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Independent predictors of mortality in adolescents ascertained for conduct disorder and substance use problems, their siblings, and community controls

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Abstract

Aims—Adolescents with conduct and substance use problems are at increased risk for premature mortality, but the extent to which these risk factors reflect family- or individual-level differences and account for shared or unique variance is unknown. The authors examined common and independent contributions to mortality hazard in adolescents ascertained for conduct and substance use problems, their siblings, and community controls, hypothesizing that individual differences in CD and SUD severity would explain unique variation in mortality risk beyond that due to clinical/control status and demographic factors.

Design—Mortality analysis in a prospective study (Genetics of Antisocial Drug Dependence Study) that began in 1993.

Setting—Multi-site sample recruited in San Diego, California and Denver, Colorado.

Participants—1,463 clinical probands were recruited through the juvenile correctional system, court-mandated substance abuse treatment programs, and correctional schools, along with 1,399 of their siblings, and 904 controls.

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Measurements—Mortality and cause-of-death were assessed via National Death Index search (released October, 2017).

Findings—There were 104 deaths documented among 3,766 (1,168 female) adolescents and young adults (average age 16.79 years at assessment, 32.69 years at death/censoring). Mortality hazard for clinical probands and their siblings was 4.99 times greater than that of controls (95% CI: 2.40 to 10.40; $p < .001$). After accounting for demographic characteristics, site, clinical status, familial dependence, and shared contributions of conduct disorder and substance use disorder, conduct disorder independently predicted mortality hazard, whereas substance use disorder severity did not.

Conclusions—Youth ascertained for conduct and substance use problems and their siblings face far greater risk of premature death than demographically similar community controls. In contrast to substance use disorder severity, conduct disorder is a robust predictor of unique variance in all-cause mortality hazard beyond other risk factors. Comprehensive psychiatric and social services are necessary to address these potentially preventable deaths among young people.

Introduction

Adolescence and early adulthood are periods of elevated risk for unnatural death; homicide, suicide, and unintentional injury accounted for 71% of the 936,000 deaths of young persons in the United States (age 15–29 years) between 1999 and 2016[1]. However, the risk of early death is not distributed evenly. American youth who engage in risk behaviors, such as substance abuse and criminal activities, are 2–9 times more likely to die prematurely than their general population counterparts[2–5], and their deaths are disproportionately caused by homicide, legal intervention, and motor vehicle accidents[2–4,6–9,5,10]. Youth with conduct- or substance-related problems (hereafter referred to as *adolescents with externalizing problems*) can often be identified through involvement in juvenile correction systems and/or placement in treatment programs; therefore, they comprise a prime target for intervention and prevention efforts. Nevertheless, our current understanding of the independent contributions of potentially modifiable risk factors for mortality hazard—information crucial to the success of such efforts—is incomplete.

Previous research has identified numerous demographic variables and individual differences that predict premature mortality among adolescents and young adults with externalizing problems, including male sex[3,4,7,11], minority ethnic status (i.e., Black/African American or Latino)[2–4,7,9,11], substance abuse[2,3,5,6,11–13], and previous criminal history[2,7,9]. These findings mirror studies of mortality in previously incarcerated individuals[14–20]. However, with few exceptions[6,11], recent studies have compared the mortality risk for youth with externalizing problems to those from retrospectively obtained population-level data rather than prospectively ascertained comparison cohorts[2–4,7,12,21–24]. Additionally, no prior study has analyzed the independent contributions of conduct disorder [CD] and substance use disorders [SUD] among legally-ascertained youth to determine hazard of premature death despite evidence of substantial psychiatric morbidity in delinquent youth populations[25] and elevated mortality risk in clinically-ascertained youth[5,11]. Further, although both genetic and environmental familial factors contribute to conduct problems and substance abuse[26–28], no study has examined whether these identified risk factors for premature death account for

independent or redundant variance beyond that explained by demographics, or whether familial effects remain salient after accounting for individual differences. In particular, it remains unclear whether severity of substance abuse increases mortality hazard after accounting for CD, a point of clinical relevance given that several researchers have suggested that further dissemination and implementation of SUD treatments will reduce mortality in youth with externalizing problems[5,13]. Finally, it is unknown whether risk for premature death is heightened among siblings of adolescents with externalizing problems, and whether any differences between clinically-ascertained youth and their siblings are evident after accounting for individual differences in CD and SUD severity.

In light of these current limitations, the present study sought to examine the independent mortality hazard conferred by previously identified risk factors. We addressed the following aims in a multi-site, longitudinal, prospective cohort study of youth ascertained for CD and SUD (clinical probands), their siblings, and matched community controls:

1. *Comparison of mortality risk and cause of death between clinical probands, their siblings, and controls.* We hypothesized that mortality risk will be highest in the clinical probands and that shared familial factors will place their siblings at elevated risk with respect to controls (though not at the level of the clinical probands). Additionally, we expected that CD- and SUD-related causes of death (e.g., homicide, legal intervention, and overdose) would account for group differences.
2. Examination of the independent and simultaneous risk for premature death conferred by CD and SUD severity, beyond demographic variables and controlling for within-family dependence, among youth with externalizing problems and community controls.

We hypothesized that individual differences in CD and SUD severity would explain unique variation in mortality risk beyond that due to clinical/control status and demographic factors.

Methods

Participants

This prospective cohort study examined a sample of youth ascertained for CD and SUD (*clinical probands*; $n = 1463$ [254 female]), their siblings ($n = 1399$ [651 female]), community controls matched to clinical proband demographics by age and sex ($n = 401$ [35 female]), and their siblings ($n = 503$ [228 female]; distinguishing between matched controls and their siblings failed to impact any of our results substantially, so we collapsed these individuals into a single designation of *controls* for clarity; results presented in Table S1 illustrate that this choice did not affect primary conclusions) participating in a study of familial transmission and genetic linkage of SUD and CD between 1993 and 2016 (Genetics of Antisocial Drug Dependence Study)[29–32]. Clinical probands were recruited from individuals currently involved in or referred to residential and outpatient treatment facilities for substance abuse and delinquency in the Denver, Colorado area ($n = 941$), from adjudicated adolescents involved in the Colorado juvenile correctional system ($n = 288$), and from two schools for troubled youth in the San Diego, California area ($n = 234$). Within the

Denver residential and outpatient treatment site, three separate rounds of ascertainment occurred following original funding and funding renewals; we treat these as separate sites in our analyses. Within the San Diego site, participants' schools were not recorded, preventing modeling efforts to account for additional dependence due to nesting of observations within institutions, though analyses excluding the San Diego site were consistent with primary results (Table S2). To be admitted to the study, clinical probands had to be judged by staff as not currently psychotic, severely developmentally delayed, suicidal, or homicidal and to have no physical illness or current intoxication which would prevent participation in treatment or evaluation.

Research staff contacted those who met eligibility requirements for the study and invited them to participate. Written consent from a parent or guardian and assent from the patient were obtained for all subjects after complete description of the study. Subjects were paid between $20 and $100 for participation, with payment increasing over time. The respective institutional review boards approved all procedures. The mortality data-collection period lasted through the end of 2016, with average an age at assessment of 16.79 years (*SD* = 2.75) and an average age at study conclusion or death of 32.69 years (*SD* = 5.04). Additional demographic information is presented in Table 1.

Measures

Demographic measures—Information regarding age, sex, race, and ethnicity was collected by self-report at enrollment.

Substance abuse/dependence—Substance use was assessed via the Composite International Diagnostic Interview-Substance Abuse Module (CIDI-SAM)[33]. The CIDI-SAM provided diagnostic data regarding the lifetime occurrence of four abuse symptoms and seven dependence symptoms on ten different drug classes (tobacco, alcohol, cannabis, cocaine, amphetamines, sedatives, opiates, PCP, hallucinogens, and inhalants), according to DSM-IV criteria[34,35]. The number of substances used on at least five separate occasions and the abuse/dependence symptom count per such substance were obtained. From this, we obtained a *substance abuse/dependence vulnerability* (SADV) index by calculating participants' average number of abuse/dependence symptoms per substance, an approach that has been shown to maximize trait heritability[32]. The decision to use SADV was made a priori. Relevant results were tested for sensitivity to this approach by repeating analyses with multiple alternative variables: the total number of abuse/dependence symptoms across substances, the maximum number of abuse/dependence symptoms for a given substance across substances, and substance-dependence diagnosis (e.g., see Table S3 for model based on dependence diagnosis); these substitutions did not influence our results and we present analyses that used SADV.

Conduct disorder—Lifetime CD symptom count was assessed using the DISC according to DSM-III-R or DSM-IV criteria depending on the time of study enrollment[36,37]. Participants were asked to answer questions about individual CD symptoms. The DSM-III-R criteria included 13 symptoms of CD, and the DSM-IV included two additional symptoms. Earlier samples using the DSM-III-R criteria (n = 916) were scored using the DSM-IV

criteria for compatibility with newer samples (with the earlier 916 participants missing scores for two items). Among clinical probands who were assessed for all DSM-IV criteria, DSM-III-R- and DSM-IV-derived symptom counts were strongly correlated ($r = 0.98$, $p < .001$). We present only results based on DSM-IV criteria.

Mortality—Mortality and cause of death data were obtained through a search of the National Death Index for all participants from the year of study enrollment through the end of 2016 (released October 2017)[38] for determination of mortality status as suggested by the National Center for Health Statistics[39]. International Classification of Disease 10 (ICD-10) classifications were hand coded as falling into eight non-mutually-exclusive categories: (non-traffic) physical accidents, medical conditions, traffic accidents, assault, suicide, substance-related incidents, legal intervention-related incidents, and firearm-related incidents[40]. For example, death due to "intentional self-harm by handgun discharge" was coded as both suicide- and firearm-related. Specific coding used was verified by a licensed physician and patterns of overlap are presented in Figure S1.

Analyses

Primary analyses were conducted using the *coxme* package[41] in the R computing environment[42]. Frailty models (also known as Cox proportional hazards models with Gaussian random effects) were used to examine the association between mortality hazard and predictor variables and covariates while controlling for dependence between siblings via a random intercept (frailty) term, among both clinical and control subjects. First, univariate frailty models were employed to (Table 2) examine the contributions of sex, sample, ethnicity, clinical/control designation, proband/sibling designation, substance/abuse dependence vulnerability, and CD symptom count to hazard of mortality. Next, multivariate frailty models (Table 3) were used to examine evidence of independent contributions of these predictors. In all models, site was included via the fixed effects of a set of orthogonal contrast codes (see Table 2 for further details). To elucidate patterns of redundancy among predictors, further analyses were conducted with several informative subsets of predictors (Table S5). Proportional hazards assumptions were validated using the *survival* package[43]. Listwise deletion was employed in primary analyses (202 participants were missing measures of SADV or CD symptoms), but possible consequences of non-random missing data were examined in supplementary sensitivity analyses (Table S4). For all models, an alpha-level of .05 was used to determine significance.

Results

Cause of death

Substance-related deaths comprised the plurality of observed deaths overall and across male and female participants, accounting for 20 of 62 deaths among clinical probands (32%), 7 of 34 deaths among their siblings (21%), and 1 of 8 deaths among controls (13%; Table 4). Traffic accidents were the second most prominent cause, accounting for 12 deaths among clinical probands (19%), 7 among their siblings (21%), and 1 among controls (13%). Violent deaths (related to suicide, assault, or legal intervention) together accounted for 26 deaths among clinical probands (42%), 10 among their siblings (31%), and 2 among controls

(26%). Note that percentages for controls are poor estimates as mortality was relatively uncommon. Additionally, three deaths classified as suicides were also classified as substance-related, as overdose was the mechanism of suicide (see Figure S1 for patterns of overlap between causes).

Univariate frailty models

After accounting for lack of independence due to family, all predictors other than site ($\chi^2(4) = 0.47$, $p = .976$) and ethnicity ($\chi^2(3) = 3.59$, $p = .309$) evidenced contributions to hazard of mortality (Table 2). Males had 2.81 times the expected hazard as females ($z = 3.56$, $p < .001$) and clinical probands had 1.95 times the expected hazard as their siblings ($z = 3.07$, $p = .002$), who in turn had 3.58 times the expected hazard as did controls ($z = 3.27$, $p = .001$). Single average symptom per substance in SADV and single symptom increases in CD were respectively associated with 1.16- and 1.18-fold increases in expected hazard ($z = 3.92$, $p < .001$; $z = 5.68$, $p < .001$).

Multivariate frailty models

Not all predictors evidenced independent contributions to hazard in models with greater saturation (Table S5). Specifically, independent contributions of SADV were not evident in any models including group or CD symptoms simultaneously (min $p = .190$). The fully saturated model (Table 3) provided evidence for independent contributions of sex ($HR = 2.09$, $z = 2.29$, $p = .020$), clinical/control contrast ($HR = 4.20$, $z = 3.32$, $p = .001$), and CD symptoms ($HR = 1.09$, $z = 2.20$, $p = .028$), but not for SADV ($HR = 0.98$, $z = -0.30$, $p = .770$) or for clinical proband/sibling contrast ($HR = 1.14$, $z = 0.47$, $p = .640$). However, siblings of clinical probands continued to evidence greater adjusted hazards than controls ($HR = 3.58$, $z = 3.21$, $p = .001$). Using total number of abuse/dependence symptoms or maximal number of abuse/dependence symptoms for any given substance not change this pattern of results (max $p = .037$ for terms associated CD symptom count, min $p = 0.54$ for terms associated with alternative substance abuse variables). Effects of site or ethnicity were not evident in any of the models (Tables 2, S5). Additionally, we conducted a series of sensitivity analyses examining possible consequences of multiple schemes of non-random missingness of baseline predictors. Our results suggested such artifacts were unlikely to have driven our primary conclusions (Table S4, Figure S2).

As we found little evidence for an independent contribution of SADV after accounting CD symptoms and additional covariates, we re-estimated the full multivariate frailty model twice, once substituting binary diagnoses of substance dependence and CD for SADV and CD symptoms, respectively (Table S3), and again including a SADV-by-CD symptoms product term in addition to their simple effects (Table S6). Results derived from the diagnosis-based model were directionally consistent with those of the primary frailty model, but with greater uncertainty regarding slope estimates. Specifically, CD diagnosis was no longer significant ($HR = 1.43$, $z = 1.29$, $p = .200$), presumably due to the reduction in power associated with dichotomizing continuous predictors and greater collinearity with the clinical versus control contrast (Table S3). There was no strong evidence of an interaction between SADV and CD symptoms ($HR = 1.01$, $z = 0.49$, $p = .330$) and simple effects were directionally consistent with the primary model excluding the interaction term (Table S6).

Discussion

The present prospective, multi-site study examined demographic and psychiatric predictors of early mortality in a sample of youth ascertained for CD and SUD, their siblings, and community controls. This study is the first to distinguish between the relative risk for premature death conferred by individual-differences versus familial factors and to examine the independent risk conferred by SADV after accounting for CD symptoms, demographic factors, and dependence due to family. In line with hypotheses, clinical probands evidenced significantly higher mortality hazard than their siblings, who in turn evidenced greater hazard than controls. Substance-related and violent causes accounted for the majority of deaths among clinical probands and their siblings, with the substance-related causes accounting for 32% of deaths among clinical probands (Table 4). Results from univariate models confirmed previous findings that male sex[3,4,7,11], conduct problems[2,7,9], and SAD[2–7,11–13] each are associated with increased mortality risk (Table 2).

Contrary to expectation, multivariate model results suggested that the risk conferred by individual differences in SADV was largely redundant with that due to CD (Tables 3, S5). That is, there was no discernible independent effect of SADV in any models accounting for CD symptoms or clinical ascertainment status, though the latter accounted for independent variance regardless of which covariates were presented in the model. However, consistent with previous findings[5,13,19,44–46], substance-related causes comprised the largest proportion of observed deaths an4d occurred disproportionately among clinical probands and their siblings vis-a-vis controls. In light of these findings, we echo previous researchers' recommendations[5,13,16] that intervention and prevention efforts include SUD treatment within a constellation treatment foci including additional psychiatric resources and social services.

Further complicating this discussion, the determination of cause of death as substance-related versus suicide is often ambiguous with respect to available evidence and misclassification errors are ubiquitous[47–49]. Some researchers have suggested that substance-related suicides are particularly likely to be erroneous classified as accidental or undetermined[48,49]. The degree to which deaths classified as physical or traffic accidents might have indirect consequences of substance use is unknown. Additional limitations to the present study include the lack of a comprehensive measure of socioeconomic status (SES), inadequate measures of race/ethnicity among multiethnic individuals (Table 1), and potential regional specificity to site locations (urban Colorado and southern California), though the first was partially mitigated by the inclusion of familial random intercepts and there was no evidence of site differences among our samples. Furthermore, the contrasts between clinical probands and their siblings may have reflected ascertainment procedures rather than individual differences. That is, it is possible that the elder or younger siblings of probands might have themselves been ascertained as probands had ascertainment occurred at a different date. Additionally, as the present study focused on individuals ascertained specifically for severe externalizing behaviors, their siblings, and community controls, the extent to which our results might generalize to individuals with moderate externalizing problems is unclear. That is, our results concerning the independent risk attributable to substance versus conduct problems might not generalize to youth with subclinical

externalizing problems or who avoid legal or clinical attention. Further, our results do not reflect the diagnostic criteria currently employed in the DSM-5, though we are skeptical that employing DSM-V criteria would have dramatically altered our results; symptoms for CD remained unchanged and substance abuse/dependence symptoms saw only the replacement of the legal troubles criterion with a craving criterion[50,51]. The utility of the callous-unemotional traits CD subtype specifier in predicting premature mortality remains unknown. Lastly, the National Death Index search likely failed to identify some deceased participants; a family member reported the death of one participant that our search did not identify as deceased. In the present study, the full name and date-of-birth were available for all participants, and social security numbers were available for a subset of participants. Previous research suggests that the sensitivity and specificity of NDI searches are above 90% even for those missing social security numbers[52]. However, whether these estimates generalize to samples with relatively high incidences of unnatural death early in life is unknown.

The degree to which forensic artifacts surrounding cause-of-death classification account for the incidence of substance-related deaths among clinically- and legally-ascertained youth comprises a prime target for future research efforts. Additionally, future work should examine the independent contributions of SUD and CD to premature mortality in the context of thorough measures of SES. Finally, we wish to caution that though it remains unclear which domains comprise the most pressing target for intervention and prevention efforts (e.g., targeting SUD versus general psychiatric care), it is clear that youth identified with conduct problems are at extreme risk for premature mortality and in critical need of greater resources.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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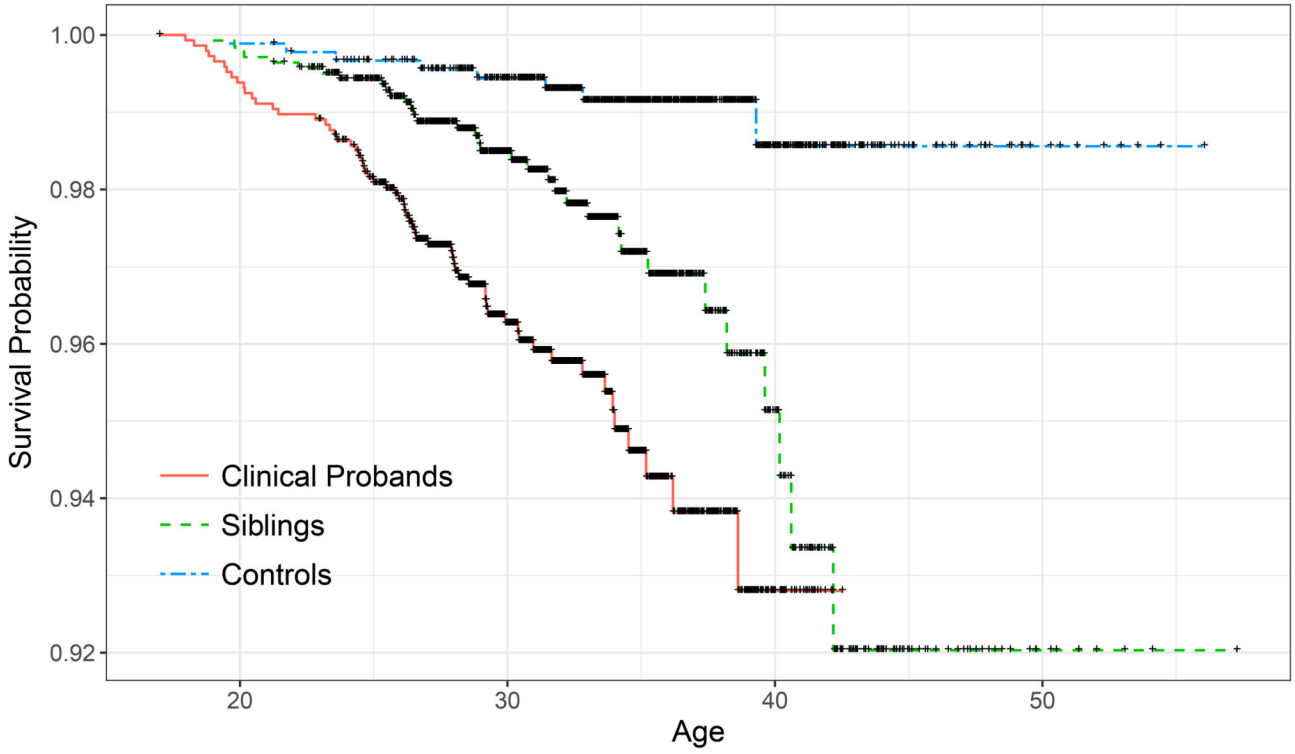

	20	25	30	35	40	45	50	55
Probands	1450	1401	883	296	35	0	0	0
Siblings	1018	1167	814	321	99	22	4	1
Controls	736	800	748	432	124	25	8	1

Figure 1.

Observed mortality among clinical probands, their siblings, and controls

Note. Black cross marks indicate censoring and the bottom table indicates the number of participants per group at each age. Mortality hazard differed by group after accounting for dependence due to family ($\chi^2(2) = 39.53$, $p < .001$). For additional contrasts see Table 2.

Table 1

Participant characteristics

	Clinical Probands	Siblings**	Controls
Sample size	1463	1399	904
Sex [percent female]	254 [17.36%]	651 [46.53%]	263 [20.09%]
*Race/Ethnicity**			
African-American	119 [8.13%]	81 [5.79%]	47 [5.12%]
Non-Latino Caucasian	605 [41.35%]	476 [33.81%]	386 [42.70%]
Multi-ethnic	233 [15.93%]	181 [12.94%]	257 [28.43%]
Other/Unreported	506 [34.59%]	661 [47.25%]	214 [23.67%]
Age at ascertainment†	16.33 [1.29]	17.50 [3.45]	16.50 [3.17]
Age at death or at end of observation period†	31.49 [4.22]	32.17 [5.31]	35.44 [4.82]
Lifetime conduct disorder symptoms at ascertainment†‡	5.36 [2.85]	2.51 [2.40]	1.31 [1.77]
Lifetime conduct disorder diagnosis at ascertainment‡	1198 [64.34%]	508 [27.28%]	156 [8.38%]
*Substance Dependence diagnosis ascertainment**	1127 [70.44%]	409 [25.56%]	64 [4.00%]
Total substance abuse/dependence symptoms across substance at ascertainment†	17.51 [12.32]	6.71 [9.75]	1.32 [3.33]
Number of substances used > 5 times at ascertainment†	3.92 [1.94]	2.24 [2.00]	1.06 [1.48]
Substance abuse/dependence vulnerability index at ascertainment†	4.23 [2.09]	1.70 [1.80]	0.53 [1.08]

Note: *Total substance abuse/dependence symptoms* reflects the sum of symptom counts for multiple substances. *Substance abuse/dependence vulnerability index* reflects the total symptom count divided by the number of substances used greater than five times.

* Number [percent of sample]

** *Siblings* indicates siblings of clinical probands

† Mean [standard deviation]

‡ Participants aged 18 or above at assessment were assessed for conduct disorder symptoms retrospectively.

Table 2

Univariate frailty models

	HR	**95% CI**	***SE*$_\beta$**	***z*/χ^2**	**df**	***p***
Site[*]	–	–	–	.470	4	.976
Sex	2.81	1.59 – 4.95	0.29	3.56	–	< .001
Ethnicity	–	–	–	3.59	3	.309
Clinical Probands vs. Clinical Siblings[†]	1.95	1.27 – 2.98	0.22	3.07		.002
Clinical Probands vs. Controls[†]	6.97	3.30 – 14.74	0.38	5.08	–	< .001
Clinical Siblings vs. Controls[†]	3.58	1.64 – 7.79	0.40	3.27	–	.001
Clinical Probands and Siblings vs. Controls[†]	4.99	2.40 – 10.40	0.37	4.30	–	< .001
Substance Abuse/Dependence Vulnerability[‡]	1.16	1.08 – 1.26	0.04	3.92	–	< .001
Conduct Disorder Symptoms[‡]	1.18	1.12 – 1.25	0.03	5.68	–	< .001

Note: Each row represents a separate frailty model estimating the contribution of the predictor to mortality hazard on the multiplicative scale while accounting for dependence due to family.

[*] Probands recruited from residential and outpatient treatment facilities for substance abuse and delinquency in the Denver, Colorado area were ascertained in the context of three separate waves of funding, each of which was treated as a separate site in case of cohort-specific differences, resulting in five total sites and four orthogonal contrasts.

[†] Group variables were estimated using orthogonal codes together in a single analysis of deviance ($\chi^2(2) = 39.53$, $p < .001$). We present four contrasts of interest above, though only two contrasts are identifiable in the context of a single model.

[‡] Slopes are unstandardized and are to be interpreted relative to unit increases in average abuse/dependence symptoms per substance and in total symptom counts for substance abuse/dependence vulnerability and conduct disorder symptoms, respectively.

Table 3

Full multivariate frailty model

	HR	95% CI	SE_{β}	z/χ^2	df	$GVIF^{1/2df}$	*p*
Site[*]	–	–	–	4.77	4	1.06	.323
Sex	2.09	1.11 – 3.92	0.32	2.29	–	1.07	.020
Ethnicity	–	–	–	1.87	3	1.07	.599
Clinical Probands vs. Clinical Siblings	1.14	0.65 – 2.01	0.29	0.47	–	1.29	.640
Clinical Probands and Siblings vs. Controls	4.20	1.80 – 9.79	0.43	3.32	–	1.16	.001
Substance Abuse/Dependence Vulnerability[†]	0.98	0.89 – 1.09	0.05	−0.30	–	1.25	.770
Conduct Disorder Symptoms[†]	1.09	1.01 – 1.18	0.04	2.20	–	1.23	.028

Note: Fully saturated frailty model estimating the simultaneous independent contributions of the predictors to mortality hazard on the multiplicative scale while accounting for dependence due to family. $GVIF^{1/2df}$ (generalized variance inflation factor) is a linear indicator of multicollinearity of predictors; greater values indicate greater collinearity with other predictors[53].

[*]Probands recruited from residential and outpatient treatment facilities for substance abuse and delinquency in the Denver, Colorado area were ascertained in the context of three separate funding efforts, each of which was treated as a separate site in case of cohort-specific differences.

[†]Slopes are unstandardized and are to be interpreted relative to unit increases in average abuse/dependence symptoms per substance and in total symptom counts for substance abuse/dependence vulnerability and conduct disorder symptoms, respectively.

Table 4

Cause of death by group and by sex

	Cause of Death									
	Substance related	***Traffic related***	***Suicide***	***Assault***	***Medical Condition***	***Firearm***	***Non-traffic Physical Accident***	***Legal Intervention***	***Unspecified***	***Totals (non-overlapping)***
Group										
Clinical Probands	20	12	13	12	3	6	3	1	1	62
Clinical Probands' Siblings	7	7	4	3	10	4	0	3	0	34
Controls	1	3	2	0	1	1	1	0	0	8
Sex										
Female	5	3	0	2	4	0	0	0	0	14
Male	23	19	19	13	10	11	4	4	1	90
Totals per cause	28	22	19	15	14	11	4	4	1	104

Note: Observed cause-of-death information as reported by the National Death Index split by group and by sex. Causes were established by categorizing International Disease Classification 10 codes and were verified by a licensed physician. Not all categories were mutually exclusive; for example, death due to "intentional self-harm by handgun discharge" was coded as both suicide- and firearm-related. Patterns of overlap are presented in Figure S1.