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Reducing urban violence: a contrast of public health and criminal justice approaches

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Abstract

Background—Cities are investing millions in Cure Violence, a public health approach to reduce urban violence by targeting at-risk youth and redirecting conflict to non-violent responses. The impact of such a program compared to criminal justice responses is unknown because experiments directly comparing criminal justice and public health approaches to violence prevention are infeasible with observational data. We simulated experiments to test the influence of two interventions on violence: a) Cure Violence; and b) directed police patrol in violence hot spots.

Methods—We used an agent-based model to simulate a 5% sample of the New York City (NYC) adult population, with agents placed on a grid representing the land area of NYC, with neighborhood size and population density proportional to land area and population density in each community district. Agent behaviors were governed by parameters drawn from city data sources and published estimates.

Results—Under no intervention, 3.87% (95% CI 3.84–3.90) of agents were victimized per year. Implementing the violence interrupter intervention for 10 years decreased victimization by 13% (to 3.35% [3.32–3.39]). Implementing hot-spots policing and doubling the police force for 10 years reduced annual victimization by about 11% (to 3.46% [3.42–3.49]). Increasing the police force by 40% combined with implementing the violence interrupter intervention for 10 years decreased violence by 19% (to 3.13% [3.09–3.16]).

Conclusions—Combined investment in a public health, community-based approach to violence prevention and a criminal justice approach focused on deterrence can achieve more to reduce population-level rates of urban violence than either can in isolation.

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Note: Data is available for replication upon request. Pseudo code is presented in an electronic appendix.

Keywords

Cure Violence; violence; policing; urban; public health; criminal justice

Introduction

Violence is a persistent health problem in United States (US) cities. In 2014, 15,809 people died of homicide in the US[1]. The homicide rate was almost twice as high in cities as in rural areas[2]. Homicides represent one outcome of a larger underlying public health crisis: 1,558,436 individuals in the U.S. suffered injuries from violent assault in 2014[3], and the rate of violent injuries was three times as high among Blacks than Whites[3].

A central criminal justice solution to urban violence has been to invest in policing, recently focusing policing efforts on "hot spots" of crime: small areas in neighborhoods that generate half of all crimes[4–7]. Indeed, the drop in violence in the 1990s has been attributed to the sizable investment cities made in policing misdemeanors in neighborhood "hot spots"[8–14]. A meta-analysis of hot-spots policing found that it produced a small reduction in crime.[15] However, the persistent problem of urban violence, and increasing concerns about issues of police abuse and racial bias in policing[16], have generated a call for alternative approaches to reducing urban violence[17].

Cure Violence has garnered considerable attention and has been applied in cities including New York, Chicago, Baltimore, San Antonio, New Orleans, and Kansas City as an urban public health response to violence (www.cureviolence.org). This community-based approach uses three key components to stop the transmission of violence: (1) working with friends and families of victims to prevent retaliation and mediate ongoing disputes; (2) changing the thinking of those at highest risk of perpetrating violence; and (3) changing group norms about violence in the broader community.[18] The program focuses on violent neighborhoods and works with community-based organizations that are integrated into the community. Street outreach workers mentor young people at highest risk for violence, and connect them to job and educational opportunities. Other staff become "violence interrupters" and identify, mediate, and stop conflicts and retaliations between residents or gangs.

Cure Violence has been implemented in major urban areas across the U.S. with mixed findings.[18–23] Quasi-experimental evaluations in a small number of neighborhoods offer limited evidence,[18] while implementation obstacles such as absence of community leaders, limited early community buy-in, and problems associated with hiring high-risk individuals as staff may have limited its success[18]. Despite these limitations, there is strong interest in a community-based violence prevention program that does not rely on punishment, and addresses concerns about community acceptability and social justice. Cure Violence has been rated as one of the most cost-efficient community-based violence prevention programs available.[18]

Using the best available data and mathematical simulation, we can approximate the conditions of an experiment to estimate the long-term impact that an intervention like Cure Violence could have in a major U.S. city under ideal conditions. This type of study allows us

to identify the minimum “dose” at which it would be necessary to implement Cure Violence to achieve a shift in population-level rates of violence. Further, we can contrast the impact of Cure Violence to the impact of policing in the same population, to estimate the optimal package of interventions required to prevent violence.

We used agent-based models to estimate the relative impact of Cure Violence and hot-spots policing on rates of non-fatal violent victimization and homicide in New York City (NYC). We also examined combinations of Cure Violence and hot-spots policing to identify the optimal combination of interventions required to produce the greatest reductions in violence. As this was a simulation study using fully de-identified data, it was exempt from human subjects review.

METHODS

We developed an agent-based model simulating dynamic processes contributing to violence among adults in NYC, including interactions between victims and perpetrators within specific geographically defined spaces, and the influence of social networks on the risk of violence. eFigure 1 illustrates the relations included in the model, building on our prior work[24,25]. Data from NYC sources were used to parameterize and calibrate the model when possible (sources in eTable 1). Key components of the model are summarized below; additional details about model parameters and processes include a description of the model following the Overview, Design concepts, Details protocol,[26,27] and a summary of model assumptions (eMethods 1), initialization parameters and default values (eTable 2), flow charts illustrating steps in the model (eFigures 2–3), and pseudo-code for the model (eMethods 2).

Model components and initialization

Agents, neighborhoods, and social networks—The population of 256,500 agents was initialized to approximate a 5% sample of the NYC adult population aged 18–64 years in the year 2000[28]. Each agent was assigned to a location on a 400 × 625 cell grid representing the physical area of NYC. The grid was divided into 59 smaller areas representing NYC community districts:[29,30] these 59 areas were scaled to approximate the relative size of each of the neighborhoods in NYC. Agents were assigned to each neighborhood, proportionate to size, so that distributions of age, sex, race/ethnicity, and household income matched Census data for the corresponding community district for the year 2000[28]. Average neighborhood income, racial composition, residential stability, and violence were aggregated at each time step from the characteristics of agents residing in the neighborhood. Other neighborhood characteristics, including proportion unemployed, foreign-born, in managerial or professional occupations, and female-headed households, were assigned according to Census 2000 data for each community district[31].

To create a social network, each agent was assigned a target number of close ties, with an average of three ties per agent[32]. Agents were matched based on age, sex, race/ethnicity, education, and spatial proximity, such that agents who were more similar and geographically closer to each other were more likely to develop social ties[32,33]. For simplicity, social

network members matched to a particular agent at baseline remained that agent's social network for the duration of the model run.

Police officers—Agents representing police officers were created, with 790 officers included in the base model to reflect 5% of the average number of police officers in NYC in 1990–1993 (before the police force was increased as part of an order-maintenance policing strategy)[8]. The number of police officers assigned to each neighborhood was proportional to the existing neighborhood allocation of officers in 1990–1993, with officers assigned to random locations within the neighborhood.

Agent behaviors and experiences

Aging, mortality, and movement—At each time step, agents aged by one year, an empirically defined proportion of agents moved to a new location in the model, and agents died consistent with 2000 NYC adult all-cause mortality rates[34]. Agents' probabilities of moving were based on their income, duration of residence in their current neighborhood, and experiences of violent victimization at the last time step, calibrated using data from longitudinal studies in urban areas, including the Detroit Neighborhood Health Study[35] and the Panel Study of Income Dynamics[36].

Violence and policing—At each time step, each agent could perpetrate violence and/or experience non-fatal or fatal violent victimization. Annual probabilities of violent perpetration were calculated from the National Epidemiologic Survey on Alcohol and Related Conditions, a national study of U.S. residents[37], and annual non-fatal violent victimization probabilities were estimated from the World Trade Center Study, a large longitudinal study of adult residents of the NYC metropolitan area initiated after the September 11th attacks[30]. Annual homicide probabilities were informed by data from the Office of the Chief Medical Examiner in NYC[12]. Probabilities of violence and homicide were calculated based on socio-demographic characteristics, prior history of violence, neighborhood characteristics, and history of violence among the agent's social network members. The assignment of probabilities of violence allowed the occurrence of violence, and racial inequalities in violence, to arise as a result of individual-, network-, and neighborhood-level characteristics, thereby mirroring variation at the population level, without imposing additional assumptions at the macro-level. Furthermore, consistent with research finding important influences of social networks and neighborhood conditions on violence[38,39], social network characteristics contributed 15% and neighborhood characteristics contributed 10% of the agents' probabilities of homicide, non-fatal victimization, and violent perpetration. Based on these probabilities, potential victims and perpetrators were identified at each time step. Potential perpetrators (i.e., those with a high predicted probability of perpetrating violence) searched a 15-cell radius around their location for potential victims (i.e., those with a high probability of being victimized); any such agents who had not already been victimized at that time step were matched to a perpetrator, unless a police officer was present within a 2-cell radius of the victim, in which case the potential victim was protected from violence. Violence in the model thus reflects sporadic instances of interpersonal violence largely driven by spatial proximity and the density of potential perpetrators and victims in an individual's social network and

neighborhood, and not necessarily more chronic types of violence between individuals such as intimate partner violence. In addition, violence in the model occurs during a year-long period, when perpetrators may have multiple victims during single or multiple incidents.

Model calibration and intervention scenarios

During model calibration, agent-based model estimates were compared to data on total and neighborhood-specific population composition and average income; social network composition; annual mortality rates; annual moves to new residences; prevalence of violent victimization and perpetration; and homicide rates. We then used an iterative process[40] to adjust predictive equations and initial conditions in the model until estimates closely matched the empirical data.

Each model was run for 30 time steps, representing 30 years in time. The first ten time steps were discarded as a "burn-in period,"[25] during which agents and neighborhoods developed a history of violence but other characteristics remained the same. Results from the final 20 time steps were included in analyses. The "no intervention" model scenario consisted of the relations and baseline values as described above. Three intervention scenarios were also considered: hot-spots policing, Cure Violence, and a combination approach.

Similar to a previous agent-based model[25], hot-spots policing was operationalized by dividing the model grid into smaller "patrol areas" consisting of 5 × 5-cell squares. The average violent victimization in each patrol area was calculated at the end of each time step, and one police officer was assigned to each of the highest-violence patrol areas at the start of the next time step, until all officers were assigned to an area. Based on a systematic review of hot-spots policing[41], this directed patrol strategy was expected to reduce violence by 10% in the years in which it was implemented[25]. Hot-spot policing was implemented for 5, 10, and 20 years, with the number of police officers available increased in 5% increments from 0% to 200%.

The violence interruption strategy was based on the Save Our Streets Cure Violence model in Crown Heights, Brooklyn[22]. During the simulation of this approach, all neighborhoods with above-average levels of violence received a number of interrupters proportionate to size, who were randomly assigned to a location in the neighborhood. Based on Save Our Streets findings[22] and model scale, interrupters could prevent violent acts from occurring within a 15-cell radius of their location; interrupters interrupted about 10 violent incidents per year, reducing violence by 20%. Outreach workers were also assigned to high-violence neighborhoods and were matched with 10 agents in the neighborhood who had the highest probabilities of violence based on their individual and network characteristics; connection with the outreach worker reduced probabilities of violence for those agents by 75%. The caseloads of outreach workers and violence prevention by interrupters in the agent-based model reflected the implementation and findings of Save Our Streets[22]. The intervention was implemented for 5, 10, and 20 years, with combinations of one to two interrupters and outreach workers. The simulation was also repeated wherein interrupters and outreach workers were deployed to only the 14 neighborhoods targeted in the current implementation of Save Our Streets, rather than all neighborhoods with above-average levels of violence.

Cure Violence was implemented in a context where police officers had been assigned to each neighborhood proportional to the neighborhood allocation of officers in NYC in 1990–1993 (i.e. the no hot-spots policing scenario). During model runs, police officers and interrupters were interdependent, as they both engaged with the potential perpetrator agents based on spatial proximity, and could interrupt violent events from occurring, albeit with different probabilities.

We also simulated hot-spots policing and Cure Violence strategies simultaneously, in order to identify the smallest increases and shortest durations that could achieve reductions in violence. In this case, police officers were reassigned to the most violent neighborhoods, and the number of police officers as well as Cure Violence interrupters and outreach workers increased across scenarios. Because police officers and interrupters were interdependent, this joint intervention scenario could generate an emergent effect on violence that was greater than the additive effect of the two interventions.

The model was developed using Recursive Porous Agent Simulation Toolkit for Java (RepastJ, version 3.0), and implemented in Eclipse (version 4.2). To account for the stochastic nature of the modeling, each model scenario was run 200 times, with the median, 2.5^{th} percentile, and 97.5^{th} percentile reported from across the 200 simulations. We also examined estimates at the extreme ends of the distributions from the 200 model runs.

Sensitivity analyses

We considered eight sets of sensitivity analyses to test the robustness of the results to alternate specifications of the model. First, we varied the level of the neighborhood influence on individual agent behaviors (1%–20%; default 10%). Second, we varied the size of the radius in which potential violent perpetrators could search for potential victims (5–25 cells; default 15 cells). Third, we varied the size of the radius in which violent acts could be prevented by police officers (one to four cells; default two cells). Fourth, we varied the size of the radius in which violent acts could be prevented by violence interrupters (five-25 cells; default 15 cells). Fifth, we varied the amount of reduction in the probability of violence among high-risk agents matched to outreach workers (55%–95%; default 75%). Sixth, we varied the level of the social network influence on individual agent behaviors (5%–25%; default 15%). Seventh, we varied the social network influence on individual agent behaviors so that it changed over the life course, either increasing or decreasing with age. Finally, we varied the stability of social networks in the model, allowing agents to form new ties or dissolve existing ties during the model run.

RESULTS

The agent population successfully mirrored the adult population of NYC and agent behaviors and experiences reflected expected distributions of violence and homicide (Table 1).

Figure 1 shows the average annual prevalence of non-fatal violent victimization under the implementation of hot-spots policing compared to the baseline “no intervention” model scenario, by race/ethnicity, while Table 2 presents findings for the whole population.

Policing produced modest reductions in victimization: for example, doubling the size of the police force and implementing hot-spots patrol strategies for 10 years reduced annual victimization by about 11% (from 3.87% [95% CI 3.84–3.90] to 3.46% [3.42–3.49]). Among Black non-Hispanic individuals, victimization decreased from 4.57% to 4.16% [4.11–4.20]. Reductions were also observed among White non-Hispanics, with longer and more intense interventions producing greater reductions. Similar patterns were noted for homicide, although reductions were generally not substantial when compared to the estimates from the "no intervention" model, except when hot-spots policing was implemented for 20 years (Table 2).

The results of the simulated Cure Violence intervention were stronger (Table 2, Figure 2). The presence of two interrupters and one outreach worker in every high violence neighborhood in the city for 10 years resulted in a 13% reduction in violent victimization (to 3.35% [3.32–3.39]). Victimization among Black non-Hispanics decreased from 4.57% to 3.98% (95% CI = 3.94, 4.03) and among White non-Hispanics it decreased from 2. 91% to 2.56% (95% CI = 2.51, 2.61). In general, adding another interrupter to the neighborhood produced greater reductions in violence than adding another outreach worker. Increasing the duration of the Cure Violence program produced similar reductions in violence to adding more staff over shorter time periods. Meaningful reductions in homicide only arose after 10 years of implementation of Cure Violence (Table 2). Patterns were similar, but reductions in violence were smaller when targeting Cure Violence to only the 14 highest-violence neighborhoods (eFigure 4).

Table 2 compares the reductions in violence and homicide produced by hot-spots policing and Cure Violence, both alone and in combination. Vast resources would be required under hot-spots policing strategies to produce the same reductions in violence possible through the interrupter and outreach efforts of a moderate number of individuals implementing Cure Violence strategies in high-violence neighborhoods. For example, a 24% reduction in homicide rates could be produced by a 150% increase in the police force for 20 years or by the work of two interrupters and one outreach worker in high-violence neighborhoods for 20 years.

Figure 3 and Table 2 illustrate that greater reductions in violence were achieved when hot-spots policing and Cure Violence approaches were simultaneously implemented. For example, deploying two interrupters and one outreach worker for 5 years reduced violent victimization by 7.7%, while the same intervention plus a 40% increase in hot spots policing reduced victimization by 10.9%. The joint impact of the two interventions means that the same reduction in violence could be achieved with fewer resources and in a shorter time than when each approach was taken alone. For example, a 19% reduction in non-fatal victimization could be achieved by increasing the police force by 40% in conjunction with deploying two interrupters and one outreach worker for 10 years. It would be necessary to increase the police force by 200% for 10 years or to deploy two interrupters and one outreach worker to high-violence neighborhoods for 20 years to achieve a similar result.

Racial/ethnic inequalities in non-fatal and fatal violence remained even when reductions in violence were successfully produced through policing and Cure Violence strategies. Even in

the most intense interventions tested (e.g., a 200% increase in the police force for 20 years), the percent of Black non-Hispanics who were violently victimized each year remained about 1.5 times higher than among White non-Hispanics and the homicide rate remained over seven times higher among Blacks compared to Whites.

Sensitivity analyses indicated that our findings were robust to alternate model specifications and initial conditions, including variations in the level of neighborhood and social network influence, social network stability, the radii within which perpetrators found victims and police and interrupters prevented violence, and the percent reduction in violence among individuals matched with an outreach worker (see eFigures 5–11). Furthermore, when examining the full range of estimates across the 200 model runs for each scenario, we found no extreme scenarios that contradicted our results for violent victimization. The relative reductions in non-fatal and fatal violence from each intervention relative to the baseline (no intervention) condition were the same whether we used the median, minimum, or maximum values from the 200 model runs (eFigure 1–2).

DISCUSSION

Through an empirically based, validated simulation, we found that investment in a public health, community-based violence prevention program such as Cure Violence could achieve the same reductions in violence as a much larger investment in hot-spots policing. Our model suggests that homicide could decrease by about 24% over 20 years with standard investment in Cure Violence in violent neighborhoods, or with more than doubling the police force over the same time period. To put such an increase in context, the police force increased by 45% in NYC in 1991–2001 – a historically unprecedented increase that was three times greater than the national average[42].

More importantly, this study suggests that effective strategies to prevent violence must involve collaboration across multiple sectors[43,44]. We found that combined approaches could achieve more, with fewer resources, and over a shorter period of time, than either intervention alone. A small investment in Cure Violence combined with a 40% increase in the police force over 10 years led to reductions in violence that were equivalent to reductions when quadrupling the investment in hot-spots policing or doubling the investment in Cure Violence alone over the same period. This pattern likely emerged from a complementary process, where police officers and Cure Violence interrupters could block different violent events from occurring in the same communities, which was complemented by Cure Violence outreach workers targeting the most violent agents. Since limited resources are available to prevent violence in urban areas, targeting resources on combination interventions that span multiple city agencies and harnessing community stakeholders may achieve the elusive combination of efficacy and health equity that is a goal of public health initiatives.

Our study found that the critical driver of program effects in the Cure Violence model was the addition of more violence interrupters into the intervention neighborhoods. Interrupters can mediate conflict to prevent violent acts from happening, thus addressing situational determinants of violent acts. Our finding is consistent with the results from the Baltimore and Chicago Cure Violence program evaluations: in Chicago, community residents

perceived the program's interrupter staff as particularly important for program success, and in Baltimore, the frequency of conflict mediations may have explained variation in program effects across sites[19,20].

Neither (alone or combined) approach produced a sizable shift in the citywide rate of violent victimization. Further, neither approach had an impact on racial/ethnic inequalities in violence. Interventions that focus on addressing the situational determinants of violence may have a limited impact on racial/ethnic inequalities in violence if they are not accompanied by policies that address the fundamental causes that give rise to such inequalities, such as residential segregation[24], unequal arrest and sentencing practices, and investment in education and community building.[45,46]

Study findings should be considered with the following limitations. First, our findings are based on a simulation, and are dependent on a series of modeling assumptions. For example, we applied a simplified version of hot-spots policing, focused on intervention in violent events; future work should investigate the potential outcomes associated with different types of hot-spots policing models.[41] Moreover, the simplified process through which perpetrators find victims in our model relied on spatial proximity as the primary determinant of violence occurrence, which ignored other salient determinants like the victim-offender relationship. Second, our model did not incorporate a social norms diffusion component in the Cure Violence intervention: hence, to the extent that the program functions through a change in social norms related to violence, our results may be an underestimate of the impact that Cure Violence can have on violence. Third, the validity of the model was contingent on the quality of data available to inform model parameters. For example, our model did not incorporate gang structures into the model, as this data was not available in New York City at a level of detail that we could use to parameterize the model. Furthermore, we modeled a simple social network structure that did not change over time. However, extensive calibration and sensitivity analyses allayed concerns about model dependence on specific assumptions and model specifications: the model replicated known distributions of victimization and perpetration before hypothetical interventions were simulated, and results were not contingent on assumptions about initial conditions such as proximity between victims and perpetrators or the magnitude of the influence of neighborhood conditions. Fourth, the model was specific to New York City –hence, generalizability to other contexts may be limited. Fifth, the model presents findings about the potential impact of hot-spots policing and Cure Violence without assessing the potential costs associated with each of these programs. In a context of limited resources for prevention efforts, future research should incorporate a cost-effectiveness component to the assessment of these types of violence prevention interventions.

Agent-based models provide insights into the potential efficacy and optimal dose of urban violence prevention interventions before policymakers invest considerable resources implementing such programs. Assuming that multi-city experiments of the two interventions is likely unfeasible,[47] a promising avenue for future research will be to take advantage of cross-city variation in the decision to implement the two programs, to evaluate the impact that joint and isolated implementation of the two approaches have on violence. Triangulation

of simulated and real-life data will provide richer insights into the effectiveness of these two types of violence prevention approaches.

Our study suggests that a combined investment in a public health, community-based approach to violence prevention, and a criminal justice approach focused on deterrence can achieve more to reduce population-level rates of urban violence than either can in isolation. Alternative strategies will be necessary to reduce persistent racial/ethnic inequalities in urban violence.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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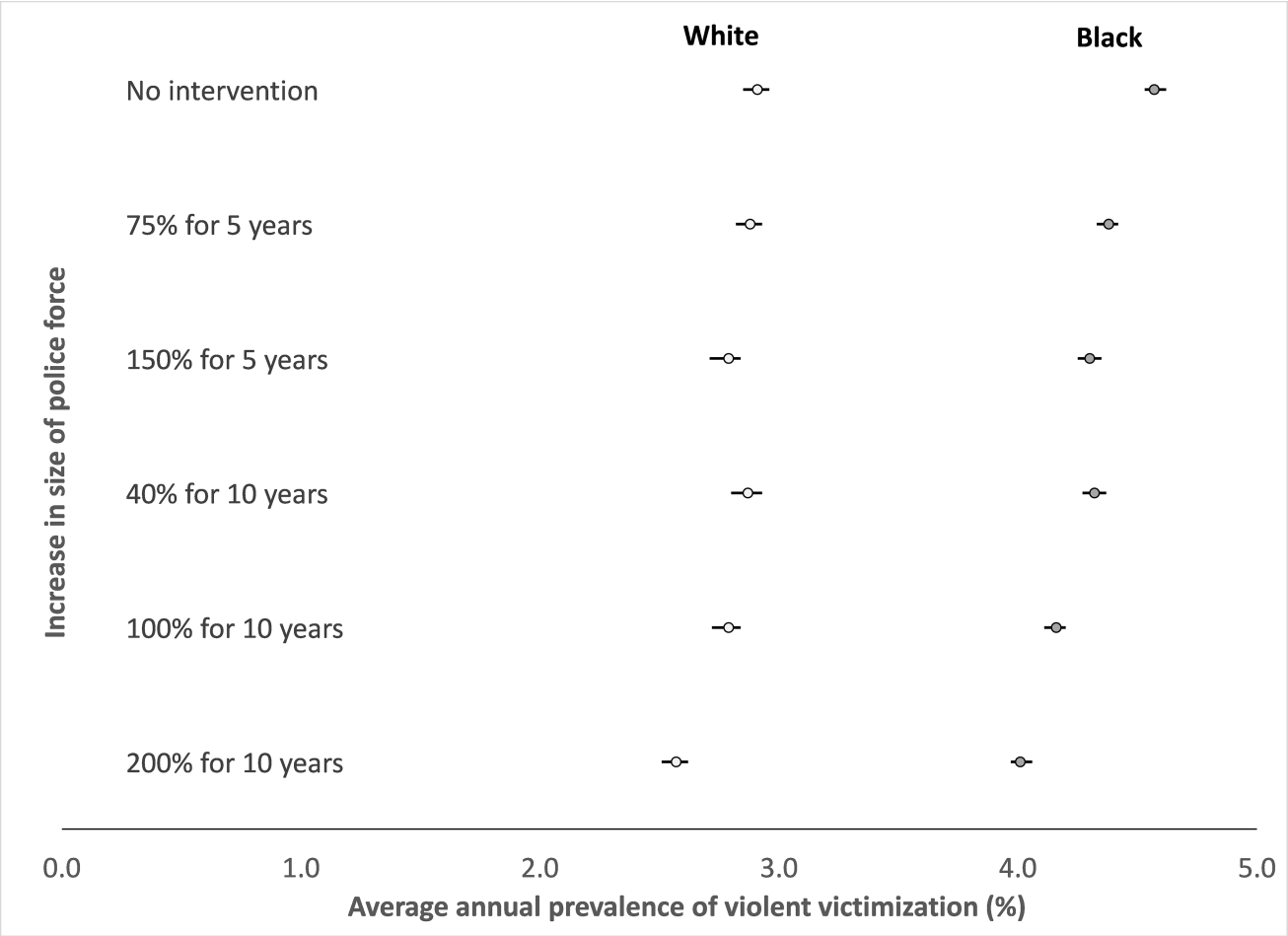

Figure 1.

Average annual prevalence of violent victimization, by race/ethnicity, given hypothetical increases in the size of the police force for varying durations, compared to no intervention

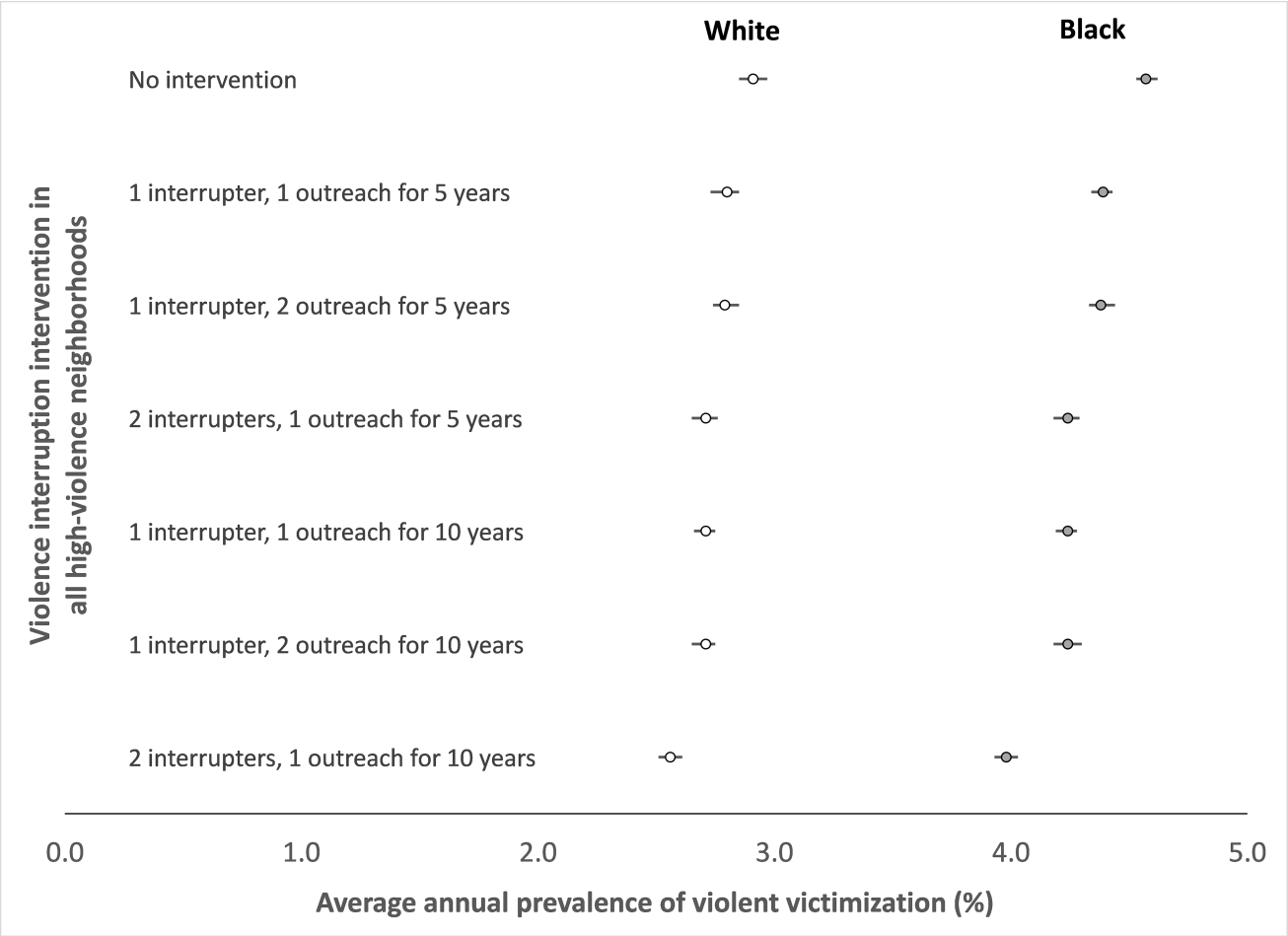

Figure 2.

Average annual prevalence of violent victimization, by race/ethnicity, given hypothetical violence interruption interventions for varying durations, compared to no intervention

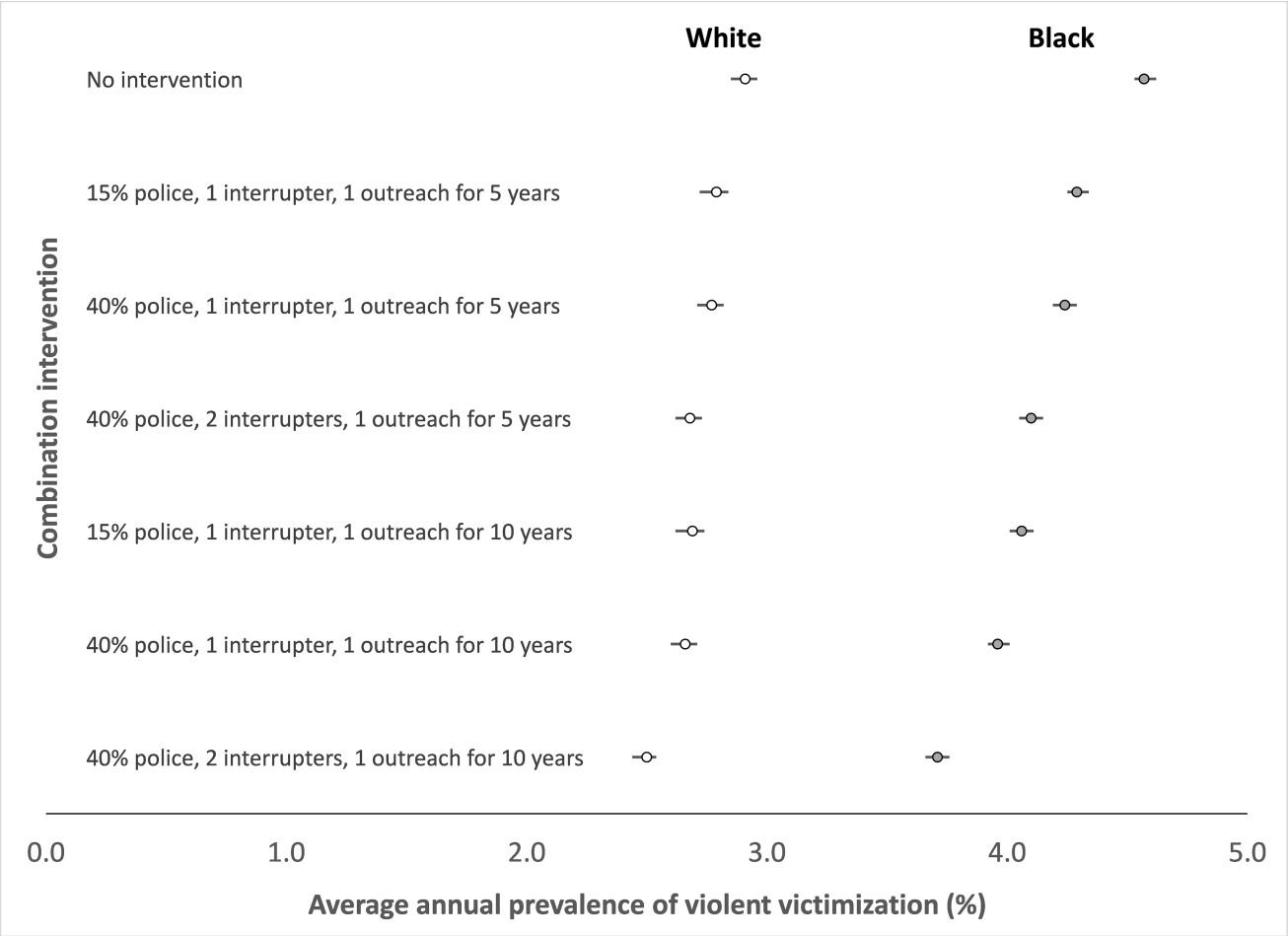

Figure 3.

Average annual prevalence of violent victimization, by race/ethnicity, given hypothetical combination interventions for varying durations, compared to no intervention

Table 1

Estimates of violence and homicide from the agent-based model (ABM), compared to other data sources, by race/ethnicity

	Total			Black non-Hispanic			White non-Hispanic		
	ABM estimates (95% CI)[a]	NYC estimates[b]	Estimates from other data sources[c]	ABM estimates (95% CI)[a]	NYC estimates[b]	Estimates from other data sources[c]	ABM estimates (95% CI)[a]	NYC estimates[b]	Estimates from other data sources[c]
Violent victimization (%)									
Past-year victimization	3.87 (3.84–3.90)	3.6	1.4–8.0	4.57 (4.53–4.62)	6.8	2.0–10.3	2.91 (2.85–2.95)	1.5	1.3–5.6
Lifetime victimization	46.8 (46.5–47.1)	32.3	15.0–50.8	50.1 (49.8–50.5)	36.0	11.6–54.7	40.4 (39.8–40.9)	29.1	18.4–51.4
Violent perpetration (%)									
Past-year perpetration	0.52 (0.51–0.53)	na	0.45–3.2	0.62 (0.61–0.64)	na	0.87–1.2	0.41 (0.40–0.42)	na	0.40–0.80
Lifetime perpetration	10.5 (10.4–10.6)	na	10.5–17.7	12.0 (11.8–12.3)	na	14.0	8.5 (8.2–8.6)	na	10.4
Homicide rate (per 100,000)									
Total homicide	10.72 (9.75–11.70)	10.72	na	21.72 (19.11–24.60)	23.67	na	2.97 (2.26–3.71)	2.84	na

ABM indicates agent-based model, na not available, NYC New York City, CI confidence interval.

[a] Median and 95% CI from 200 runs of agent-based model

[b] From World Trade Center Study (2003–2004); homicide from NYC Office of the Chief Medical Examiner (1998–2002)

[c] From National Epidemiologic Survey on Alcohol and Related Conditions (NESARC, 2001–2002) and published sources

Epidemiology. Author manuscript; available in PMC 2019 January 01.

Table 2

Average annual prevalence of violent victimization and homicide

Intervention type	Intervention amount	Intervention duration	Violent victimization (%; 95% CI)	% reduction	Homicide rate (per 100,000; 95% CI)	% reduction
No intervention	--	--	3.87 (3.84, 3.90)	--	10.72 (9.75, 11.70)	--
Hot-spots policing	75%	5 years	3.69 (3.66, 3.72)	4.72%	10.24 (9.36, 11.21)	4.45%
Hot-spots policing	150%	5 years	3.56 (3.53, 3.59)	7.98%	9.96 (9.10, 10.82)	7.09%
Hot-spots policing	40%	10 years	3.65 (3.62, 3.68)	5.72%	10.43 (9.45, 11.25)	2.73%
Hot-spots policing	100%	10 years	3.46 (3.42, 3.49)	10.78%	9.69 (8.85, 10.47)	9.64%
Hot-spots policing	200%	10 years	3.17 (3.14, 3.21)	18.10%	9.14 (8.40, 9.92)	14.73%
Hot-spots policing	10%	20 years	3.67 (3.62, 3.79)	5.35%	10.72 (9.71, 11.56)	0.00%
Hot-spots policing	40%	20 years	3.48 (3.44, 3.51)	10.18%	9.91 (9.16, 10.82)	7.55%
Hot-spots policing	75%	20 years	3.28 (3.24, 3.30)	15.45%	8.95 (8.26, 9.65)	16.55%
Hot-spots policing	150%	20 years	2.88 (2.85, 2.90)	25.65%	8.16 (7.29, 8.79)	23.91%
Hot-spots policing	200%	20 years	2.64 (2.61, 2.67)	31.76%	7.68 (6.98, 8.34)	28.36%
Violence interruption	1 interrupter, 1 outreach worker	5 years	3.70 (3.66, 3.73)	4.47%	10.19 (9.14, 11.29)	5.00%
Violence interruption	2 interrupters, 1 outreach worker	5 years	3.58 (3.54, 3.60)	7.68%	9.77 (8.91, 10.80)	8.91%
Violence interruption	1 interrupter, 1 outreach worker	10 years	3.57 (3.54, 3.60)	7.80%	9.86 (9.02, 10.80)	8.00%
Violence interruption	2 interrupters, 1 outreach worker	10 years	3.35 (3.32, 3.39)	13.40%	9.17 (8.28, 10.12)	14.45%
Violence interruption	1 interrupter, 1 outreach worker	20 years	3.35 (3.32, 3.38)	13.54%	9.20 (8.42, 10.18)	14.18%
Violence interruption	2 interrupters, 1 outreach worker	20 years	2.98 (2.94, 3.02)	23.07%	8.13 (7.19, 9.03)	24.18%
Combination	15% increase in police, 1 interrupter, 1 outreach worker	5 years	3.62 (3.58, 3.66)	6.47%	10.11 (9.22, 10.90)	5.73%
Combination	40% increase in police, 1 interrupter, 1 outreach worker	5 years	3.58 (3.55, 3.60)	7.66%	9.84 (8.97, 10.82)	8.18%
Combination	40% increase in police, 2 interrupters, 1 outreach worker	5 years	3.45 (3.42, 3.49)	10.85%	9.43 (8.40, 10.43)	12.00%
Combination	15% increase in police, 1 interrupter, 1 outreach worker	10 years	3.43 (3.39, 3.46)	11.47%	9.64 (8.75, 10.51)	10.09%
Combination	40% increase in police, 1 interrupter, 1 outreach worker	10 years	3.35 (3.31, 3.37)	13.64%	9.22 (8.44, 10.27)	14.00%
Combination	40% increase in police, 2 interrupters, 1 outreach worker	10 years	3.13 (3.09, 3.16)	19.25%	8.59 (7.72, 9.26)	19.91%
Combination	15% increase in police, 1 interrupter, 1 outreach worker	20 years	3.09 (3.06, 3.12)	20.20%	8.65 (7.85, 9.43)	19.27%
Combination	40% increase in police, 1 interrupter, 1 outreach worker	20 years	2.94 (2.91, 2.96)	24.17%	7.89 (7.19, 8.85)	26.36%
Combination	40% increase in police, 2 interrupters, 1 outreach worker	20 years	2.56 (2.53, 2.60)	33.91%	6.78 (6.12, 7.56)	36.73%

CI indicates confidence interval.