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Adolescents with Elevated Psychopathic Traits are Associated with an Increased Risk for Premature Mortality

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Abstract
The mortality rate among adolescents has been steadily increasing in recent years. Researchers have previously identified forms of externalizing psychopathology measured during adolescence associated with an increased risk for premature mortality, including attention-deficit/hyperactivity disorder (ADHD), substance use disorders (SUDs), oppositional defiant disorder (ODD), and conduct disorder (CD). The current study investigated whether additional personality traits (i.e., adolescent psychopathic traits, assessed via the Hare Psychopathy Checklist: Youth Version [PCL:YV]) were also associated with premature mortality risk among maximum-security incarcerated adolescents ($N = 332$). During a follow-up period ranging from 10 to 14 years, premature mortality was observed in $n = 33$ participants (9.94%), a mortality rate nearly ten times higher than population norms. We observed that adolescents scoring the highest on PCL:YV total scores exhibited significantly higher rates of premature mortality compared to adolescents scoring lower on PCL:YV total scores via Fisher's exact tests. Additionally, through univariate Cox proportional hazard regression analyses, PCL:YV total, Factor 2 (measuring lifestyle/behavioral and antisocial/developmental psychopathic traits), Facet 1 (measuring interpersonal psychopathic traits), and Facet 3 (measuring lifestyle/behavioral psychopathic traits) scores were associated with faster time to premature mortality. In supplemental analyses performed, we observed that adolescents meeting criteria for externalizing psychopathology (i.e., ADHD, SUDs, ODD, and CD) did not exhibit higher rates of premature mortality compared to control participants. The current study therefore identifies additional maladaptive personality traits to consider in relation to premature mortality risk (i.e., psychopathic traits) among a high-risk sample of incarcerated adolescents.

Keywords Adolescent psychopathic traits · Mortality · Risky behavior · Incarceration · Impulsivity

Introduction

Adolescence is a developmental period occurring between the ages of ten and 24, characterized by substantial changes across behavioral, cognitive, neurobiological, and social domains (Sawyer et al., 2018). This developmental period is characterized by increased risk-taking behavior (e.g., engaging in activities where the outcome, either positive or negative, is unknown; Crone et al., 2016). Positive forms of risk-taking include initiating friendships or trying new experiences (e.g., trying out for sports teams) (Duell & Steinberg, 2021). Such positive forms of risk-taking are considered normative and adaptive, allowing for identity exploration and increased autonomy, easing the transition to adulthood (Dworkin, 2005).

Negative forms of risk-taking also occur during adolescence, including engaging in nicotine, alcohol, or illicit substance use (Cavallo & Krishnan-Sarin, 2019; Feldstein & Miller, 2006), unprotected sexual activity (Irwin & Shafer, 2021), and hazardous driving (Romer et al., 2014). Adolescents often pursue novel, exciting, and dangerous forms of risk-taking, with little consideration of the potential consequences and risks associated with such actions (e.g., developing substance use disorders [SUDs], unwanted

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pregnancies, and sexually transmitted infections). Negative forms of risk-taking are also associated with fatal events leading to premature mortality, including motor vehicle crashes, unintentional injuries, homicide, suicide, and drug overdoses (Fielgelman & Gorman, 2010; Heron, 2017; Kochanek et al., 2019).

Premature mortality among adolescents represents a significant public health concern, with rates steadily increasing in recent years. For example, between 2019 and 2020, injury-related mortality increased by 22.6%, death by homicide increased by 39.1%, and deaths from drug overdoses increased by 113.5% among adolescents (Woolf et al., 2023). Researchers have attempted to identify personality traits associated with an increased risk for premature mortality. For example, longitudinal studies have observed that adolescents who meet criteria for various forms of externalizing psychopathology exhibit higher rates of future premature mortality, including neurodevelopmental disorders (e.g., attention-deficit/hyperactivity disorder [ADHD]) (Scott et al., 2017; Sun et al., 2019; Warrilow et al., 2021), SUDs (Border et al., 2018; Chassin et al., 2013; Scott et al., 2017), and disruptive behavior disorders (e.g., oppositional defiant disorder [ODD] and conduct disorder [CD]) (Border et al., 2018; Maughan et al., 2014; Scott et al., 2017; Warrilow et al., 2021). These forms of externalizing psychopathology are highly comorbid with one another (Conner & Lochman, 2010; Gnanavel et al., 2019; Schubiner, 2000), sharing common symptomatology including impulsivity (Dougherty et al., 2007; Gullo & Dawe, 2008; Winstanley et al., 2006), aggression (Doran et al., 2012; Farrington, 2004; Retz & Rosler, 2009), and antisocial behavior (Frick, 1998; McAdams et al., 2012; McKay & Halperin, 2001).

Surprisingly, previously published studies have not investigated whether adolescents with elevated psychopathic traits are associated with an increased risk for premature mortality. Adolescents with elevated psychopathic traits are characterized by higher externalizing psychopathology symptomatology, including ADHD (Kaplan & Cornell, 2004; Kosson et al., 2002), SUDs (Sakki et al., 2023), and CD/ODD (Kosson et al., 2002; Forth et al., 2003). However, adolescents with elevated psychopathic traits are also characterized by unique symptomatology not commonly shared with forms of externalizing psychopathology. Psychopathic traits are commonly assessed among adolescents using the Hare Psychopathy Checklist: Youth Version (PCL:YV; Forth et al., 2003). Factor analyses of the PCL:YV reveal a two-factor and four-facet structure, with Factor 1 consisting of interpersonal psychopathic traits (e.g., Facet 1 traits, including pathological lying and conning and manipulative behavior) and affective psychopathic traits (e.g., Facet 2 traits, such as a lack of empathy, guilt, and remorse) and Factor 2 consisting of lifestyle/behavioral (e.g., Facet 3 traits, including impulsivity and irresponsibility) and antisocial/developmental (e.g., Facet 4 traits, such as juvenile delinquency and early behavioral problems) psychopathic traits (Forth et al., 2003; Kosson et al., 2013; Neumann et al., 2006; Sevecke et al., 2009). PCL:YV Factor 2 traits show strong overlap with externalizing psychopathology (e.g., impulsivity and antisocial behavior); as such, PCL:YV Factor 2 scores should be associated with an increased risk for premature mortality. However, PCL:YV Factor 1 scores may also contribute to premature mortality risk.

Items included within PCL:YV Facet 2, often referred to as callous-unemotional (CU) traits, are now included within the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, Text Revision (DSM-5-TR) as a limited prosocial emotion (LPE) specifier for CD (American Psychiatric Association, 2022). By identifying adolescents meeting criteria for CD with significant affective dysfunction, clinicians can improve upon their ability to identify youth at significant risk for future antisocial behavior (Frick et al., 2014; Kimonis et al., 2015). However, it is currently not known whether CU/affective psychopathic traits contribute to premature mortality risk, as previous studies investigating the association between CD and premature mortality have incorporated previous DSM-III or DSM-IV criteria for assessing CD (Border et al., 2018), which do not assess adolescent psychopathic traits included within the LPE specifier. Furthermore, Warrilow et al. (2021) suggest that additional PCL:YV Factor 1 traits may be important to consider in relation to premature mortality risk. Specifically, this study observed that the symptom "lies often" from the Rutter Behaviour Questionnaire (RBQ; Rutter, 1967) was associated with risk for premature mortality. Lying is a symptom included within the DSM-5-TR criteria for CD (APA, 2022), but is also measured via item four of the PCL:YV (i.e., pathological lying), which is included in both PCL:YV Factor 1 and Facet 1 (Forth et al., 2003).

PCL:YV Factor 1 scores may additionally relate to higher premature mortality risk when considered in tandem with PCL:YV Factor 2 scores (i.e., individuals scoring high on both PCL:YV Factor 1 and Factor 2, or PCL:YV total scores). For example, adolescents scoring high on both interpersonal/affective and lifestyle/antisocial psychopathic traits are believed to represent adolescents at highest risk for significant behavioral problems and future antisocial behavior (Allen et al., 2024; Andershed et al., 2018; Braga et al., 2023; Vincent et al., 2008). In fact, adolescents with elevated psychopathic traits are associated with increased rates of future antisocial behavior, even when controlling for childhood behavioral problems (Virtanen et al., 2022). Adolescents scoring highest on psychopathic traits are believed to represent life-course persistent antisocial offenders (Corrado et al., 2015; Lussier et al., 2022; Moffitt et al., 2002;

Piquero et al., 2012), reflecting a subset of adolescents who continue to engage in criminal activity throughout their life (DeLisi, 2005; Vaughn et al., 2011). Compared to adolescent-limited offenders, life-course persistent offenders are more likely to die prematurely, largely relating to unnatural reasons (e.g., homicide or accidents; Zane et al., 2019).

Therefore, beyond the contribution of PCL:YV Factor 2 scores alone, which share considerable variance with forms of externalizing psychopathology, adolescents scoring high on both PCL:YV Factor 1 and Factor 2 (i.e., PCL:YV total scores) should be associated with higher premature mortality rates compared to adolescents characterized by lower PCL:YV total scores. Supporting this notion, adult men (Vaurio et al., 2018) and adult women (Vaurio et al., 2022) scoring high on the PCL-R (i.e., a PCL-R total score 25 or above) exhibited higher rates of premature mortality compared to participants scoring below 25 on the PCL-R total score. Vaurio et al. (2018) also observed that adult men scoring low on the PCL-R were more likely to die from natural causes (e.g., cardiovascular disease and cancer), whereas adult men scoring high on the PCL-R primarily died due to unnatural causes (e.g., homicide or traffic accidents). However, our understanding of the association between psychopathic traits and premature mortality risk remains limited to these previous studies with adults (Vaurio et al., 2018, 2022).

Here, we investigated the association between psychopathic traits (assessed via the PCL:YV; Forth et al., 2003) and risk for premature mortality among adolescents recruited from a maximum-security juvenile correctional facility. The current study incorporated two separate analytical approaches. First, we investigated whether adolescents scoring the highest on PCL:YV total scores were associated with higher rates of premature mortality compared to adolescents with low PCL:YV scores via Fisher's exact tests. We hypothesized that adolescents scoring the highest on baseline PCL:YV total scores (i.e., adolescents scoring high on both PCL:YV Factor 1 and Factor 2) would exhibit higher rates of premature mortality compared to participants scoring lower on PCL:YV total scores, consistent with previous studies with adults (Vaurio et al., 2018, 2022). Additionally, we investigated whether PCL:YV total, factor, and facet scores were associated with faster time to premature mortality via univariate Cox proportional hazard regression analyses. We specifically hypothesized that PCL:YV total, Factor 2, and Facet 3 scores would be associated with faster time to premature mortality. Finally, in supplemental analyses, we investigated whether participants meeting criteria for externalizing psychopathology (e.g., ADHD, SUDs, ODD, and CD) exhibited higher rates of premature mortality compared to participants who did not meet criteria for externalizing psychopathology via Fisher's exact tests. These additional analyses were performed, to ensure that results obtained in the present study specifically related to adolescent psychopathic traits, rather than externalizing psychopathology more generally.

Method

Participants

Incarcerated adolescents were recruited from a maximum-security juvenile correctional facility to participate in a research study funded by R01 MH071896 (PI: Kiehl). Data collection occurred from the years 2007 to 2011 and study participants completed multiple clinical assessments and neuroimaging tasks as part of this research study. In total, $N = 498$ participants (420 males, 78 females) were enrolled, together forming the SouthWest Advanced Neuroimaging Cohort – Youth (SWANC-Y) sample. During the original consent session, individuals 18 years of age or older provided written informed consent and individuals younger than 18 years of age provided written informed assent in conjunction with their parent or guardian's informed consent. Participants were informed of their right to terminate participation at any point and were compensated at a rate consistent with the hourly labor wage of the juvenile correctional facility. Participants additionally provided extensive demographic information (e.g., full legal name, date of birth [DOB], social security number) to allow for our research team to perform longitudinal follow-ups, with the goal to identify variables assessed during original data collection predictive of future outcomes.

Longitudinal data, including current location and/or incarceration status, for these former SWANC-Y study participants was additionally obtained by a grant awarded by the National Institute of Child Health and Human Development (R01 HD092331; PI: Kiehl). As part of this new grant, former study participants were re-contacted either through phone calls (i.e., either directly to the participant or through designated family members and/or friends), messages through social media websites, postcards mailed to their last known address, federal/state/county offender search sites, state court case sites, and/or direct, in-person contact at correctional facilities in the state of New Mexico. After successful re-contact, individuals were asked whether they would like to participate in a follow-up study, in which they would complete the same assessment battery and neuroimaging protocol they previously completed as adolescents. For participants that we were not able to successfully re-contact, multiple research coordinators assessed whether individuals had died since their original participation through a variety of avenues, including direct contact

with designated family members or friends by phone, posts and/or comments provided on social media websites, articles or stories posted by news stations, obituary searches (i.e., through Google, Newspapers.com premium account, FindAGrave.com, and/or social media posts by designated family members or friends), or court cases noting that participants were deceased in proceedings notes. An electronic manual of procedures outlined these aforementioned steps to identify mortality status, which was followed by all research staff when determining former study participant's mortality status. In order to verify the individual's identity, we compared information from these sources to other matching identifiers, including full legal name or DOB. It was determined that $n=45$ (40 males, 5 females) out of $N=498$ former study participants had died since their original participation, representing a mortality rate of 9.04% during a 10- to 14-year follow-up period. All research protocols were approved by multiple IRBs, including the Ethical and Independent Review Services, the Office for Human Research Protections, and the New Mexico Corrections Department.

For the current study, analyses were restricted to $N=332$ [1] former study participants (277 males and 55 females[2]) who previously completed the PCL:YV assessment while incarcerated as adolescents. While $N=498$ participants were originally consented to the research study, $n=165$ participants did not previously complete the PCL:YV, due to reasons ranging from unannounced facility transfers, early releases, and disciplinary actions resulting in ineligibility to continue to participating in research[3]. Study participants ranged from 14.15 to 19.98 years of age ($M=17.77$ years, $SD=1.09$ years) at the time of PCL:YV data collection. Participants self-identified as American Indian or Alaskan Native ($n=43$), Black or African American ($n=18$), Native Hawaiian or other Pacific Islander ($n=1$), White ($n=201$), or more than one race ($n=12$); $n=57$ participants chose not to self-disclose their race. Additionally, $n=244$ participants self-identified as Hispanic or Latino, $n=83$ participants self-identified as not Hispanic or Latino, and $n=5$ participants chose not to self-disclose their ethnicity. Mortality status did not significantly differ regarding self-identified race or ethnicity categories (more details are provided in our Supplemental Material). There was at least one contact attempt made for all participants in this study ($N=332$), using at least one of the previous methods mentioned above (i.e., phone call, postcards, checking jail/prison rosters, etc.). In this sample, $n=299$ participants (90.06%) were able to be successfully re-contacted; for those that we were not able to re-contact, an obituary search was performed. Overall, $n=33$ (30 males, 3 females) study participants were verified to have died during the 10- to 14-year follow-up period, representing a mortality rate of 9.94%. This mortality rate is nearly ten times the expected mortality rate for individuals of comparable age (i.e., <1% of individuals 25 to 33 years of age, Social Security Administration, 2024). Additionally, this observed mortality rate is considerably higher compared to previously published studies describing the association between externalizing psychopathology and mortality for individuals of comparable age (e.g., 2.8% among all study participants, 4.2% among clinical probands of adolescents involved in the juvenile justice system; Border et al., 2018). These results suggest that a significant portion of our sample was characterized by an unfortunate, premature loss of life.

Assessments

Adolescent psychopathic traits were assessed using the PCL:YV (Forth et al., 2003), an expert-rater assessment incorporating both a semi-structured interview and review of collateral information, including institutional file review. Each of the 20 items of the PCL:YV are scored based on the following three-point scale: *zero* (does not apply to the individual), *one* (somewhat applies to the individual), or *two* (definitely applies to the individual). PCL:YV total scores can potentially range from zero to 40; the mean PCL:YV total score in the current sample was 23.38 ($SD=6.09$, range: 2–36, $\alpha=0.83$). The inter-rater reliability of the PCL:YV was assessed using intraclass correlation coefficients (ICC), which were calculated using a two-way, random effects model on average measures, with absolute agreement. Thirty-one participants (9.3% of the sample) had double-rated PCL:YV interviews completed, with excellent agreement observed between raters for PCL:YV total scores (ICC = 0.96, $p<.001$).

In addition to PCL:YV total scores, we investigated whether PCL:YV factor and facet scores were associated with premature mortality risk. In the full sample, PCL:YV Factor 1 scores ranged from zero to 15 ($M=6.66$, $SD=3.11$, $\alpha=0.73$) and PCL:YV Factor 2 scores ranged from one to 20 ($M=14.60$, $SD=3.20$, $\alpha=0.72$). Additionally, the mean PCL:YV Facet 1 score was 2.24 ($SD=1.87$, range: 0–7, $\alpha=0.67$), the mean PCL:YV Facet 2 score was 4.42 ($SD=1.84$, range: 0–8, $\alpha=0.62$), the mean PCL:YV Facet 3 score was 6.34 ($SD=2.00$, range: 0–10, $\alpha=0.62$), and the mean PCL:YV Facet 4 score was 8.26 ($SD=1.66$, range: 0–10, $\alpha=0.56$). See

[1] In total, $N=333$ participants completed the PCL:YV; however, one participant was excluded from the current study as they served a continuous correctional sentence from adolescence to adulthood. As this participant did not have a release date to include in Cox proportional hazard regression analyses, this participant was excluded from subsequent analyses.

[2] Fisher's exact test indicated that male and female participants did not significantly differ with respect to premature mortality rate, $p=.324$.

[3] An additional Fisher's exact test indicated that the mortality rate among former study participants who previously completed the PCL:YV ($n=33$ out of $N=332$ participants, 9.94%) was not significantly higher than former study participants who did not previously complete the PCL:YV ($n=12$ out of 165 study participants, 7.27%), $p=.205$.

Table 1 Descriptive Statistics for PCL:YV Total, factor, and facet scores

Variable	All Participants	Male Participants	Female Participants	*t*	*p*-value
PCL:YV Total	23.38 (6.09)	23.45 (6.06)	23.07 (6.27)	0.41	0.680
PCL:YV Factor 1	6.66 (3.11)	6.63 (3.06)	6.82 (3.41)	-0.43	0.670
PCL:YV Factor 2	14.60 (3.20)	14.57 (3.24)	14.79 (3.01)	-0.47	0.642
PCL:YV Facet 1	2.24 (1.87)	2.18 (1.85)	2.58 (1.96)	-1.47	0.142
PCL:YV Facet 2	4.42 (1.84)	4.45 (1.79)	4.25 (2.12)	0.74	0.460
PCL:YV Facet 3	6.34 (2.00)	6.29 (2.02)	6.58 (1.95)	-0.96	0.340
PCL:YV Facet 4	8.26 (1.66)	8.27 (1.68)	8.21 (1.55)	0.23	0.819

Note: Table 1 reports mean PCL:YV total, factor, and facet scores for all participants ($N=332$), male participants ($n=277$), and female participants ($n=55$). Mean PCL:YV scores for each sample are presented with standard deviations entered in parentheses. Independent samples *t*-tests indicated that male and female participants did not significantly differ with respect to any PCL:YV scores. PCL:YV refers to the Hare Psychopathy Checklist: Youth Version (PCL:YV; Forth et al., 2003). Factor 1 refers to interpersonal (Facet 1) and affective (Facet 2) psychopathic traits and Factor 2 refers to lifestyle/behavioral (Facet 3) and antisocial/developmental (Facet 4) traits (Forth et al., 2003; Kosson et al., 2013; Neumann et al., 2006; Sevecke et al., 2009)

Table 1 for full descriptive statistics for all PCL:YV scores. Inter-rater reliability was assessed for PCL:YV factor and facet scores, with excellent agreement observed between raters for PCL:YV Factor 1 (ICC = 0.93, $p<.001$), Factor 2 (ICC = 0.91, $p<.001$), and Facet 2 scores (ICC = 0.90, $p<.001$) scores and good agreement observed between raters for PCL:YV Facet 1 (ICC = 0.87, $p<.001$), Facet 3 (ICC = 0.87, $p<.001$), and Facet 4 (ICC = 0.87, $p<.001$) scores.

We also assessed externalizing psychopathology via the Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS; Kaufman et al., 1997), specifically investigating whether participants met criteria for ADHD, SUDs, ODD, or CD. In total, 324 participants completed the KSADS. Overall, $n=24$ participants (7.4%) met criteria for ADHD, $n=97$ participants (29.9%) met criteria for ODD, $n=284$ participants (87.7%) met criteria for a SUD, and $n=308$ participants (95.1%) met criteria for CD. Full Fisher's exact tests comparing mortality rates between externalizing psychopathology groups can be found in our Supplemental Material.

Data Analysis

First, we investigated whether participants scoring the highest on baseline PCL:YV total scores exhibited higher premature mortality rates compared to participants scoring lower on baseline PCL:YV total scores. Here, we incorporated two different operational definitions of high- and low-scorers. First, we incorporated a median split of baseline PCL:YV total scores, with $n=168$ participants scoring 24 or above on the PCL:YV total score (i.e., high-scorers) and $n=164$ participants scoring 23 or below on the PCL:YV total score (i.e., low-scorers). Next, we identified high-scorers in a manner consistent with the criteria used for adult psychopathy (i.e., individuals scoring one standard deviation above the sample mean for PCL-R total scores, or individuals with a PCL-R total score ≥ 30; Hare, 2003). Based on this criteria, $n=60$ participants scored one standard deviation above the sample mean, with those scoring 30 or above on the PCL:YV total score being considered high-scorers, and low-scorers included $n=272$ participants scoring 29 or below on the PCL:YV total score. Fisher's exact tests were performed to identify whether high- and low-scorers (using two different operational definitions) significantly differed with respect to premature mortality rates. Additionally, we investigated whether baseline PCL:YV total, factor, and facet scores were associated with time to premature mortality via univariate Cox proportional hazard regression analyses[4]. In supplemental analyses performed, we investigated (with Fisher's exact tests) whether participants who met criteria for ADHD, SUDs, ODD, and CD exhibited higher premature mortality rates compared to control participants. Fisher's exact tests were analyzed using IBM SPSS Statistics version 20 (IBM Corp., 2011) and Cox proportional hazard regressions were analyzed using the survival package (Therneau et al., 2020) available in RStudio.

All analyses incorporated one-tailed statistical tests, given previous research suggesting psychopathic traits are associated with risk for premature mortality (Vaurio et al., 2018, 2022). Furthermore, results presented did not correct for multiple comparisons, to be consistent with these previously published studies. For transparency however, we denote results surviving a Bonferroni multiple comparison correction with footnotes.

Results

Cause of Death for Former Study Participants

Consistent with previous research (Vaurio et al., 2018; Zane et al., 2019), former study participants largely died due to

[4] Univariate, rather than multivariate, Cox proportional hazard regression analyses were performed given significant correlations observed between PCL:YV factor and facet scores (see our Supplemental Material). Univariate statistical tests were incorporated to avoid statistical issues related to significantly correlated variables (e.g., multicollinearity, regression instability, and/or potential suppression effects), which may further convolute our understanding regarding the association between adolescent psychopathic traits and premature mortality risk.

Table 2 Mortality Rates Among Participants Scoring High and Low on PCL:YV Total Score

	Results Using Median Split of PCL:YV Total			Results Using Criteria Consistent With Adult Psychopathy		
	Low-Scorers	High-Scorers	Total Participants	Low-Scorers	High-Scorers	Total Participants
Number of Deceased Participants	10	23	33	22	11	33
Number of Comparison Participants	154	145	299	250	49	299
Total Participants	164	168	332	272	60	332

unnatural and preventable reasons. Participants died from being involved in car accidents ($n=2$), drug overdoses ($n=1$), deleterious health issues associated with prolonged substance use ($n=1$), exposure to elements ($n=1$), homicide ($n=15$), wrongful death while incarcerated ($n=1$), and suicide ($n=6$). Notably, the majority of participants who died due to homicide were killed during the commission of a crime, including being shot by police officers. For the remaining $n=6$ participants who died during the 10- to 14-year follow-up period, cause of death was not readily available. All causes of death, both known and unknown, were collapsed into a single mortality category, consistent with previously published studies (Border et al., 2018; Vaurio et al., 2018, 2022; Zane et al., 2019). Cause of death was recorded in a number of ways, including directly from family members and friends via phone calls, articles and news stories detailing cause of death, obituary details, court case notes, and social media posts and/or comments about former study participants. Each individual's identity was verified from these sources using matching identifiers (e.g., full legal name, DOB).

Fisher's Exact Tests: Adolescent Psychopathic Traits

With Fisher's exact tests performed, we investigated whether adolescents who scored the highest on baseline PCL:YV total scores (i.e., adolescents scoring high on both PCL:YV Factor 1 and 2) exhibited higher rates of premature mortality compared to participants scoring lower on baseline PCL:YV total scores. Two separate analyses were performed, one incorporating a median split of baseline PCL:YV total scores, and another identifying PCL:YV high-scorers in a manner consistent with adult psychopathy (Hare, 2003).

When identifying high- and low-scorers via a median split of baseline PCL:YV total scores, high-scorers were determined to be to participants scoring 24 or above on baseline PCL:YV total scores ($n=168$, range: 24–36) and low-scorers included participants scoring 23 or below on baseline PCL:YV total scores ($n=164$, range: 2–23). Using this split, 23 out of 168 participants scoring 24 or above on baseline PCL:YV total scores died during the follow-up period, representing a mortality rate of 13.7%, compared to 10 out of 164 participants scoring 23 or below on baseline PCL:YV total scores, representing a mortality rate of 6.1%. Fisher's exact test indicated this reflected a significant group difference ($p=.016$), with high-scorers exhibiting higher rates of premature mortality compared to low-scorers (see Table 2).

Table 3 Cox Proportional hazard regression analyses predicting time to mortality

Variable	β	Hazard Ratio	95% CI for Hazard Ratio	Wald	*p*-value
PCL:YV Total	0.07	1.08	1.01–1.14	5.59	0.009*
PCL:YV Factor 1	0.09	1.09	0.98–1.22	2.58	0.054
PCL:YV Factor 2	0.14	1.15	1.01–1.31	4.60	0.016*
PCL:YV Facet 1	0.15	1.16	0.97–1.37	2.76	0.048*
PCL:YV Facet 2	0.10	1.10	0.91–1.34	1.03	0.156
PCL:YV Facet 3	0.23	1.25	1.04–1.51	5.51	0.009*
PCL:YV Facet 4	0.16	1.17	0.92–1.50	1.60	0.103

Note: Univariate Cox proportional hazard regressions were run, investigating whether PCL:YV scores were associated with faster time to premature mortality. Table 2 presents results from these analyses, whereby each PCL:YV score was entered independently, without the influence of other PCL:YV scores or covariate measures. PCL:YV total, Factor 2, Facet 1, and Facet 3 scores were associated with faster time to premature mortality ($p<.05$, one-tailed, outlined with an asterisk). Factor 1 scores were associated with faster time to premature mortality at trend-level, whereas Facet 2 and Facet 4 scores were not significantly associated with faster time to premature mortality

Similar results were obtained when incorporating an operational definition of high-scorers consistent with the criteria used to define adult psychopathy (Hare, 2003). Specifically, the mean PCL:YV total score observed across all $N=332$ participants was 23.38 ($SD=6.09$). Therefore, high-scorers were deemed to be those scoring 30 or above (i.e., one standard deviation above the sample mean) on baseline PCL:YV total scores ($n=60$, range: 30–36), whereas comparison participants were those scoring 29 or below on baseline PCL:YV total scores ($n=272$, range: 2–29). Using this split, 11 out of 60 participants scoring 30 or above on baseline PCL:YV total scores died during the follow-up period, representing a mortality rate of 18.3%, compared to 22 out of 272 participants scoring 29 or below on baseline PCL:YV total scores, representing a mortality rate of 8.1%. Fisher's exact test indicated this reflected a significant group difference ($p=.020$[5]), with high-scorers exhibiting higher rates of premature mortality compared to low-scorers (see Table 3).

[5] Both Fisher's exact tests survive Bonferroni multiple comparison correction (i.e., 0.05/2, or $p<.025$).

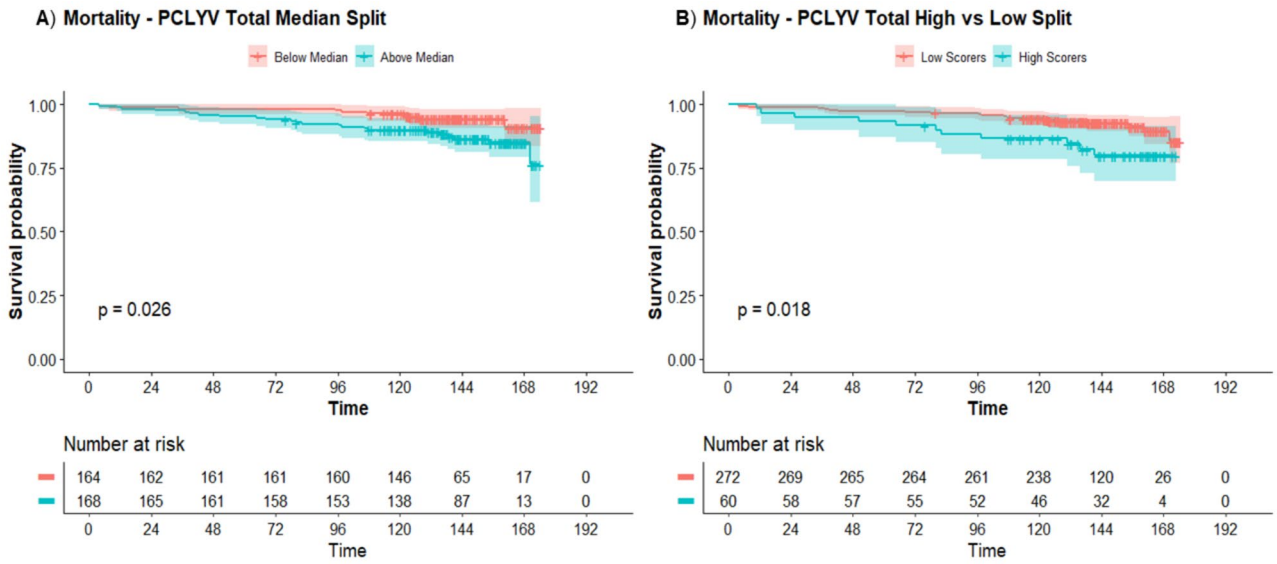

Fig. 1 Kaplan-Meier curves. *Note*: Kaplan-Meier curves showing mortality rates (in months) with 95% confidence intervals and survival risk tables across both a median split of PCL:YV scores (shown on the left side, A) and a high/low split of PCL:YV scores (high: those scoring 30+ on the PCL:YV total score; low = those scoring below 29 on the PCL:YV total score, B).

Cox Proportional Hazard Regression Analyses

We also investigated whether baseline PCL:YV total, factor, and facet scores were associated with faster time to premature mortality using univariate Cox proportional hazard regression analyses, with time at risk defined as the time period between participant's release date from the maximum-security juvenile correctional facility and (a) the date that they died or (b) the end of the follow-up window (December 31st, 2021). Individual PCL:YV scores were entered alone, without the influence of other PCL:YV scores or covariate measures, to see if baseline PCL:YV total, factor, or facet scores were associated with faster time to premature mortality. At the univariate level, PCL:YV total scores ($\beta = 0.07$, $p = .009$), Factor 2 scores ($\beta = 0.14$, $p = .016$), Facet 1 scores ($\beta = 0.15$, $p = .048$) and Facet 3 scores ($\beta = 0.23$, $p = .009$) were associated with faster time to premature mortality. Additionally, baseline PCL:YV Factor 1 scores ($\beta = 0.09$, $p = .054$) showed a trend-level effect, with higher scores being associated with faster time to premature mortality. Baseline PCL:YV Facet 2 ($\beta = 0.10$, $p = .156$) and Facet 4 ($\beta = 0.16$, $p = .103$) scores were not significantly associated with faster time to premature mortality[6] (see Table 3). Time to premature mortality for each of the two operational definitions of high-/low-scorers is visualized with Kaplan-Meier survival curves (see Fig. 1).

[6] None of the univariate Cox proportional hazard regression analyses presented survived a modified Bonferroni multiple comparison correction (i.e., 0.05/7 or $p < .007$).

Discussion

The present study investigated the association between adolescent psychopathic traits (assessed via the PCL:YV [Forth et al., 2003]) and risk for premature mortality in a high-risk forensic sample. Overall, we observed that $n = 33$ former study participants (out of $N = 332$ total) died during a follow-up period ranging from 10 to 14 years, representing a premature mortality rate of 9.94%. This observed mortality rate is significantly higher than the expected mortality rate for individuals of comparable age (i.e., < 1% for individuals 25 to 33 years of age; Social Security Administration, 2024). Consistent with our original hypotheses, we observed via Fisher's exact tests that adolescents scoring the highest on baseline PCL:YV total scores exhibited higher rates of premature mortality compared to adolescents scoring low on baseline PCL:YV total scores, using two operational definitions. We also observed that PCL:YV total, Factor 2, Facet 1, and Facet 3 scores were associated with faster time to premature mortality via univariate Cox proportional hazard regressions. Furthermore, our results related largely to adolescent psychopathic traits, rather than externalizing psychopathology more generally. As reported in our Supplemental Material, Fisher's exact tests revealed that adolescents who met criteria for ODD and SUDs exhibited higher rates of premature mortality compared to control participants only at trend-levels. Furthermore, Fisher's exact tests indicated that adolescents meeting criteria for ADHD and CD did not exhibit higher rates of premature mortality compared to control participants. Our results therefore suggest that adolescent psychopathic traits, an established risk factor for

severe antisocial behavior (Allen et al., 2024; Braga et al., 2023; Forth et al., 2003; Vincent et al., 2008), may additionally serve as an important risk factor for premature mortality risk among incarcerated adolescents.

To date, our understanding regarding the association between psychopathic traits and premature mortality risk has been limited to two studies performed with adult men (Vaurio et al., 2018) and adult women (Vaurio et al., 2022). In both studies, individuals scoring above 25 on the PCL-R total score exhibited higher rates of premature mortality compared to individuals scoring 25 or below on PCL-R total scores (Vaurio et al., 2018, 2022). Results reported in our study were therefore consistent with these two previously published studies. Specifically, when incorporating a median split of PCL:YV total scores, Fisher's exact tests revealed that adolescents scoring high baseline PCL:YV total scores (≥ 24) exhibited a higher premature mortality rate (13.7%) compared to adolescents scoring low on baseline PCL:YV total scores (≤ 23, 6.1%). Similarly, when operationally defining high-scorers in a manner consistent with adult psychopathy (i.e., individuals scoring one standard deviation above the sample mean; Hare, 2003), Fisher's exact test observed that high-scorers (≥ 30 on baseline PCL:YV total scores) exhibited a higher mortality rate (18.3%) compared to low-scorers (≤ 29 on baseline PCL:YV total scores, 8.1%). Additionally, PCL:YV total scores were associated with faster time to premature mortality via Cox proportional hazard regression analyses. Therefore, our results suggest that incarcerated adolescents with elevated psychopathic traits (i.e., scoring high on PCL:YV total scores, measuring both PCL:YV Factor 1 and 2 traits) exhibited increased rates of premature mortality compared to incarcerated adolescents scoring lower on baseline PCL:YV total scores. Additionally, such at-risk youth were also more likely to die in close proximity to their release date from the juvenile correctional facility, largely in violent ways, including being involved in accidents or victims of homicide.

Additionally, we observed that PCL:YV Factor 2 scores, measuring lifestyle/behavioral and antisocial/developmental psychopathic traits, and PCL:YV Facet 3 scores, measuring lifestyle/behavioral psychopathic traits, were associated with faster time to premature mortality via univariate Cox proportional hazard regression analyses. This association was expected, given that these adolescent psychopathic traits have been previously associated with reckless and risky forms of negative risk-taking, including risky sexual behavior (Pechorro et al., 2015) and more prolonged patterns of hazardous substance use (Sakki et al., 2023). Furthermore, we observed that PCL:YV Factor 1 scores (at a trend-level), measuring interpersonal and affective psychopathic traits, and Facet 1 scores ($p = .048$), measuring interpersonal psychopathic traits, were associated with increased risk for premature mortality. While we did not specifically hypothesize that PCL:YV Factor 1 and Facet 1 scores would be associated with increased premature mortality risk, our results suggest that additional adolescent psychopathic traits, beyond those measured with PCL:YV Factor 2, may be important to consider in relation to premature mortality risk. Moreover, while PCL:YV Factor 2 shares common symptomatology across broad forms of externalizing psychopathology, items contained within PCL:YV Factor 1 are largely unique to adolescents with elevated psychopathic traits. For example, Forth (1995) observed that among adolescents scoring 30 or above on the PCL:YV total score (i.e., participants scoring high on both Factor 1 and Factor 2), 100% met criteria for CD; however, only 30% of those meeting criteria for CD scored above 30 on the PCL:YV total score. These results suggest that adolescents meeting criteria for CD are not typified by the same interpersonal and affective dysfunction as adolescents with elevated psychopathic traits. Similar results have been observed in relation to SUDs and ADHD, with lifestyle/behavioral and antisocial/developmental psychopathic traits strongly related to forms of externalizing psychopathology, whereas mixed evidence exists regarding the same associations with interpersonal and affective psychopathic traits (Kaplan & Cornell, 2004; Sakki et al., 2023). Therefore, while the current study observed stronger associations with PCL:YV Factor 2 scores and premature mortality risk, PCL:YV Factor 1 scores may be also important to consider as well, either by themselves, or especially when assessed in conjunction with PCL:YV Factor 2 scores.

Previously published studies have identified significant associations between externalizing psychopathology measured during adolescence and increased risk for future mortality (Border et al., 2018; Chassin et al., 2013; Maughan et al., 2014; Scott et al., 2017; Sun et al., 2019; Warrilow et al., 2021). As reported in our Supplemental Material, we observed largely non-significant associations between externalizing psychopathology and increased risk for premature mortality. For example, we observed that adolescents meeting criteria for ODD ($n = 97$) exhibited a higher rate of premature mortality (14.4%) compared to control participants ($n = 227$, 7.5%) and adolescents meeting criteria for a SUD ($n = 284$) exhibited a higher rate of premature mortality (10.9%) compared to control participants ($n = 40$, 2.5%), only at trend-levels ($p = .058$; $p = .071$, respectively). However, premature mortality rates did not significantly differ between participants meeting criteria for ADHD or CD and control participants. Differences between our study and previously published studies may simply relate to differences in sample composition. For example, it is important to note that besides ODD (29.9% prevalence), prevalence estimates for externalizing psychopathology ranged from

extremely low (i.e., ADHD, 7.4%) to extremely high (i.e., SUDs [87.7%] and CD [95.1%]). Non-significant associations between these forms of externalizing psychopathology and premature mortality risk may have been observed due to ceiling or floor effects relating to extremely high or low rates of externalizing psychopathology reported in the current sample.

Given the rate of mortality has been increasing among adolescents (Woolf et al., 2023), researchers have attempted to identify a constellation of behaviors preceding premature mortality, commonly referred to as "behaviors of despair" (Godwin, 2020). These "behaviors of despair" include harmful behaviors such as suicidal ideations and attempts and harmful patterns of alcohol and illicit substance use (Godwin, 2020). Additionally, researchers have identified forms of externalizing psychopathology (e.g., conduct problems, ADHD) associated with "behaviors of despair", including harmful patterns of alcohol and illicit substance use. However, Yu et al. (2023) suggest that these forms of externalizing psychopathology may differentially relate to "behaviors of despair". For example, the authors noted that while conduct problems assessed during adolescence were strongly associated with future problematic patterns of alcohol and substance use, the association between ADHD and hazardous patterns of future substance use was mixed. Sun et al. (2019) observed a significant association between adolescent ADHD and future mortality risk relating to both natural causes and suicide; however, they observed that these associations no longer remained significant when controlling for psychiatric comorbidity. Therefore, beyond externalizing psychopathology, it is important to identify additional variables associated with "behaviors of despair", especially among adolescents at highest risk for future antisocial and criminal behavior (e.g., incarcerated adolescents). Given that adolescents with elevated psychopathic traits are associated with future problematic patterns of alcohol and substance use (Andershed et al., 2018; Virtanen et al., 2022), this suggests that adolescent psychopathic traits should also be considered in relation to the "behaviors of despair" literature, allowing for the identification of additional variables associated with harmful behaviors preceding premature mortality.

Limitations

In the current study, we did not perform gender-specific analyses, due to the smaller number of female participants ($n = 55$, $n = 3$ deceased) compared to male participants ($n = 277$, $n = 30$ deceased). While we observed that male and female participants did not significantly differ with respect to either PCL:YV scores or mortality status, it remains to be seen whether the same adolescent psychopathic traits are associated with premature mortality risk for both male and female participants. Additionally, our research group has conducted follow-up investigations from former study participants for a time period ranging from 10 to 14 years. There is the possibility that the results obtained in the current study do not extend to longer follow-up windows (e.g., 25 to 40 years). With additional data collected at future follow-up windows, we will investigate whether psychopathic traits measured during adolescence are associated with higher risk for premature mortality at different developmental periods throughout life. Finally, we investigated whether adolescent psychopathic traits and externalizing psychopathology were associated with premature mortality risk in separate analyses performed, rather than combining these variables within multivariate analyses. Adolescent psychopathic traits and externalizing psychopathology are highly comorbid with one another. In fact, when identifying adolescents scoring above 30 on the PCL:YV total score, only $n = 1$ participant did not meet criteria for either ADHD, SUDs, CD, or ODD. Therefore, it becomes incredibly difficult to attempt to disentangle unique effects associated with adolescents with elevated psychopathic traits and externalizing psychopathology within a multivariate framework. Supporting this notion, while Border et al. (2018) observed that conduct problems were associated with premature mortality risk, the authors observed that when including substance use in the same model, substance use and CD were largely redundant with one another, due to sharing common symptomatology.

Conclusions

Here, we observed that psychopathic traits measured during adolescence were associated with an increased risk for premature mortality during a 10- to 14-year follow-up period. However, we observed (in supplemental analyses reported) that forms of externalizing psychopathology (i.e., ADHD, SUDs, ODD, and CD) were not significantly associated with premature mortality risk. The current results highlight that among participants at risk for severe antisocial and criminal outcomes (e.g., incarcerated adolescents), psychopathic traits may confer unique risk for premature mortality.

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Data availability The data presented in this article are not readily available because of the potential for personal re-identification of participants in the present sensitive population (incarcerated juveniles). Interested parties should contact Dr. Kent Kiehl (kkiehl@mrn.org) for the data used in this report which may be shared under a data use agreement.

Compliance with Ethical Standards

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