemporary fear is a stronger stressor for men than women. Regarding frequent mental distress, our study found the effects of increased violence to be stronger for women than men. A previous study on African American youths in the USA showed that neighborhood fear may contribute to depressive symptoms for males but not for females [38]. The difference in population and context hinders the possibility to contrast both studies. Nonetheless, it reinforces the idea that there are gender differences in how

neighborhood fear and public goods availability affect health outcomes [39, 40]. Both quantitative and qualitative studies in developing countries must include gender differences in their research designs.

Colombian cities are constantly growing. It has been shown that the urban setting and public goods provided by the government, including homicide deterrence, generate positive environmental factors that influence the health outcomes of its residents [2, 16]. The important variation in terms of the availability of adequate public space and district crime rates is a call for the government to introduce interventions to provide better and equally distributed public goods to improve the physical and mental health outcomes of its citizens as well as contribute to the curtailment of the obesity epidemic.

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