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Joint Consideration of Distal and Proximal Predictors of Premature Mortality among Serious Juvenile Offenders

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Abstract

Purpose—Juvenile offenders are at heightened risk of death in adolescence and young adulthood compared to adolescents in the general population. The current study extends previous research by testing the joint contributions of distal (historical and demographic characteristics) and proximal (closer to the time of the death) predictors of mortality. We also tested and whether proximal variables were potential mediators of the effects of distal variables on mortality.

Methods—Participants were 1,354 serious juvenile offenders, 45 (3.32%) of whom were deceased by the completion of the study. Data were collected through self-reports and official records.

Results—Significant distal predictors of mortality were being African-American and having a history of substance use disorder. Proximal predictors that added significantly to prediction included gun carrying, gang membership, and substance use problems. Potential mediators of the effects of substance use disorder history were continuing substance use problems and gang membership. However, proximal variables could not explain the heightened risk for African-Americans.

Conclusions—Gang membership, gun carrying, and substance use problems are risk factors for early mortality among juvenile offenders, but they do not explain the elevated risk for death among African Americans. Thus, further research is needed to understand the mechanisms underlying risk for premature death among African-American adolescent offenders.

Implications and contributions—Findings suggest that interventions to reduce substance use problems, gang membership, and gun carrying have the potential to reduce risk of mortality for serious juvenile offenders. However, these factors cannot explain the heightened risk for death among African-American participants.

Keywords

predictors of mortality; juvenile criminal offending

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Juvenile offenders are at increased risk for many negative outcomes, including mental health and substance use disorders [1,2], and adverse health outcomes [3,4]. Moreover, a growing body of literature has linked juvenile offending to higher rates of premature mortality [2,5–8]. However, the factors that link the two remain unclear [5,7]. The current study expands existing knowledge by examining predictors of mortality in a sample of serious juvenile offenders, followed over seven years, testing an expanded array of risk factors including those more proximal to the death, and testing whether these proximal factors can explain the effects of more distal predictors.

As in the larger adolescent population, the most common causes of death for juvenile offenders include homicides, suicides, and accidents, rather than disease [5,7]. However, adolescents in the general population are most likely to die from accidents, with homicide and suicide being the second and third most common causes of death, respectively [9]. In contrast, mortality among juvenile offenders is caused by homicide, accidents, and suicides, in that order [2,10].

Previous research has identified multiple predictors of mortality among juvenile offenders. Although studies have not explicitly categorized them, these predictors might be considered to be either distal factors (historical characteristics and demographic factors) or factors more proximal to the death (e.g., current behaviors such as weapons carrying). The current study expanded previous research by testing whether proximal risk factors make a contribution over and above distal factors when considered jointly and whether proximal factors can explain the effects of more distal predictors. Proximal factors are of particular interest because they are potentially more modifiable than are distal variables that include demographic statuses and long-standing historical or trait factors. Our selection of distal and proximal factors was guided by prior research.

In terms of distal predictors, being African-American increases the risk for premature death [10–12] as does low SES [13] and being male [2,6]. Accordingly we tested race/ethnicity, gender, and parent education as distal predictors. Moreover, both offending and early mortality have been attributed to the increased impulsive behaviors that are common among juvenile offenders [5,6,11,14,15]. Thus, we tested impulse control as a distal predictor as well as the adolescent's lifetime total number of court petitions [16]. Finally, a history of mental health disorders has been reported to be a predictor of mortality [5], so we tested lifetime diagnoses of substance use disorders and internalizing disorders as distal predictors.

In terms of more proximal variables, substance use has been identified as a predictor of mortality [5,10]. Acute effects of substance use include impaired judgment and reduced cognitive control [17] and substance use may place adolescents in peer contexts in which accidents and/or violence are more likely [18]. Accordingly, we examined adolescents' substance use-related consequences as an indicator of the severity of their recent substance use involvement. In addition, affiliation with delinquent peers (including gang membership [19–21] as well as weapon carrying, increase the risk of exposure to dangerous situations and predict mortality [10] as does high-rate current criminal behavior [10,22]. Thus, these factors were tested as proximal predictors. Moreover, because exposure to violence could be the common mediator of the effects of these predictors, we also tested adolescents' self-reported exposure to violence as a proximal predictor. Finally, we extended previous research by testing adolescents' residence as a proximal predictor. Although previous studies have examined neighborhood conditions [23], none, to our knowledge, have examined the living arrangement of the juvenile before death. Adolescents who live with parents may experience more monitoring and constraints on risky behavior and thus may be at lowered risk for mortality.

In short, we both replicate previous work and extend it by testing whether proximal factors (on average six months before the death) add significantly to prediction over and above distal historical and demographic factors and whether proximal factors can potentially explain the effects of distal predictors. Finally, unlike previous research, we focus on serious juvenile offenders over an age range from adolescence to early adulthood that captures the important transition phase when many criminal careers (and their negative consequences) end but others continue [4,24].

Method

Participants

Participants were enrolled in the Pathways to Desistance study, a longitudinal investigation of the transition from adolescence to young adulthood in serious adolescent offenders. Participants are adolescents who were found guilty of a serious offense (almost entirely felony offenses) in the juvenile or adult court systems in Maricopa County, AZ or Philadelphia County, PA. Participants were ages 14 through 18 ($M = 16.5$) at the baseline interview (one was 19). A total of 1,354 adolescents were enrolled, representing approximately one in three adolescents adjudicated on the enumerated charges in each locale during the recruitment period (November, 2000 through January, 2003). The sample is comprised mainly of non-white (44% African American, 29% Hispanic) males (86%), who had an average of three court petitions prior to the baseline interview. Participants completed interviews every six months for the first three years and then annually thereafter through seven years. Information regarding the study rationale can be found in Mulvey et al. [25], while additional details regarding the study design, sample, and methodology are in Schubert et al. [26]. Additional information regarding the measures can be found at www.pathwaysstudy.pitt.edu.

Measures

Descriptive data are presented in Table 1 for the total sample and for deceased and non-deceased subgroups by race/ethnicity.

Dependent Variable

Our outcome variable is death before the end of the study (84 months after baseline). A record search of the National Death Index (NDI) was requested for 95 participants who were not successfully contacted at the last interview (including those whose deaths had been reported over the course of the study and those consistently not located in earlier waves). Results indicated that 43 individuals were matched with sufficient certainty to be considered a “true match” and their dates and causes of death were provided. The remaining 52 cases were examined through a web-based search of the Social Security Death Index (SSDI), resulting in two additional confirmed deaths (with the dates but not causes of death available). Our 45 confirmed deaths out of 1,354 original participants creates a prevalence of 3.32%. This is much higher than the rate of .00062 found in the general population of adolescents aged 15 – 19 years [27], but is similar to other studies of juvenile offenders [2,8].

Distal predictors

Distal variables (static demographic characteristics, traits, or historical variables) were obtained at the initial (baseline) interview.

Race/ethnicity—We tested race/ethnicity as “African-American” versus all others because of previous evidence (confirmed in our data, see below) that African-Americans were at highest risk for mortality.

Parent education—Parent education was reported by the participant and a collateral (usually a parent) and was the mean of the biological mother’s and father’s education, using the lowest level reported if the informants disagreed. The scale ranged from 1 (Some post-college education) to 6 (Grade school or less) ($M=4.30$, $SD=0.95$).

Impulse Control—Impulse control was the average score for an 8-item self-report subscale of the Weinberger Adjustment Inventory [28] (e.g., “*I say the first thing that comes into my mind without thinking enough about it.*”) ($M=2.96$, $SD=0.95$, $Range=1-5$). Higher scores indicate greater impulse control.

Prior Offending—The total number of court petitions before the baseline interview was obtained from court records ($M=3.16$, $SD=2.22$, $Range=1-15$).

History of Mental Health Disorders—Lifetime (DSM-IV) disorders were measured by the Composite International Diagnostic Interview [29]. There were two predictors: (1) whether the adolescent met criteria for lifetime alcohol or drug disorder (45.08% met criteria), and (2) whether the adolescent met lifetime criteria for internalizing disorders including major depressive disorder, dysthymia, mania, or PTSD (14.60% met criteria).

Proximal Variables—We tested eight variables that described the participant or his/her social context more proximally to the time of their death (within the past 18 months). This information was obtained from the last interview before the death. For 94% of cases, this interview reported on a one-year recall period and for the others it was a six-month report. For those who died, the last interview date averaged 184 ($SD=252$) days before the death.

Substance use-related consequences—We measured the severity of substance use-related problems with the total number of alcohol and drug consequences and dependence symptoms [30] ($M=1.40$, $SD=3.36$, $Range=0-23$).

Severity of offending—Severity of offending was the total offending variety proportion assessed with the Self-Reported Offending Inventory [31] ($M=0.05$, $SD=0.097$, $Range=0-0.68$).

Gang membership—Gang membership was a single item assessing either continuing gang membership from baseline or past year gang membership, for those who were not gang members at baseline (adapted from Thornberry, Lizotte, Krohn, Farnworth, and Jang) [32]. At the last interview, 6.2% of the full sample and 15.6% of the deceased youth were in a gang. These rates are somewhat lower than the 14–30% in other studies of high risk adolescents [33] both because they represent current (rather than lifetime) gang membership and because gang membership has been found to peak at ages 14 and 15 [34] and our participants were older than 20 at last assessment.

Exposure to violence—Exposure to violence was measured by the Exposure to Violence Inventory [35]. The final score was the sum of violent events that were either experienced or observed (e.g., rape, sexual attack, threat of serious harm) ($M=1.20$, $SD=1.80$, $Range=0-10$).

Peer antisocial behavior—Peer antisocial behavior was assessed with 12 questions from the Rochester Youth Study (e.g., “How many of your friends have sold drugs”) [33] ($M=1.64$, $SD=0.72$, $Range=1-5$). *Gun carrying*. A single, self-report item asked whether or not participants “carried a gun in the recall period”. At the last interview, among those who were not incarcerated, rates of gun-carrying were 4% overall and 17.1% among deceased youth. These rates are similar to other studies of juvenile offenders [34,36].

Living situation—Participants reported their current living situation. Two dichotomous variables were created to indicate whether the participant lived with a parent = “1”; not with parent = “0”; or was institutionalized = “1”; not institutionalized = “0”. Living in the community but not with parents was the reference group. At the last recall period, 26.2% were living with parents and 31.9% were institutionalized.

Analysis

Analyses predicted mortality as a dichotomous outcome. Because the prevalence of death was only 3.32% (45 deaths), we used a rare-event logit (REL) model [37,38], an extension of logistic regression that is designed to deal with rare events data where $\Pr(Y=1)$ is underestimated and hence $\Pr(Y=0)$ is overestimated. Because of strong theory about the direction of effects combined with the very low prevalence of death, we report one-tailed tests (with z-values included for comparison with two-tailed significance levels). Because there are no model fit statistics for REL we report pseudo r-squared values from similarly estimated logistic regressions.

For ease of presentation, we begin by describing the deaths and reporting zero-order correlations among the predictors and outcome. We then present three REL models predicting mortality from (a) distal (baseline) characteristics only, (b) proximal characteristics only, and (c) a full model containing both distal and proximal characteristics. Finally, although the small number of deaths precludes a formal test of a mediational model, we identified the proximal variables that could potentially explain the effects of distal variables (i.e., that are potential mediators). To accomplish this, we tested the effects of distal predictors on proximal predictors. Proximal predictors that are both a) significantly predicted by distal variables and b) significantly predictive of mortality over and above the distal predictors meet the pre-conditions to be mediators that explain the effects of distal predictors on mortality.

RESULTS

Description of Deaths

There were 45 deaths by the end of the study (see Table 1 for descriptive data). On average, participants were 20 years old at death (range 15.43–25.63 years). Death rates were 4.45% for African-Americans, 2.19% for non-Hispanic Caucasians, and 1.77 for Hispanics. Of the 45 deaths, 27 (60.0%) were due to homicide, eight (17.8%) were suicides, eight (17.8%) were accidents (seven of which were either drug poisonings or motor vehicle accidents) and two (4.4%) were from unknown causes. Homicides were most common among African-Americans. Among African-Americans, 80% of deaths (20/25) were due to homicide whereas corresponding percentages were 16.7% of Non-Hispanic Caucasians, 55.6% of Hispanics participants, and 20% of participants of other racial backgrounds. Overall, African-Americans accounted for 74.1% of deaths due to homicide followed by Hispanics who accounted for 18.5% of deaths due to homicide. Among non-Hispanic Caucasians, accidental drug poisonings were the leading cause of death.

Intercorrelations among variables are in Table 2. Mortality was positively correlated with being male, having more substance use consequences, higher offending variety proportion, greater peer antisocial behavior, gang membership, and gun carrying. The relations between race/ethnicity and mortality showed that the Hispanic participants, compared to all other groups were less likely to die, whereas African-American participants were marginally more likely to die. Non-Hispanic Caucasian adolescents were more likely to suffer consequences from substance use, showed less impulse control, had fewer prior court petitions, were less likely to be gang members, had parents with more education, reported less exposure to violence, and were less likely to be institutionalized during the last recall period. Hispanics showed lower levels of impulse control, had parents with less education, reported less exposure to violence, less peer antisocial behavior, and were more likely to be gang members. African-Americans were less likely to meet criteria for a substance use disorder, to report substance use consequences, and to be gang members. African-Americans also had more delinquent peer associations, more exposure to violence, higher impulse control, higher parental education, more prior court petitions, and were more likely to be institutionalized at the last recall period.

Rare-Events Logistic Regression

Results of the REL analyses are in Table 3. Model 1 predicted mortality from the six distal predictors (pseudo r-square=.054). African-American participants were at higher risk of death as were participants with a history of substance use disorder at baseline.

Model 2 predicted mortality from the proximal variables alone (pseudo r-square=.055). Participants who were gang members, who associated with antisocial peers, and who reported carrying a gun during the period prior to their deaths were at a significantly higher risk of death.

Model 3 tested a fully-specified model that included both the distal and proximal predictors (pseudo r-square=.104). Results were generally unchanged. Being African-American and meeting criteria for a lifetime substance use disorder at baseline predicted increased likelihood of death. There were three significant proximal predictors —two of which were significant in the previous model (gang involvement and gun carrying). One additional variable, the number of substance use consequences was positively associated with death, but peer antisocial behavior was no longer significantly related to death.

Regressions predicting proximal variables from distal variables

The REL models suggest that gang membership, gun carrying, and substance use problems were potential candidates to explain the effects of the distal variables on mortality. Accordingly, we predicted gang involvement and gun carrying (logistic regressions) and substance use problems (OLS regression) from the proximal variables (Table 4).

Gang membership was significantly predicted by lower parent education, less impulse control, being male, and having a lifetime substance use disorder diagnosis. Gun carrying was significantly predicted by higher parent education. Substance use-related problems were predicted by low impulse control, being non-African American, and having a lifetime substance use disorder diagnosis. Thus, the significant effect of lifetime substance use disorder diagnosis on mortality might be explained by continuing substance use-related problems and gang membership, but the significant effect of being African-American on mortality could not be explained by gang involvement, gun carrying, or substance use-related problems.

DISCUSSION

This paper examined the prevalence of—and factors associated with—death in a large-scale, longitudinal study of 1,354 serious juvenile offenders followed over seven years. We built on previous research by testing whether proximal variables could explain the effects of distal predictors, by considering a very high-risk sample and by considering a range of distal and proximal factors some of which have not been previously explored.

Results indicated that being African-American and having a lifetime diagnosis of substance use disorder were distal predictors of mortality. In addition, being a gang member, carrying a gun, and having high levels of current substance use problems were significant proximal predictors of mortality. Substance use disorders and their continuing substance use-related consequences can raise risk for death in multiple ways including direct effects of the substance itself (i.e., potentially impaired judgment) and substance use-related accidents (e.g., overdose or impaired driving). Our findings also suggested that substance use disorders can raise risk for death by making gang membership more likely.

Unpacking the high risk among African-American participants

Our findings raise issues about the mechanisms underlying the heightened risk of death among African-American adolescents. Importantly, in our data, the heightened risk for African-American participants cannot be fully explained by our other proximal variables that predict mortality. African-American adolescents were actually *less* likely than other race/ethnic groups to have a substance use disorder, and no more likely to be a member of a gang or to carry a gun. Although they reported more delinquent peer associations, institutionalization, and exposure to violence, these factors did not predict mortality. Our findings are consistent with data from the Bureau of Justice Statistics [12] that African Americans account for a large percentage of homicide victims but that gang violence accounted for a slightly lower percentage than among non-Hispanic Caucasian victims.

All of this raises the intriguing question: why are African-Americans at an increased risk of death—especially death by homicide? Although definitive answers are beyond the scope of our data, we offer some speculation from national data. African-Americans experience higher levels of mortality by homicide than other racial groups [12,39] and research points to community disadvantage as the major factor that explains violent deaths among African-American adolescents [40]. The highly segregated residential placement of African-Americans makes it more likely for this racial group to reside in communities with high levels of poverty, unemployment, and residential instability [40]. Piquero and colleagues suggest that contextual factors associated with neighborhood characteristics account for the disproportionate involvement of African-Americans in violent victimization [11]. Disadvantaged communities experience the highest rates of violent crime and also contain large concentrations of minority groups [23]. It is also worth noting that causes of death varied by race/ethnicity. Non-Hispanic Caucasians had the highest prevalence of accidental death. Because this category includes toxic exposure to drugs and non-Hispanic Caucasians had the highest rates of substance use problems, we speculate that this elevated risk among non-Hispanic Caucasians is connected to substance use problems. In general, given the role of substance use problems as both a distal and a proximal predictor of mortality, interventions that reduce substance use may be useful in reducing mortality risk [16], particularly among non-Hispanic Caucasians.

Several limitations should be noted. Although we captured variables more proximal in time to an adolescent's death, we could not assess the circumstances immediately preceding the death and those that might change further in the days or weeks before the event. Second, although we verified prior history of offending in court records, other variables relied on

self-report. Third, because study site is strongly correlated with race/ethnicity we cannot rule out site effects. However, the consistency of our findings with the broader literature provides confidence in the validity of the self-report data and the existence of race/ethnicity effects. Third, although we followed a large sample there were a relatively small number of deaths, so testing interactions in which predictors of deaths vary across subgroups, particularly race/ethnic subgroups is not feasible. Finally, we did not have adequate data on neighborhood conditions proximal in time to the death.

Despite these limitations, the current study adds to the literature by identifying distal and proximal predictors of early mortality among serious juvenile offenders. Findings suggest that interventions to reduce substance use problems, gang membership, and gun carrying have potential to reduce risk of early mortality. However, findings also suggest that these factors cannot fully explain the heightened risk for early death among African-American serious juvenile offenders.

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References

1. Grisso T. Adolescent offenders with mental disorders. *The Future of Children*. 2008; 18:143–164. [PubMed: 21338001]
2. Teplin LA, McClelland GM, Abram KM, Mileusnic D. Early violent death among delinquent youth: A prospective longitudinal study. *Pediatrics*. 2005; 115:1586–1593. [PubMed: 15930220]
3. Piquero AR, Daigle LE, Gibson C, et al. Are life-course-persistent offenders at risk for adverse health outcomes? *J Res Crime Delinq*. 2007; 44:185–207.
4. Reingle JM, Jennings WG, Piquero AR, Maldonado-Molina MM. Is violence bad for your health? An assessment of chronic disease outcomes in a nationally representative sample. *Justice Q*. 2012;10.1080/07418825.2012.689315
5. Laub JH, Vaillant GE. Delinquency and mortality: A 50-year follow-up study of 1,000 delinquent and nondelinquent boys. *Am J Psychiat*. 2000; 157:96–102. [PubMed: 10618019]
6. Nieuwbeerta P, Piquero AR. Mortality rates and causes of death of convicted Dutch criminals 25 years later. *J Res Crime Delinq*. 2008; 45:256–286.
7. Sailas ES, Feodoroff B, Lindberg NC, et al. The mortality of young offenders sentenced to prison and its association with psychiatric disorders: A register study. *E J Public Health*. 2005; 16:193–197.
8. Coffey C, Veit F, Wolfe R, Cini E, Patton GC. Mortality in young offenders: Retrospective cohort study. *BMJ*. 2003; 326:1064. [PubMed: 12750207]
9. Centers for Disease Control and Prevention. Deaths, Percent of Total Deaths, and Death Rates for the 15 Leading Causes of Death in Selected Age Groups, by Race and Sex: United States, 1999–2009. Available at: <http://www.cdc.gov/nchs/nvss/mortality/lcwk1.htm>
10. Lattimore PK, Linster RL, MacDonald JM. Risk of death among serious young offenders. *J Res Crime Delinq*. 1997; 34:187–209.
11. Piquero AR, MacDonald J, Dobrin A, et al. Self-control, violent offending, and homicide victimization: Assessing the general theory of crime. *J Quant Criminol*. 2005; 21:55–71.
12. Harrell, E. Special Report: Black victims of violent crime (NCJ 214258). Washington, D.C: U.S. Dept. of Justice, Office of Justice Programs, Bureau of Justice Statistics; 2007. Available at: <http://bjs.ojp.usdoj.gov/content/pub/pdf/bvvc.pdf>

13. Jokela M, Elovainio M, Sign-Manoux A, Kivimaki M. IQ, socioeconomic status, and early death: The US National Longitudinal Survey of Youth. *Psychosom Med*. 2009; 71:322–328. [PubMed: 19251867]
14. Gottfredson, MR.; Hirschi, T. *A General Theory of Crime*. Palo Alto, Calif: Stanford University Press; 1990.
15. Pratt TC, Cullen FT. The empirical status of Gottfredson and Hirschi's general theory of crime: A meta-analysis. *Criminology*. 2000; 38:931–964.
16. Zlodre J, Fazel S. All-cause and external mortality in released prisoners: Systematic review and meta-analysis. *Am J Public Health*. 2012; 0:1–9.
17. Curtin JJ, Fairchild BA. Alcohol and cognitive control: Implications for regulation of behavior during response conflict. *J Abnorm Psychol*. 2003; 112:424–436. [PubMed: 12943021]
18. U.S. Department of Health and Human Services. *The Surgeon General's Call to Action To Prevent and Reduce Underage Drinking*. U.S. Department of Health and Human Services, Office of the Surgeon General; 2007.
19. Gibson CL, Miller JM, Jennings WG, Swatt M, Gover A. Using propensity score matching to understand the relationship between gang membership and violent victimization: A Research Note. *Justice Q*. 2009; 26:625–643.
20. DeLisi M, Barnes JC, Beaver KM, Gibson CL. Delinquent gangs and adolescent victimization revisited: A propensity score matching approach. *Crim Justice Behav*. 2009; 36:808–823.
21. Gover RA, Jennings WG, Tewksbury R. Adolescent male and female gang members' experiences with violent victimization, dating violence, and sexual assault. *Am J Crim Justice*. 2009; 34:103–115.
22. Piquero AR, Farrington DP, Shepherd JP, Auty K. Offending and early death in the Cambridge study in delinquent development. *Justice Q*. 2011; 28:1–28.
23. Sampson RJ, Morenoff JD, Raudenbush S. Social anatomy of racial and ethnic disparities in violence. *Am J Pub Health*. 2005; 95:224–231. [PubMed: 15671454]
24. Loeber, R.; Farrington, DP., editors. *From Juvenile Delinquency to Adult Crime, Criminal Careers, Justice Policy, and Prevention*. New York, NY: Oxford University Press; 2012.
25. Mulvey EP, Steinberg L, Fagan J, et al. Theory and research on desistance from antisocial activity among serious adolescent offenders. *Youth Violence Juv Justice*. 2004; 2:213–236. [PubMed: 20119505]
26. Schubert CA, Mulvey EP, Steinberg L, et al. Operational lessons from the Pathways to Desistance Project. *Youth Violence Juv Justice*. 2004; 2:237–255. [PubMed: 20119515]
27. U.S. Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. *Child Health USA 2011*. Rockville, Maryland: U.S. Department of Health and Human Services; 2011.
28. Weinberger DA, Schwartz GE. Distress and restraint as superordinate dimensions of self-reported adjustment: A typological perspective. *J Pers*. 1990; 58:381–417. [PubMed: 2213473]
29. World Health Organization. *Composite International Diagnostic Interview*. Geneva, Switzerland: World Health Organization; 1990.
30. Chassin L, Rogosch F, Barrera M. Substance use and symptomatology among adolescent children of alcoholics. *J Abnorm Psychol*. 1991; 100:449–463. [PubMed: 1757658]
31. Huizinga D, Esbensen F, Weiher A. Are there multiple paths to delinquency? *J Crim Law Crim*. 1991; 82:83–118.
32. Thornberry TP, Lizotte AJ, Krohn MD, et al. Delinquent peers, beliefs, and delinquent behavior: A longitudinal test of interactional theory. *Criminology*. 1994; 32:47–83.
33. Thornberry TP, Huizinga D, Loeber R. The causes and correlates studies: Findings and policy implications. *Juvenile Justice*. 2004; 9:3–19.
34. Loeber, R.; Stouthamer-Loeber, M.; Farrington, DP.; White, HR., editors. *Violence and Serious Theft: Development and Prediction from Childhood to Adulthood*. New York, NY: Taylor & Francis Group, LLC; 2008.
35. Selner-Ohagan M, Kindlon D, Buka S, et al. Assessing exposure to violence in urban youth. *J Child Psychol Psc*. 1998; 39:215–224.

36. Lizotte A, Sheppard D. Gun use by male juveniles: Research and prevention. *OJJDP Bulletin*. 2001 Jul.;1–12.
37. Tomz, M.; King, G.; Zeng, L. RELOGIT: Rare Events Logistic Regression, Version 1.1. Cambridge, MA: Harvard University; 1999.
38. King G, Zeng L. Explaining rare events in international relations. *Int Organ*. 2001; 55:693–715.
39. Loeber R, DeLamatre M, Tita G, et al. Gun injury and mortality: The delinquent backgrounds of juvenile victims. *Violence and Victims*. 1999; 14:339–352. [PubMed: 10751043]
40. McNulty TL, Bellair PE. Explaining Racial and Ethnic Differences in Serious Adolescent Violent Behavior. *Criminology*. 2003; 41:709–748.

Descriptive Data for Study Variables

	Total Sample (N=1354)		Deceased (N=45)				Not Deceased (N=1309)			
			Non-Hispanic Caucasian (n=6)		African- American (n= 25)		Non-Hispanic Caucasian (n=268)		African- American (n=536)	
<i>DISTAL (Taken at Baseline)</i>										
Age	16.5 (1.1)	16.4 (1.03)	16.6 (1.14)	16.6 (.997)	16.8 (.674)	16.5 (1.29)	16.5 (1.28)	16.8 (.99)	16.6 (.778)	16.6 (.778)
Impulse Control ^a	2.96 (.95)	2.67 (1.27)	3.27 (.778)	2.72 (.893)	2.60 (.647)	2.71 (.859)	3.22 (.94)	2.23 (.94)	2.75 (1.0)	2.75 (1.0)
Prior Petitions ^b	3.16 (2.22)	3.67 (3.93)	3.84 (2.23)	4.00 (2.78)	2.60 (1.52)	2.80 (2.12)	3.3 (2.27)	3.14 (2.12)	3.17 (2.41)	3.17 (2.41)
Parent Education ^c (% Less than High School Diploma)	34.8%	33.33%	24.0%	44.4%	0.0%	17.9%	28.8%	54.6%	26.3%	26.3%
Study Site (% Philadelphia)	51.7%	33.3%	84.0%	33.3%	20.0%	26.1 %	89.7%	23.3%	30.5%	30.5%
Gender (% Male)	86.4%	100%	96.0%	100%	100%	81.7%	87.5%	87.4%	81.4%	81.4%
Substance Use Disorder ^d	45.08%	66.7%	64.0%	55.6%	40.0%	49.6%	37.0%	48.5%	58.2%	58.2%
Mental Health Disorder ^e	14.6%	16.7%	12.0%	22.2%	20.0%	16.7%	12.4%	14.8%	22.8%	22.8%
<i>PROXIMAL (Taken at Last Recall Period)</i>										
Age at death	-	19.5 (.729)	20.2 (2.38)	20.0 (1.77)	21.5 (2.96)	-	-	-	-	-
Homicide	-	16.67%	80.0%	55.6%	20.0%	-	-	-	-	-
Suicide	-	16.67%	12.0%	44.4%	0.0%	-	-	-	-	-
Accident	-	50.0%	8.0%	0.0%	60.0%	-	-	-	-	-
Unknown cause of death	-	16.67%	0.0%	0.0%	20.0%	-	-	-	-	-
Days between interview and death	-	171 (226.1)	225 (315.8)	103 (47.1)	139.4 (60.6)	-	-	-	-	-
Substance Use Consequences ^f	1.4 (3.36)	6.67 (6.5)	1.16 (2.39)	1.55 (3.09)	5.00 (7.91)	2.3 (4.31)	.82 (2.30)	1.32 (3.29)	2.37 (4.71)	2.37 (4.71)
Offending ^g	.05 (.097)	.152 (.179)	.084 (.149)	.04 (.066)	.218 (.244)	.053 (.086)	.049 (.095)	.049 (.090)	.07 (.141)	.07 (.141)
Exposure to Violence ^h	1.2 (1.80)	2.0 (3.16)	1.48 (2.08)	.667 (1.12)	3.40 (3.13)	.944 (1.56)	1.48 (1.89)	.971 (1.64)	1.25 (2.25)	1.25 (2.25)
Peer ASB ⁱ	1.64 (.72)	2.08 (.78)	2.01 (.804)	1.55 (.850)	2.26 (1.13)	1.58(.641)	1.7 (.726)	1.56 (.718)	1.68 (.807)	1.68 (.807)
Gangs ^j (%Yes)	6.2%	0.0%	16.0%	11.1%	40.0%	2.6%	3.8%	10.3%	6.8%	6.8%
Gun Carrying ^k (%Yes)	2.9%	16.7%	12.5%	11.1%	20.0%	3.40%	2.5%	2.0%	3.5%	3.5%
Institutionalized ^l	31.9%	33.3%	16.0%	22.2%	40.0%	22.8%	22.2%	32.3%	30.5%	30.5%
Lived with Parent ^m	26.2%	50%	36.0%	55.6%	0.0%	28.0%	26.4%	24.0%	25.4%	25.4%

Notes:

^aHigh score=more impulse control;

- b* Number of court petitions prior to baseline interview;
- c* High score=less education;
- d* Lifetime substance use disorder (yes=1, no=0);
- e* Lifetime major depressive disorder, dysthymia, mania, or PTSD (one or more, yes=1, no=0);
- f* Total number of alcohol and drug problems;
- g* Offending variety proportion score, high score=more offending;
- h* Exposure to Violence, high=more exposure;
- i* Peer antisocial behavior, higher=more antisociality;
- j* Gang membership (yes=1, no=0);
- k* Carried a gun (yes=1, no=0);
- l* Institutionalized (yes=1, no=0);
- m* Lived with parent (yes=1, no=0).

Intercorrelations among Study Variables (N=1354)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Deceased																				
2. Non-Hispanic Caucasian ^d	-.03																			
3. African-American ^b	.05 ⁺	-.42 ^{**}																		
4. Hispanic ^c	-.06 [*]	-.36 ^{**}	-.60 ^{**}																	
5. Impulse ^d Control	.01	-.14 ^{**}	.23 ^{**}	-.10 ^{**}																
6. Prior Petitions ^e	.05 ⁺	-.08 ^{**}	.06 [*]	.00	-.08 ^{**}															
7. Parent Education ^f	-.05 ⁺	-.22 ^{**}	-.11 ^{**}	.34 ^{**}	-.00	.05 [*]														
8. Study Site ^g	-.03	.26 ^{**}	-.64 ^{**}	.40 ^{**}	-.23 ^{**}	-.03	.02													
9. Gender ^h	-.06 [*]	-.06 [*]	-.04	-.03	.01	-.17 ^{**}	-.01	.00												
10. Substance Use Disorder ⁱ	-.01	.05 ⁺	-.06 [*]	.05 ⁺	.01	-.03	.03	.02	-.02											
11. Mental Health Disorder ^j	.03	.00	-.01	.02	.04	.00	-.01	-.08	-.02	.68 ^{**}										
12. Age at Death	-	-.09	-.02	-.10	.07	.13	-.14	-.10	.11	.02	.23									
13. Days Between Interview and Death	-	-.02	.18	-.16	.24	.23	-.01	-.14	.05	.02	-.01	.43 ^{**}								
14. Substance Use Consequences ^k	.06 [*]	.15 ^{**}	-.14 ^{**}	-.02	-.11 ^{**}	-.01	-.04	.10 ^{**}	.02	.02	-.02	.23	-.10							
15. Offending ^l	.09 ^{**}	.02	-.02	-.03	-.13 ^{**}	.08 ^{**}	-.05 ⁺	.03	-.10 ^{**}	.02	.01	.01	-.13	.41 ^{**}						
16. Exposure to Violence ^m	.04	-.07 [*]	.13 ^{**}	-.09 [*]	-.01	.05 ⁺	.00	-.17 ^{**}	-.07 [*]	-.03	-.03	.21	-.08	.18 ^{**}	.50 ^{**}					
17. Peer ASB ⁿ	.08 ^{**}	-.03	.09 ^{**}	-.08 ^{**}	-.18 ^{**}	.09 ^{**}	.01	-.10 ^{**}	-.14 ^{**}	.00	.01	-.13	-.14	.31 ^{**}	.46 ^{**}	.42 ^{**}				
18. Gang Membership ^o	.07 ^{**}	-.08 ^{**}	-.07 [*]	.12 ^{**}	-.09 ^{**}	.09 ^{**}	.09 ^{**}	.16 ^{**}	-.09 ^{**}	-.03	-.03	-.05	-.11	.03	.22 ^{**}	.14 ^{**}	.14 ^{**}			
19. Gun Carrying ^p	.12 ^{**}	.02	.00	-.03	-.04	.02	-.04	.03	-.07 [*]	-.01	-.03	-.02	-.18	.12 ^{**}	.33 ^{**}	.12 ^{**}	.12 ^{**}	.03		
20. Institutionalized ^q	-.04	-.10 ^{**}	.08 ^{**}	.00	-.08 ^{**}	.24	.06 [*]	.01	-.22 ^{**}	-.05 ⁺	-.06 [*]	.15	.27 ⁺	-.05 ⁺	.03	.10 ^{**}	.06 [*]	.13 ^{**}	-.10 ^{**}	
21. Lived with Parent ^r	.05 ⁺	.03	.01	-.03	.07 ^{**}	-.12 ^{**}	-.05 ⁺	-.06 [*]	.04	.03	.06	-.43 ^{**}	-.07	.03	.01	-.00	.01	-.10 ^{**}	-.00	-.41 ^{**}

Notes:

⁺ p<.10;

^{*} p<.05;

^{**} p<.01 (two-tailed tests).

- ^aNon-Hispanic Caucasian=1, all others=0;
- ^bAfrican-Americans=1, all others=0;
- ^cHispanics =1, all others=0;
- ^dHigh score=more impulse control;
- ^eNumber of court petitions prior to baseline;
- ^fHigh score=less parent education;
- ^gPhiladelphia=1, Phoenix=2;
- ^hMale=1, female=2;
- ⁱLifetime substance use disorder (yes=1, no=0);
- ^jLifetime major depressive disorder, dysthymia, mania, or PTSD (one or more, yes=1, no=0);
- ^kTotal number of alcohol and drug problems;
- ^lOffending variety proportion score, high score=more offending;
- ^mExposure to Violence, high=more exposure;
- ⁿPeer antisocial behavior, high=more antisociality;
- ^oGang membership (yes=1, no=0);
- ^pCarried a gun (yes=1, no=0);
- ^qInstitutionalized (yes=1, no=0),
- ^rLived with parent (yes=1, no=0).

Table 3

Rare Events Logistic Regression Predicting Mortality from Study Variables

	Model 1		Model 2		Model 3	
	Coef (SE)	z	Coef (SE)	z	Coef (SE)	z
<i>DISTAL (Taken at Baseline)</i>						
Parent Education ^a	-0.253 (0.157)	-1.61			-0.245 (0.164)	-1.49
Impulse Control ^b	0.091 (0.159)	0.57			0.145 (0.160)	0.90
Gender ^c	-1.288 (0.993)	-1.30			-1.232 (0.994)	-1.24
Race ^d	0.643* (0.331)	1.94			0.754* (0.330)	2.29
Prior Petitions ^e	0.069 (0.065)	1.05			0.080 (0.068)	1.17
Substance Use Disorder ^f	0.667* (0.342)	1.95			0.585* (0.355)	1.65
Mental Health Disorders ^g	-0.061 (0.456)	-0.13			-0.022 (0.495)	-0.04
<i>PROXIMAL (Taken at Last Recall Period)</i>						
Substance Use Consequences ^h			0.035 (0.040)	0.89	0.073* (0.036)	2.02
Offending ⁱ			0.052 (1.723)	0.03	-0.665 (1.772)	-0.38
Gang membership ^j			0.996* (0.493)	2.02	1.200* (0.506)	2.37
Exposure to violence ^k			-0.017 (0.095)	-0.19	-0.01 (0.104)	-0.10
Peer ASB ^l			0.365* (0.219)	1.67	0.138 (0.229)	0.60
Gun carrying ^m			1.551* (0.564)	2.75	1.266* (0.600)	2.11
Institutionalized ⁿ			-0.172 (0.406)	-0.43	-0.388 (0.435)	-0.89
Lived with parent ^o			0.501 (0.362)	1.38	0.485 (0.392)	1.24
Constant	-1.982 (1.573)		-4.261 (0.442)		-2.74 (1.615)	

Notes:

* p<.05 (one-tailed).

^a High score=less parent education;^b high score=more impulse control;^c Male=1, female=2;

- d African-Americans=1, all others = 0;
- e Number of court petitions prior to baseline;
- f Lifetime substance use disorder (yes=1, no=0);
- g Lifetime major depressive disorder, dysthymia, mania, or PTSD (one or more, yes=1, n=0);
- h Total number of alcohol and drug problems;
- i Offending variety proportion score, high score=more offending;
- j Gang membership (yes=1, no=0);
- k Exposure to Violence, high=more exposure;
- l Peer Antisocial Behavior, high=more antisociality,
- m Carrying a gun (yes=1, no=0);
- n Institutionalized (yes=1, no=0);
- o Lived with parent (yes=1, no=0).

Table 4

Prediction of Proximal Variables from Distal Variables

	Gang Membership ^h		Substance Use Consequences ⁱ		Gun Carrying ^j	
	Coeff (SE)	z	Coeff (SE)	z	Coeff (SE)	z
Parent Education ^a	0.407 (0.137) *	2.97	-0.157 (0.100)	-1.57	-0.309 (0.175) *	-1.76
Impulse Control ^b	-0.289 (0.140) *	-2.06	-0.172 (0.105) *	-1.64	-0.287 (0.190)	-1.51
Gender ^c	-2.519 (1.016) *	-2.48	0.078 (0.279)	0.28	##	##
Race ^d	-0.293 (0.275)	-1.06	-0.786 (0.197) *	-3.97	0.140 (0.349)	.040
Prior Petitions ^e	0.075 (0.048)	1.56	-0.028 (0.044)	-0.65	0.061 (0.070)	.087
Substance Use Disorder ^f	0.638 (0.266) *	2.40	0.679 (0.203) *	3.33	-0.456 (0.370)	-1.23
Mental Health Disorder ^g	0.318 (0.310)	1.03	0.296 (0.272)	1.09	0.201 (0.474)	.043
Constant	-1.658 (1.311)		2.573 (0.664)		-1.319 (0.977)	

Notes:

* p < .05 (one-tailed). Logistic regression estimated for Gang membership and Gun carrying; OLS estimated for Substance Use Consequences;

= no females reported carrying a gun.

^a High score=less parent education;

^b High score=more impulse control;

^c Male=1, female=2;

^d African-American=1, all others=0;

^e Number of court petitions prior to baseline interview;

^f Lifetime substance use disorder (yes=1, no=0);

^g Lifetime major depressive disorder, dysthymia, mania, or PTSD (one or more, yes=1, no=0);

^h Gang membership (yes=1, no=0);

ⁱ Total number of alcohol and drug problems;

^j Carried a gun (yes=1, no=0).