

Violent Behavior by Girls Reporting Violent Victimization

A Prospective Study

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Objective: To assess the relationships between individual victimization and neighborhood-level violence on subsequent violent perpetration by adolescent girls in a community-based sample.

Design: Longitudinal, multilevel analysis of data collected by the Project on Human Development in Chicago Neighborhoods. Three in-home interviews were conducted approximately 24 months apart between November 1995 and January 2002 with youth and their caregivers. Community-level data also were collected in 1995 from a random sample of Chicago residents. Hierarchical regression models and propensity scores were used.

Setting: Families and neighborhoods in Chicago.

Participants: Population-based sample of 637 girls, ages 9 to 15 years at baseline, and the neighborhoods in which they resided. This sample is diverse in race/ethnicity, socioeconomic status, family structure, and neighborhood characteristics.

Main Outcome Measure: Self-reports of violent behavior in the 12 months before the third interview.

Results: At baseline, 38% of the girls reported perpetrating at least 1 violent behavior in the prior 12 months, 28% reported past year violent behavior at the first follow-up interview, and 14% reported past year violent behavior at the third interview. The odds of violent behavior were 2.2 times higher among girls who reported prior violent victimization, after prior confounding factors and baseline violent behavior were controlled (95% confidence interval, 1.3- 4.4). Homicides and concentrated poverty in girls' neighborhoods also were associated with aggression by girls.

Conclusions: Improving safety in communities and homes may reduce rates of violent perpetration by adolescent girls. Study results suggest that, to facilitate identification of and healing among adolescent survivors of violence, practitioners should recognize perpetration of violence as potential sequelae of prior violent victimization.

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VIOLENCE EXPERIENCED AND perpetrated by adolescents is a serious public health problem, affecting individuals, families, and communities. Adolescents are exposed to a great deal of violence in their homes and communities; this exposure has been associated with their own violent perpetration as reported across numerous studies.^{1,2} Rates of sexual assault^{3,4} and victimization occurring at home^{5,6} are typically higher for girls than for boys, whereas rates of nonsexual violent victimization outside the home are lower for girls.^{3,7}

Two types of data provide prevalence estimates of youth violence: arrest data and self-report data. Although both sources indicate a decrease in rates of violence among youth since the mid 1990s, levels of in-

volvement remain high. National arrest data showed a peak in arrests of teenagers for violent crimes in 1994 of just over 500 arrests for every 100 000 youth aged from 10 to 17 years, and a subsequent decline of 47% by 2002 to 276 arrests for every 100 000.⁸ However, in contrast to declining rates for boys, rates of arrest for violent crimes by adolescent girls either increased, or decreased less, across categories of violent offenses.⁸ This trend gave rise to concern that girls were becoming more violent.⁹⁻¹²

Arrest rates can be difficult to interpret. Large increases in arrest rates for girls are, in part, a result of low base rates.¹⁰ Even with increases in arrest rates, girls accounted for just 24% of juvenile arrests for aggravated assaults in 2002.⁸ Arrest rates also measure societal reactions to be-

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havior, not necessarily behavior itself; growth in arrests may represent changes in the application of laws by gender or in the willingness of the public to report crimes.⁸ Thus, while there is a popular belief that girls' violence is growing, the true extent of violence by girls is unknown.

Self-report data by teens show a decrease in violent behavior over the past decade for both girls and boys.¹³ The percentage of students reporting "being in a physical fight in the past 12 months" in the nationally representative Youth Risk Behavior Surveillance Survey, a school-based survey of 9th through 12th graders, declined from 1993 through 2003. Specifically, the percentage of girls involved in a physical fight dropped from 31.7% in 1993 to 25.1% during 2003 (a decrease was reported by boys from 51.2% to 40.5%).^{4,14} Still, that one quarter of 9th through 12th grade girls nationwide reported physically fighting with others in a 12-month period underscores the need for further investigation of potential causes.

EXPOSURE TO VIOLENT VICTIMIZATION

Exposure to violence in the home includes being the victim of child physical or sexual abuse by intimates, witnessing violence between caregivers, and violent altercations with family members, including siblings. Each type of victimization has been shown to be a risk factor for adolescent aggression as well as for delinquency and involvement with the criminal justice system.¹⁵⁻²⁰ Additionally, studies indicate that girls who perpetrate violence are significantly more likely to have experienced sexual violence than nonaggressive girls.^{1,17,21-23}

Research consistently identifies exposure to violence in the neighborhood as a precursor to adolescents' violent behavior, typically using individual reports of neighborhood exposures.^{1,3,21,24,25} Examining the effects of aggregated neighborhood conditions in addition to individual reports is a burgeoning area of scientific inquiry in public health,²⁶ especially as the statistical methods for analyzing hierarchical data have evolved.²⁷ As an example of the effect of neighborhood conditions on adolescent behavior, higher levels of physical and social disorder and having fewer safe places for children to play both were associated with a higher likelihood of youths carrying concealed firearms, even when individual risk factors for gun carrying were controlled.²⁸

The current inquiry focuses on individual-level victimization and neighborhood violence and their relationships to the subsequent perpetration of violent behaviors by adolescent girls. Although most studies focusing on girls' violent behavior have used special populations (eg, clinically referred or juvenile justice samples) or cross-sectional surveys, this study examines girls' violent behavior prospectively among a representative, diverse, community-based sample. Aims of the inquiry were to describe violent behaviors by girls across 3 waves of data and to identify both individual- and neighborhood-level risk factors for violence perpetration, in addition to more traditional factors such as age, family composition, family socioeconomic status, and baseline rates of violent behavior.

Data for this study of girls' violence came from the Project on Human Development in Chicago Neighborhoods (PHDCN). The PHDCN is a multidisciplinary, longitudinal study of the development of antisocial behavior, prosocial behavior, and mental health among youth and their primary caregivers, as well as a study of their neighborhoods over time. Detailed methods are published elsewhere.²⁹

STUDY DESIGN

Informed consent for each interview was obtained from a parent or guardian of the subject in the longitudinal cohort study. Assent was obtained from the youth respondents prior to each assessment. Procedures were approved by 2 institutional review boards at Harvard University, Boston, Mass.

The design of the PHDCN consists of a longitudinal cohort study imbedded within a community study. Neighborhood-level data for PHDCN participants were obtained from (1) a community survey of 8782 randomly selected Chicago residents conducted in 1995, (2) data on violent crime in 1995, obtained from the Chicago Police Department, and (3) US Census data from 1990. Individual- and family-level data were collected by a longitudinal cohort study completed between November 1994 and January 2002, in which overall 6226 children and their caregivers were enrolled.

SAMPLING

Chicago neighborhoods were initially grouped into 343 neighborhood clusters, each with approximately 8000 residents. Stratified probability sampling was then used to select a sample of 80 neighborhood clusters diverse in race/ethnic and socioeconomic composition for intensive study.

For the longitudinal cohort study, dwelling units were enumerated and approximately 35 000 randomly sampled households were screened for children and adolescents of eligible ages within the 80 selected neighborhoods. Children who were within 6 months of 7 target cohort ages (0 [in utero through the age of 6 months], 3, 6, 9, 12, 15, and 18 years) were invited to participate. The participation rate was 75%. A primary caregiver was enrolled for all children except the 18-year-old cohort. Three in-home interviews were conducted at approximately 24-month intervals between 1995 and 2002. Individual-level data for the current analyses come from girls enrolled in cohorts 9, 12, and 15 years and their primary caregivers.

MEASURES

Table 1 displays the instruments used at each of the 3 interviews and how each measure was used in the present analysis. As noted in Table 1, the individual-level confounders and neighborhood-level variables described below were measured at wave 1 (the first interview), individual-level victimization exposures were measured at wave 2, and outcomes were measured at wave 3. Additionally, 3 waves of self-report violent behavior data were used to describe prevalence across the age range of study participants.

OUTCOMES: PERPETRATION OF VIOLENCE

Questionnaires were administered in respondents' homes by trained interviewers. Based on a scale adapted from an earlier instrument by Elliott et al,³⁰ perpetration of 1 or more of the following 8 past-year violent behaviors with intent to cause in-

Table 1. Temporal Ordering of Variables Included in the Study Analyses of Data From the PHDCN, Waves 1 Through 3, Ages at Enrollment: 9, 12, and 15 Years

Variable	Timing of Measurement		
	Wave 1 (1995-1997)	Wave 2 (1997-2000)	Wave 3 (2000-2002)
Outcome			
Self-reported offenses in past year			X
Exposures			
Individual-level violent victimization past year		X	
Neighborhood homicide rate, 1995	X		
Neighborhood violent victimization	X		
Individual-level confounders: propensity score components			
Family socioeconomic status	X		
Deviance of peers past year	X		
Frequency of substance use past year	X		
Family structure	X		
Self-reported offenses past year	X		
Age at entry in study (cohort)	X		
Parental marital status	X		
Race/ethnicity	X		
Neighborhood-level confounders			
Concentrated poverty	X		
Homicide rate	X		

Abbreviation: PHDCN, Project on Human Development in Chicago Neighborhoods.

jury were examined at each of the 3 interviews: (1) hitting someone outside of the home; (2) attacking with a weapon; (3) using weapons or force to rob someone; (4) picking pockets or purse snatching; (5) throwing rocks and bottles; (6) setting fires to buildings, cars, or property; (7) carrying a hidden weapon; and (8) participating in a gang fight. The outcome measure was developed based on third-interview responses by girls on this scale. Items were selected because they were aggressive acts against people and because item-response analysis^{31,32} of their psychometric properties showed that, as a scale, they had good reliability and validity. An item measuring hitting people within the home did not fit well and was dropped.³³

At the third interview, girls reported 6 of 8 original violent act items (at baseline they had reported all 8). This led us to base the outcome measures for the statistical model solely on the 6 outcomes that were reported by at least 1 of the respondents—hitting someone outside the home; attacking with a weapon; throwing rocks or bottles; setting fires to buildings, cars or property; carrying a hidden weapon; and participating in a gang fight. (Using weapons or force to rob someone and picking pockets or purse snatching were not reported in the third interview.)

INDIVIDUAL-LEVEL EXPOSURE: VIOLENT VICTIMIZATION

The main individual-level exposure variable for this study was violent victimization, as reported at the second interview. Measures included whether girls were attacked with a weapon, beaten up, chased, shot at, or threatened with serious harm in the past year, as well as reports of past-year sexual assault (molestation or rape). These measures come from My Exposure to Violence, an instrument developed by the PHDCN.³⁴ Psychometric study of the scale of violent victimization showed good item fit, good reliability (Cronbach $\alpha = .83$), and good construct validity (the scale relates to behavioral and emotional symptoms in predictable ways). It was initially determined that sexual assault was better treated as a separate item since it did not cor-

relate as highly with the others and the Cronbach α for the non-sexual victimization scale did not decrease with its deletion. However, given that a high degree of overlap existed between those who were physically and sexually victimized and the low prevalence of past-year sexual assault in our sample, we constructed one combined measure of violent victimization, indicating experiencing at least one of those forms—sexual and/or nonsexual—of violent victimization in the past year.

INDIVIDUAL-LEVEL CONFOUNDERS

All individual and family confounders were measured at baseline. Using the same measures of violent events as was used for the study outcome measure, self-reported violence is a sum of violent behaviors by the girls in the year prior to the baseline interview. Family socioeconomic status is a composite of 3 variables: parental income, parental educational level, and parental occupational code, created using principal components analysis. The maximum value was used for each of the 3 variables if there were 2 parents in the household. Deviance of peers consists of the degree to which girls' peer groups engaged in risky and/or prosocial behaviors. Given the large number of indicators of peer deviance, cluster analysis helped us to first identify groupings that represented substantive dimensions of interest. Principal components analysis then allowed us to create uncorrelated weighted linear composites with maximum variances. The original 30 variables measured the number of peers who displayed the following specific characteristics in the past year: cluster 1, involved in risky activities (skipping school, taking a vehicle without permission, selling drugs, using illegal substances, and/or having sexual intercourse); cluster 2, displaying negative relations with others (not getting along with teachers, disobeying school rules, getting in trouble in school and/or at home, lying and/or disobeying adults, and hitting someone to hurt them); cluster 3, displaying positive characteristics (considered good citizens, good students, and/or generally honest); cluster 4, involved in criminal activities (stealing, breaking and/or entering, and/or attacking with a weapon); and

cluster 5, involved in prosocial activities (nonsport school activity, school sports, or community and/or religious activities). Illegal substance use is the number of days of use of alcohol, marijuana, cocaine, crack, and inhalants in the past year. Family structure was classified as whether the youth respondent was living with 1 biological parent, 2 biological parents, 1 nonbiological parent, or 1 biological and 1 nonbiological parent. Age, race/ethnicity, and parents' marital status (married vs not married) also were included.

NEIGHBORHOOD-LEVEL EXPOSURES

For each neighborhood cluster, neighborhood-level measures were estimated using aggregated data from 3 sources: the US Census, the 1995 PHDCN Community Survey, and the Chicago Police Department. These data sources provided estimates of neighborhood conditions independent of data obtained from individual girls and their caregivers. Violent victimization at the neighborhood level was measured by 1 dichotomous item from the 1995 community survey (aggregated to the neighborhood cluster level) asking whether anyone in the household had been the victim of a mugging, fight, or sexual assault since they began living in that neighborhood. The Chicago Police Department provided data to estimate the 1995 homicide rate for each neighborhood cluster. This rate was calculated by taking the number of homicides and dividing by the 1990 population count, using the formula $\log\{[(\text{homicides}/\text{population count}) \times 100\,000] + 1\}$. Additionally, a neighborhood-level covariate was used to control for potential confounding: a scale of concentrated poverty was derived from 1990 US Census measures of (1) percentage living below the poverty line, (2) percentage unemployed, and (3) percentage on public assistance, using principal components analysis.

STATISTICAL ANALYSES

To describe the patterns of violent behavior across the 3 waves of data collection, we constructed age-violence curves delineated by individual-level victimization. Coefficients from a repeated-measures marginal model with a binomial distribution were used to create the curves. Violent behaviors and history of victimization at all 3 waves were in the model, as well as family socioeconomic status. Since there is a trend for violence perpetration to desist during late adolescence,³⁵ it was expected that violence would decrease across the years of the study. Age-violence curves were created for the whole sample, as well as separately for girls exposed and unexposed to violent victimization. We hypothesized that girls exposed to violence would have higher rates of violent perpetration and perhaps desist more slowly during the study period.

Next, we estimated the likelihood of perpetrating violence by using a multivariate, 3-level random intercept Rasch measurement model with wave 3 violence items at level 1; individual-level predictors, a propensity score in quintiles, and random effects at level 2; and neighborhood-level covariates at level 3. Raudenbush et al³³ described and demonstrated the validity of this method.

PROPSENSITY SCORE ANALYSIS

Rather than include a large set of potential confounders of the main relationship of interest in the multilevel models, a propensity score derived from the baseline data was used to represent the confounders in a single composite.³⁶ Propensity score analysis has been shown to produce estimates that are less biased, more robust, and more precise than logistic regression

estimates when there are 7 or fewer exposed subjects per confounder.³⁷ Propensity score analysis uses a preliminary regression model to identify predictors of victimization (the exposure in this study) from observed background characteristics that preceded the victimization. It then uses the estimated probability of being victimized to represent all of the background characteristics. By dividing the propensity score into quintiles, and examining the data to see whether a balanced number of victimized and nonvictimized girls fall into each quintile, we were able to ensure that we had sufficient data to compare exposed and unexposed subjects who had similar values on the confounding variables. Additionally, use of this method avoided potential overparameterization of the model, given the large number of confounders and the low prevalence of violent behavior by the third interviews.

Confounders in the propensity score (all described above) included age at enrollment, race/ethnicity, parental marital status, family structure, and socioeconomic status, in addition to behavioral indicators found to have a significant association with being in fights as either perpetrator or victim: peer deviance,³⁸⁻⁴¹ illegal substance use,⁴⁰ and previous perpetration of violence.⁴¹ Missing confounder variables were given "0" if categorical and the mean value if continuous, and dummy variables indicating the presence of missing observations for each specific covariate were included. This imputation of missing confounder variables affected 5.0% of the sample. The one neighborhood-level variable included as a potential confounder, concentrated poverty, was entered separately into the 3-level analytic models, rather than as a neighborhood-level propensity score.

STATISTICAL MODELS

Models first estimated the association between victimization and propensity to perpetrate violence, controlling solely for age (centered at the age of 14 years, since it was the mean age to commit violent acts among girls as noted in the literature) and age squared at level 1. The models then introduced the propensity score to adjust for individual-level confounders at level 2. The propensity score was divided into quintiles and entered as 4 categories (quintile 5 as the reference) to avoid assumptions of linearity of the association between the propensity score and the outcome. In addition to its inclusion in the propensity score, additional adjustment for baseline reports of perpetration of violence was initially introduced in the models. However, since such adjustment did not change the magnitude or significance of the associations and baseline violence was not significantly associated with future perpetration after adjustment for the propensity score, this variable was deleted from the models. Models then estimated the association between neighborhood-level violence and perpetration by introducing neighborhood-level victimization and the 1995 neighborhood homicide rate at level 3. Further adjustment was made for neighborhood-level confounding by introducing concentrated poverty. Propensity scores were estimated using SAS, version 8,⁴² and multilevel models were estimated using HLM, version 5.⁴³

ANALYTIC SAMPLE

Of the 1164 girls who had completed the first interview, 82% were retained at the second interview, and 68.6% were retained at the third interview. Of the 799 respondents who participated in all 3 interviews, 5 persons had missing observations on all the victimization exposure items at wave 2, and 1 person had missing data on all the violent perpetration items at wave 3. This led to a sample of 793 subjects. To maximize the longitudinal order of the data, we then removed 156 sub-

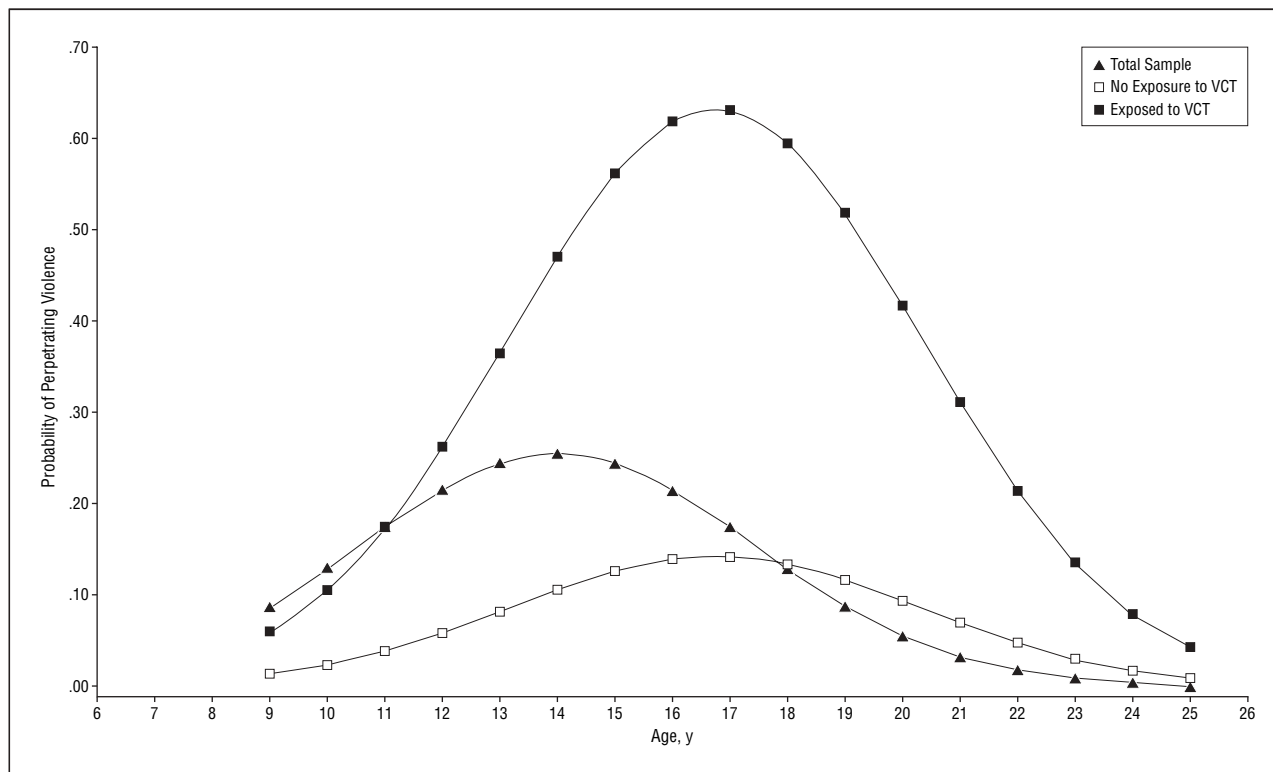


Figure. Age-violence curves by history of victimization and for total sample: Project on Human Development in Chicago Neighborhoods waves 1 through 3, for cohorts aged 9 through 15 years. VCT indicates violent victimization.

jects who had been victimized prior to wave 2. We had initially considered using the sample of 793 subjects and controlling for victimization prior to wave 2. This led to an imbalance in the propensity score whereby 157 subjects did not have a “match” of unexposed in terms of control for confounding and would have to be removed from the analysis. The final sample thus consisted of 637 girls who (1) completed all 3 interviews, (2) answered at least 1 of the items of interest on violent perpetration and 1 of the items of interest on victimization exposure, and (3) had not been victimized prior to wave 2.

The final analytic sample differed in 3 important ways from those who dropped out of the study or were removed from the study because of missing observations or prior victimization: the removed subjects were more likely to report deviant peers, less likely to have married caregivers, and more likely to have a higher rate of baseline violence.

RESULTS

The **Figure** illustrates the pattern of girls’ violent behavior across the 3 waves of data. Looking at the curve for the full sample, there was a peak in violent behavior for all girls at the age of 14 years, with an initial increase with age, then a later decrease, as expected during adolescence.³⁵ By displaying stratified curves (victimized at any wave vs not victimized at any wave vs all respondents), these curves give preliminary indications that the prevalence of violent behavior is higher among girls who report violent victimization than among girls who did not. Additionally, the acceleration of violent behavior was steeper for the victimized girls, with a peak at the age of 17 years. More than one third (38%) of the respondents

Table 2. Girls’ Violent Behavior, by Violent Victimization in the Past Year, PHDCN Wave 3, Ages at Enrollment: 9, 12, and 15 Years*

Violent Behaviors	Victimized in the Past Year (n = 184)	Not Victimized (n = 453)
At least 1 violent behavior with intent to cause injury	45 (24.5)	51 (11.3)
No violent behaviors	139 (75.5)	402 (88.7)
Hit someone outside the home	30 (16.4)	38 (8.4)
Threw rocks or bottles	15 (8.2)	16 (3.5)
Set fires to buildings, cars, or property	1 (0.5)	0
Participated in a gang fight	4 (2.2)	5 (1.1)
Picked pockets or snatched purses	0	0
Attacked with a weapon	2 (1.1)	2 (0.44)
Used weapons or force to rob	0	0
Carried a hidden weapon	15 (8.2)	9 (1.9)

Abbreviation: PHDCN, Project on Human Development in Chicago Neighborhoods.

*Data are given as the number (percentage) of female respondents.

reported perpetrating at least 1 type of violent behavior in the 12 months prior to the baseline interview; more than one quarter (28%) of the girls reported perpetrating violent behavior in the 12 months prior to the first follow-up interview, and one-seventh (14%) of the girls reported violence at the third interview.

Table 2 lists the prevalence of girls’ perpetration of violent acts by history of exposure to violent victimization. Girls who had been violently victimized in the past year (n = 184) were more likely to report perpetration of

Table 3. Girls' Sociodemographic Characteristics, by Violent Victimization in the Past Year PHDCN Waves 1 and 2; Ages at Enrollment: 9, 12, and 15 Years*

Variable	Victimized in the Past Year (n = 184)	Not Victimized (n = 453)
Exposures, mean (SD)		
Family socioeconomic status	-0.08 (1.5)	-0.16 (1.4)
Peer risky behaviors	0.6 (2.2)	-0.2 (1.6)
Peer negative relations	0.6 (1.8)	-0.2 (1.5)
Peer positive characteristics	-0.2 (1.3)	0.07 (1.2)
Peer criminal activities	0.4 (1.9)	-0.2 (1.5)
Peer prosocial activities	-0.07 (1.1)	0.03 (1.2)
Substance use	19.1 (85.8)	3.7 (33.0)
Exposures		
At least 1 violent behavior at baseline	29 (15.8)	63 (13.9)
No violent behaviors at baseline	155 (84.2)	390 (86.1)
Age at enrollment, y		
9	42 (22.8)	193 (42.6)
12	63 (34.2)	164 (36.2)
15	79 (42.9)	96 (21.2)
Race/ethnicity		
Black	69 (37.5)	130 (28.7)
Hispanic	65 (35.3)	195 (43.1)
White	15 (8.2)	77 (17.0)
Other	29 (15.8)	38 (8.4)
Family structure in the home		
1 Biological parent	60 (32.6)	115 (25.4)
2 Biological parents	80 (43.5)	269 (59.4)
1 Nonbiological parent	22 (11.9)	38 (8.4)
1 Biological and 1 nonbiological parent	22 (11.9)	31 (6.9)
Parents married	88 (47.8)	286 (63.1)

Abbreviation: PHDCN, Project on Human Development in Chicago Neighborhoods.

*Data are given as the number (percentage) of female respondents unless otherwise indicated.

violence at wave 3 (24.5%) than girls who had never been victimized (11.3%) (Table 2). As summarized in **Table 3**, girls who had been violently victimized also were more likely to report associations with deviant peers and using illegal substances, and were in the oldest age cohort at baseline. They were less likely to report having peers who exhibited positive characteristics and more likely to report black or other race/ethnicity and having unmarried parents (Table 3).

The propensity score model, which denotes the propensity of individuals to be victimized, had a c-statistic of 0.72. This indicated that the propensity score model had an adequate capacity to predict exposure to victimization; thus, by including the propensity score in the main study model, it was possible to adequately control for selection.

Table 4 lists the crude and adjusted models estimating the association between past-year victimization experiences reported at wave 2 and the probability of reporting perpetrating violence in wave 3. It also reports on the association between neighborhood violence and the probability of violent behavior by girls. Model 1 indicates that, controlling only for age at wave 3, girls who had been victimized by wave 2 had 2.9 times higher odds (95% confidence interval [CI] = 1.7-5.1) of reporting having perpetrated violence at wave 3 than girls who had not

been victimized. Adjustment for the propensity score resulted in a decrease in magnitude of the odds of perpetrating violence (odds ratio [OR] = 2.4, 95% CI = 1.3-4.5). Further adjustment for concentrated poverty of the neighborhood did not change the magnitude of the estimate. Concentrated poverty was independently associated with a higher probability of perpetrating violence (OR = 1.5, 95% CI = 1.1-2.1).

The probability of violent perpetration by girls was not higher in neighborhoods with more reports of violent victimization by residents. However, in neighborhoods with higher homicide rates, there was a trend toward higher probability of violence by girls (OR = 1.1, 95% CI = 0.9-1.02). When we examined cross-level interactions between neighborhood violence and individual victimization (**Table 5**), we found that the effect of individual-level victimization on subsequent violent behavior was approximately the same whether girls lived in neighborhoods without homicides (OR = 5.5, 95% CI = 2.3-13.0) or in neighborhoods with a 1-unit increase in the homicide rate (OR = 5.4, 95% CI = 4.3-6.8). However, we found a cross-level interaction between neighborhood concentrated poverty and individual victimization. The effect of individual-level victimization (with or without homicides, OR = 3.9, 95% CI = 3.0-4.9 or OR = 4.0, 95% CI = 1.8-9.0, respectively) on violent behavior was greater for girls from neighborhoods which were better off (with or without homicides) while the effect of victimization on violent behavior in neighborhoods with a 1-unit higher level of concentrated poverty was less strong and no longer statistically significant, with or without homicides (OR = 1.9, 95% CI = 0.4-8.7 or OR = 2.0, 95% CI = 0.4-9.0, respectively).

COMMENT

In this study, adolescent girls were more likely to act violently if they had previously experienced violent victimization, and if they lived in impoverished and/or severely violent communities. Additionally, a cross-level interaction was found indicating that, in neighborhoods that have less concentrated poverty, the effect of individual-level victimization on violent behavior is even stronger. Further investigation into neighborhood characteristics is needed to explain this differential impact of victimization.

These results highlight the critical role that violent victimization plays in the development of aggression by girls. Even when socioeconomic status, previous violence perpetration, deviant peer behavior, illegal substance use, and other family and individual characteristics were considered, violent victimization remained an important risk factor for subsequent violent behavior by girls.

In the current sample of girls who were aged 9 through 15 years at baseline and followed up for 7 years, violent behavior peaked at the age of 14 years. Other studies of girls' violence have shown that rates of the most serious self-reported violence by girls peaks about age 14 years and then decline, except for a highly aggressive subgroup.^{14,30,44} In this study, there was a steep decline in the prevalence of girls' violent behavior between the base-

Table 4. Multilevel, Hierarchical Nonlinear Models of the Odds of Perpetrating Violence Associated With Prior Violent Victimization and Neighborhood Characteristics PHDCN Waves 1 Through 3; Ages at Enrollment: 9, 12, and 15 Years (n = 637)

Variable	OR (95% CI)		
	Model 1	Model 2*	Model 3*
Intercept	0.004 (0.002-0.01)†	0.02 (0.01-0.05)†	0.02 (0.004-0.05)†
Violent victimization	2.9 (1.7-5.1)†	2.4 (1.3-4.5)†	2.4 (1.3-4.4)†
Propensity score, quintile			
1		0.05 (0.01-0.2)†	0.08 (0-11.0)
2		0.3 (0.1-0.9)†	0.4 (0.1-1.1)
3		0.5 (0.2-1.2)	0.5 (0.2-1.2)
4		0.4 (0.2-1.0)	0.5 (0.2-1.1)
5		1.0 (Reference)	1.0 (Reference)
Neighborhood characteristics			
Homicide rate 1995			1.01 (0.9-1.02)‡
Concentrated poverty			1.5 (1.1-2.1)§

Abbreviation: CI, confidence interval; OR, odds ratio; PHDCN, Project on Human Development in Chicago Neighborhoods.

*The propensity score includes age at enrollment, race/ethnicity, parental marital status, family structure, and socioeconomic status, in addition to behavioral indicators: peer deviance, illegal substance use, and previous perpetration of violence.

† $P < .01$.

‡ $P < .10$.

§ $P < .05$.

Table 5. Multilevel, Hierarchical Nonlinear Models of the Odds of Perpetrating Violence Associated With Prior Violent Victimization and Neighborhood Characteristics, Which Include Cross-Level Interactions Between Individual-Level Victimization and Neighborhood-Level Features: PHDCN Waves 1 Through 3; Ages at Enrollment: 9, 12, and 15 Years (n = 637)

Variable	OR (95% CI)	
	Model 4* (Includes Interaction Between Victimization and Homicide)	Model 5* (Includes Interactions Between Victimization and Homicide, and Victimization and Neighborhood Poverty)
Intercept	0.01 (0.003-0.03)†	0.01 (0.003-0.3)†
Odds of perpetrating violence for subjects who had individual experiences of violent victimization and live in neighborhoods with		
No homicides	5.5 (2.3-13.0)†	
1-Unit increase in homicide rate	5.4 (4.3-6.8)†	
Low concentrated poverty and no homicide		4.0 (1.8-9.0)†
Low concentrated poverty and a 1-unit increase in homicide		3.9 (3.0-4.9)†
1-Unit increase in concentrated poverty and no homicide		2.0 (0.4-9.0)
1-Unit increase in concentrated poverty and a 1-unit increase in homicide		1.9 (0.4-8.7)

Abbreviation: CI, confidence interval; OR, odds ratio; PHDCN, Project on Human Development in Chicago Neighborhoods.

*These models include the propensity score, age at enrollment, race/ethnicity, parental marital status, family structure, and socioeconomic status, in addition to behavioral indicators: peer deviance, illegal substance use, and previous perpetration of violence.

† $P < .01$.

line interview (38%) and subsequent interviews (28% and 14%, waves 2 and 3, respectively). This decline echoes the decrease noted in other assessments of youth violence in the United States during this period.^{8,13,14,45} The finding that violently victimized girls show higher levels of violence across all age groups indicates a need for early intervention, as well as a possibility that early support for girl survivors of violence would avert later aggression.

In this study, victimization might have happened at home, at school, or in neighborhoods. One could argue that both victimization and perpetration could have been in the context of a single fight between youth. However, we controlled for baseline factors that put youth in such

risky contexts, including illegal substance use, deviant peer behaviors, girls' own previous violent behavior, and neighborhood-level concentrated poverty. With these controlled, the effects of prior victimization on girls' perpetration of violence persisted over time, independent of being in a peer group with norms of fighting and other risky behaviors.

Studies of the relationship between sexual assault and subsequent violent behavior are scarce in the literature; only 2 previous studies with related findings were identified,^{46,47} both using cross-sectional, individual-level data. One analyzed 1995 National College Health Risk Behavior Survey data and found that lifetime forced sexual intercourse among girls was associated with over twice the

odds of fighting with spouses or boyfriends in the 12 months prior to the survey.⁴⁶ The second was a nationally representative sample of students in grades 8 to 12 in France; this study found a significant relationship between rape and regular perpetration of violence in the past year for both girls and boys.⁴⁷ These findings suggest that, from a clinical perspective, violence by girls may serve as an indicator of need for interventions focused on healing from sexual assault. Unfortunately, because of the low prevalence of past-year reported sexual assault among this sample of girls, we had to combine it with other types of victimization, rather than evaluate this relationship separately.

In addition to suggesting the potential importance of early interventions for victimized children and adolescents, results of the current inquiry suggest that a much stronger emphasis on safety for children in their neighborhoods, schools, and families would yield the largest reduction in youth violence. To restrict the focus to individual interventions alone will leave those in unsafe settings with correspondingly poor outcomes.

STUDY STRENGTHS AND LIMITATIONS

Limitations

This study relied primarily on girls' self-reports. These may have been subject to social desirability bias if girls exaggerated aggressive behaviors or were reluctant to disclose victimization experiences, especially sexual assault. With the longitudinal design, we also had missing data that resulted in the deletion of respondents from the analysis. This may have resulted in the introduction of additional bias since removed subjects were more likely to report deviant peers, less likely to have married caregivers, and more likely to have a higher rate of baseline violence. Additionally, the steep decline in perpetration of violence across the 3 waves of data resulted in a low prevalence of the outcome, which may have affected statistical power to detect associations prospectively.⁴⁸ For example, we expected to see an association between parent-to-child physical aggression⁴⁹ and subsequent violent behavior, but this was the case only at baseline. Finally, although the propensity score analysis allowed us to account for many potential confounders, there is a possibility that there were unmeasured confounders that were not included in the analysis.

Strengths

A major strength of this study is its multilevel, longitudinal design. Prospective designs are particularly important in assessing exposures to or experiences with violence across multiple settings, especially when studying adolescence, a time of so many developmental changes. The focus on perpetration by girls also is significant, given the relatively scant literature on the origin of girls' aggression using population-based samples. Finally, we used multilevel methods to evaluate the independent contribution of neighborhood effects on girls' violence, including their interactions with individual exposure to violent victimization.

IMPLICATIONS FOR RESEARCH AND PREVENTION

Knowledge of mechanisms by which victimization and exposure to neighborhood violence affects perpetration by youth is as yet unrefined. Turner and Lloyd,⁵⁰ discussing their findings on the effects of multiple traumas for a child, suggest that one mechanism may be impairment of the development of coping skills to deal with stressors. Some theorists posit a social learning model in which adolescents learn from others that violent behavior is normative^{51,52}; others offer biosocial explanations for the development of youth violence.³

Current youth violence prevention efforts focus primarily on intervention at the individual level: counseling for children or teens who demonstrate problems, punishment for children as individuals, attributions of adult intentions or characteristics to children, and application of adult remedies. In contrast, successful interventions, to the extent that they have been evaluated, include multilevel interventions integrating family, school, and community-level efforts.⁵³ Our results suggest that a continued emphasis on individual-based remedies or penalties will be unsuccessful unless additional efforts are undertaken to reduce childhood victimization and improve the conditions in which many urban girls live.

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