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# Do psychopathic personality traits in childhood predict subsequent criminality and psychiatric outcomes over and above childhood behavioral problems?

## Abstract

*Purpose:* We investigated whether childhood psychopathic personality traits predicted subsequent self-reported and register-based criminality and psychiatric outcomes when childhood behavioral problems (conduct disorder [CD] and ADHD symptoms) were accounted for.

*Methods:* In the Child and Adolescent Twin Study in Sweden, parents rated their children's (n=12,394) psychopathic personality traits, CD, and ADHD symptoms at age 9/12. We studied the risk for self-reported delinquency, problematic substance use, and anxiety/depression at age 18. The sample was also linked to nationwide registers where we studied suspicion of crimes, and diagnoses of substance use disorders and anxiety/depression up to age 21.

*Results:* Childhood psychopathic personality traits were associated with self-reported delinquency ( $\beta=0.65$ , 95% CI: 0.41-0.90) and suspicions of violent (hazard ratio [HR]=1.33, [1.23-1.45]) and non-violent (HR=1.28, [1.22-1.36]) crimes. The estimates were attenuated, but remained elevated for delinquency and violent crimes after accounting for childhood behavioral problems. Psychopathic personality traits were associated with substance use problems and anxiety/depression, but these associations were mainly explained by childhood behavioral problems.

*Conclusions:* Psychopathic personality traits were a risk marker for criminality and psychiatric outcomes, particularly in children with co-occurring behavioral problems. However, the independent contribution of psychopathic personality traits was modest at best, when behavioral problems were accounted for.

*Keywords:* psychopathy, childhood, longitudinal, criminality, substance use, psychiatric disorders

## 1. Introduction

Psychopathy is defined as a personality disorder characterized by a constellation of personality traits and behavioral patterns involving affective, interpersonal, lifestyle, and antisocial domains (Cooke, Hart, Logan, & Michie, 2012; Hare & Neumann, 2008; Salekin, 2017). The affective-interpersonal domain includes personality features such as lack of empathy and remorse, superficial charm, and callousness, whereas the lifestyle-antisocial domain includes mostly behavioral patterns involving persistent antisocial behavior such as early conduct problems, juvenile delinquency, and weak behavioral controls. Several meta-analyses and systematic reviews have shown an increased risk of antisocial outcomes such as conduct problems, delinquency, aggression, and violent and non-violent recidivism in children, adolescents, and adults with psychopathy (Asscher et al., 2011; Frick, Ray, Thornton, & Kahn, 2014; Geerlings, Asscher, Stams, & Assink, 2020; Leistico, Salekin, DeCoster, & Rogers, 2008; Longman, Hawes, & Kohlhoff, 2016; Salekin, Rogers, & Sewell, 1996; Walters, 2003; Zych, Ttofi, & Farrington, 2019). However, studies have suggested that when investigated separately, the lifestyle-antisocial domain outperforms the affective-interpersonal domain in predicting criminality-related outcomes (Asscher et al., 2011; Geerlings, et al., 2020; Leistico et al., 2008; Salekin et al., 1996; Kennealy, Skeem, Walters, & Camp, 2010), raising the issue whether psychopathic personality traits, i.e. traits not indexing antisocial behavior and criminality, provide incremental value over and above other risk factors in predicting outcomes. This issue has relevant practical implications, because different measures of the psychopathy construct are widely used, for instance, within the criminal justice system to assess the risk of recidivism and violence (Neal & Grisso, 2014).

A large proportion of longitudinal studies examining antisocial outcomes associated with psychopathy has been conducted in relatively small samples of adolescent or adult offenders (Asscher et al., 2011; Geerlings et al., 2020; Leistico et al., 2008; Salekin et al., 1996). Yet, maladaptive behavior often has its origins in childhood (Achenbach, 1990), and psychopathy is

not an exception as there is compelling evidence that psychopathic personality traits first develop in childhood and show moderate stability into adulthood (Salekin, 2006; Salekin, Rosenbaum, & Lee, 2008). In order to better understand the link between psychopathy and adverse outcomes, there is a need for prospective, large-scale community studies covering the important developmental period from childhood to early adulthood. Such studies could elucidate whether psychopathic traits may be used as valid risk markers for later adverse outcomes in a broader context than within selected groups of individuals (e.g., incarcerated youth), and could thus be useful in informing how to develop better community-based prevention strategies. Previous studies in children have predominantly focused on the association of psychopathic traits, specifically, callous-unemotional traits, with antisocial behavior. Similar to adolescent and adult studies, callous-unemotional traits have been found to be associated with an increased risk of subsequent antisocial behavior in both community and forensic samples, but when childhood conduct problems were accounted for, the independent association of callous-unemotional traits has been modest or disappeared entirely (Frick et al., 2014; Longman et al., 2016). These inconsistent findings show that it still remains unclear whether childhood psychopathic personality traits add incremental value in predicting antisocial behavior over and above childhood conduct problems. In addition, the bulk of research on the prospective relation between psychopathic personality traits and antisocial behavior has focused on boys. In the light of evidence of subtle sex differences in the predictive utility of psychopathy scores (e.g., Shaffer et al., 2016), it bears relevance to test if the incremental contribution of psychopathic personality traits differs across sex.

Studies in children have largely departed from the adult psychopathy literature by not conceptualizing psychopathy through a multicomponent model, but rather focusing mainly on a single element of psychopathy, i.e., callous-unemotional traits. In contrast, some researchers have highlighted the benefits of examining a broader construct of psychopathic personality, which includes maladaptive interpersonal style and impulsivity in addition to callous-unemotional

traits (Colins & Andershed, 2018; Lilienfeld, 2018; Salekin, Andershed, Batky & Bontemps, 2018). They argue, for instance, that it remains unclear if callous-unemotional traits alone are enough to identify children and adolescents with psychopathic personality, and that using the multicomponent model would help in linking the findings from child studies with the adult psychopathy literature (Colins & Andershed, 2018; Salekin et al., 2018).

Studies of adolescent forensic samples found that different measures of the full range of psychopathic personality traits were not associated with recidivism and antisocial behavior (Colins, Vermeiren, De Bolle, & Broekaert, 2012; Colins, Damme, Andershed, Fanti, & DeLisi, 2017; Colins et al., 2017). Similar results were reported in a community-based study of children, where a multicomponent measure of psychopathic personality was not associated with persistent delinquency (Pardini, Obradovic, & Loeber, 2006). These findings seem to further suggest that the association between psychopathy and subsequent antisocial behavior may be driven by items on criminality and conduct problems that are included in other frequently used psychopathy measures, such as the Psychopathy Checklist-Youth Version (Forth, Kosson, & Hare, 2003; Skeem & Cooke, 2010).

In recent years, a growing number of studies have investigated whether psychopathic personality traits can be used to identify a subtype of children with conduct problems. Several studies found children with both conduct problems and callous-unemotional traits to have a greater risk for severe and persistent antisocial behavior than children with conduct problems only (Frick et al., 2014), leading to the recent inclusion of callous-unemotional traits as a specifier in the Diagnostic and Statistical Manual of Mental Disorders (5<sup>th</sup> ed.; DSM-5; American Psychiatric Association, 2013) for a particularly severe subtype of conduct disorders. Although individuals with callous-unemotional traits may constitute a high-risk subgroup of children with conduct problems, the full range of psychopathic personality has been largely overlooked in these studies (Colins, Van Damme, Hendriks, & Georgiou, 2020; Frick et al., 2014). Prior community-based studies investigating the multicomponent model of childhood psychopathy

with and without high levels of conduct problems have found the combination of both psychopathic personality traits and conduct problems to be more strongly associated with antisocial outcomes than conduct problems alone, or the combination of callous-unemotional traits and conduct problems (Andershed et al., 2018; Frogner, Gibson, Andershed, & Andershed, 2016; Colins, Andershed, Salekin, & Fanti, 2018; López-Romero, Romero, & Luengo, 2012). These findings suggest that there is a need for more research focusing on the multicomponent model of psychopathic personality when investigating subgroups of children with conduct problems, as the combination of these traits appears to be a strong predictor of subsequent antisocial behavior.

While the association of psychopathic personality traits with antisocial and criminal behavior has received considerable attention, much less is known about other outcomes such as psychiatric and substance use disorders. Prior studies in both forensic and community populations have found childhood and adolescent psychopathic personality traits to be associated with an increased risk of substance use (Andershed et al., 2018; Hawes et al., 2015; Loney, Taylor, Butler, & Iacono, 2007; Waller & Hicks, 2019; Wymbs et al., 2012) and internalizing psychopathology, including anxiety and depression (Fontaine, McCrory, Boivin, Moffitt, & Viding, 2011; Hyde, Burt, Shaw, Donnellan, & Forbes, 2015; Moran et al., 2009), but the comorbidity of psychopathic personality traits with childhood conduct problems was often found to drive these associations. Conversely, in a community sample of school-aged boys, psychopathic personality traits were associated with a decreased risk of subsequent internalizing psychopathology (Pardini & Fite, 2010).

Importantly, other psychiatric disorders are also associated with the same types of outcomes as are psychopathy and conduct problems. Attention deficit-hyperactivity disorder (ADHD) is often comorbid with both internalizing and externalizing disorders (Spencer, 2006), and with psychopathy (Colins et al., 2014; Eisenbarth et al., 2008). Further, there is consistent evidence for ADHD being associated with an increased risk of criminality and substance use

(Charach, Yeung, Climans, & Lillie, 2011; Pratt, Cullen, Blevins, Daigle, & Unnever, 2002; Young, Moss, Sedgwick, Fridman, & Hodgkins, 2015). Overlooking potentially important confounding factors such as ADHD may thus lead to biased estimates when investigating the association between psychopathic personality traits and outcomes such as criminality, substance use, and internalizing disorders.

The overall aim of the present study was to better understand the association of childhood psychopathic personality traits with criminality, substance use, and internalizing psychopathology. Using a large prospective sample of Swedish twins, we first investigated the associations of childhood psychopathic personality traits with subsequent self-reported delinquency and register-based suspicions of crime, problematic substance use, and anxiety/depression. We also tested for potential sex differences. The second aim was to study whether psychopathic personality traits were associated with these outcomes when childhood conduct disorder and ADHD symptoms were accounted for. Finally, we examined whether individuals with high levels of both psychopathic personality traits and conduct disorder symptoms had a higher risk of being suspected of crime than individuals with high levels of either trait alone.

## **2. Methods**

### *2.1. Sample*

The Child and Adolescent Twin Study in Sweden (CATSS) is an ongoing longitudinal study targeting all twins born in Sweden since July 1<sup>st</sup> 1992 (Anckarsäter et al., 2011; Magnusson et al., 2013). As of 2004, parents of all 12-year-old (born 1992–1995) and 9-year-old (born July 1<sup>st</sup> 1995 and after) twins have been invited to participate in a telephone interview about their children’s physical and mental health and psychosocial environment. Interviews were primarily completed by the mother, and the overall response rate in the present sample was 76%. The sample consists of 12,394 individuals (48.5% women) born 1992–1998 whose parents participated in the age 9/12 interview and who provided answers on a short version of the Child Problematic Traits Inventory (Colins et al., 2014), which was being developed at the time of the data collection. At the age of 18, the twins and their parents were asked to participate in a follow-up study by completing a web-based questionnaire designed to provide longitudinal information on the development of major mental health disorders. In the present sample, the retention rate was 40% (n=5,004). The CATSS study was approved by the Karolinska Institute Ethical Review Board (Dnr 02–289 and 2010/507–31/1). Consent to participate was provided by the parents for their children at age 9/12 and by the twins themselves at age 18.

### *2.2. Measures*

#### *2.2.1. Psychopathic personality traits*

Psychopathic personality traits were measured at age 9/12 with the 12-item short version of the Child Problematic Traits Inventory (CPTI), derived from an early version of the full 28-item scale (Colins et al., 2014) which was being developed at the time these data were collected. The majority of the items in the short version of the CPTI are identical to the items of the full scale, and because of this, the relation between the short and full version of the CPTI

can be assumed to be strong. The items in the short version were chosen from the full scale based on content, i.e., face validity, of the three respective dimensions that the CPTI aims to assess. The 12-item version of the CPTI was developed by its original authors specifically for the CATSS study due to a need for a shorter, less time consuming measure for psychopathic personality traits. The CPTI assesses three dimensions of psychopathic personality in children aged 3-12 years. The three factors include: 1) a grandiose-deceitful factor, 2) a callous-unemotional factor, and 3) an impulsive-need for stimulation factor (list of items is displayed in Table S1 and item correlations in Table S2), which correspond with the affective, interpersonal, and lifestyle facets of adolescent and adult psychopathy. The CPTI does not include traits or behaviors directly measuring rule-breaking, conduct problems, or antisocial behavior, corresponding with the antisocial facet of adult psychopathy. The factor structure, reliability, and validity of the full version of the CPTI has been confirmed in different age samples and countries (Colins et al., 2014; Colins, Fanti, Larsson, & Andershed, 2017; López-Romero, Maneiro, Colins, Andershed, & Romero, 2019; Somma, Andershed, Borroni, & Fossati, 2016; Wang et al., 2018). The original CPTI response scale was used. That is, the parents were asked to rate their children on each item on a four-point scale (0 = Does not apply at all, 1 = Does not apply well, 2 = Applies fairly well, 3 = Applies very well) during a telephone interview. We used the standardized CPTI total score in the analyses. Internal consistency of the CPTI total scale was acceptable (coefficient  $\alpha=0.78$ ).

### *2.2.2. Conduct disorder and ADHD symptoms*

Conduct disorder (CD) and ADHD symptoms were assessed during the age 9/12 telephone interview with the Autism - Tics, AD/HD and other Comorbidities Inventory (A-TAC) (Hansson et al., 2005). The A-TAC is a validated instrument covering all common psychiatric disorders in child and adolescent psychiatry, and includes items worded similarly to DSM-IV criteria (Larson et al., 2010; Mårland et al., 2017). ADHD and CD symptoms are each included

as sub-scales in the A-TAC. The parents were asked to rate their children on a three-point scale: 0 = item does not apply; 0.5 = applies to some extent; and 1 = applies in full. We used total scores of ADHD and CD symptom scales in the analyses (list of items in Table S1). Internal consistency for CD and ADHD symptom scales were  $\alpha=0.78$  and  $\alpha=0.93$ , respectively.

### *2.2.3. Co-occurring conduct disorder symptoms and psychopathy*

To investigate whether the combination of high levels of CD symptoms and psychopathic personality traits was more strongly associated with being suspected of crime than psychopathic personality traits or CD symptoms each alone, participants were classified into four mutually exclusive groups: 1) a normative group with both psychopathic personality traits and CD symptoms below 1 SD above the mean, 2) high CD symptoms only (only CD symptoms over 1 SD above the mean), 3) high psychopathic personality traits only (only psychopathic personality traits over 1 SD above the mean), 4) high CD symptoms and psychopathic personality traits (both traits over 1 SD above the mean).

### *2.2.4. Self-report outcomes*

All self-report outcomes were measured during the CATSS age 18 follow-up. Delinquency was assessed with a modified version of the Self-Reported Delinquency Scale (Junger-Tas, Terlouw, & Klein, 1994; Ring, 1999). The scale consists of 25 items on various delinquent acts, e.g., stealing, destroying property, harassing or hurting other people. The items were rated on a five-point scale (0=never, 1=1-2 times, 2=3-5 times, 3=6-10 times, 4=more than 10 times). Internal consistency of the scale was  $\alpha=0.80$ .

Problematic alcohol use was measured with the Alcohol Use Disorder Identification Test (AUDIT), a 10-item screening tool assessing alcohol consumption, drinking behaviors, and alcohol-related problems during the past year (Babor, de la Fuente, Saunders, & Grant, 1992).

We used the AUDIT total score as the outcome measure. Internal consistency of the scale was  $\alpha=0.75$ .

The Drug Use Disorders Identification Test (DUDIT) was used to measure drug-related problems (Berman, Bergman, Palmstierna, & Schlyter, 2005). Due to low variability in the DUDIT scale, the measure was dichotomized to measure whether the participant had ever used drugs (1=yes, 0=no).

We measured anxiety and depressive symptoms with parent-rated anxious-depressed subscale of the Adult Behavior Checklist (ABCL; Achenbach & Rescorla, 2003). The ABCL is completed by a person who knows the adult well, and includes normed scales for adaptive functioning, empirically based syndromes, substance use, internalizing, externalizing, and total problems. The anxious-depressed subscale includes 14 items on symptoms such as low mood, anxiousness, nervousness, and feelings of worthlessness, guilt, and loneliness. Internal consistency of the scale was  $\alpha=0.87$ .

#### *2.2.5. Register-based outcomes*

The CATSS sample was linked to Swedish nationwide registers using the unique personal identity number assigned to each individual living in Sweden (Ludvigsson, Otterblad-Olausson, Pettersson & Ekblom, 2009). We included data on suspicions of crimes from the Register of People Suspected of Offences for individuals aged 15 or older (the age of criminal responsibility in Sweden). The register has coverage from January 1, 1998, with follow-up available until December 31, 2013. Suspicions of violent crimes included murder, manslaughter, assault, kidnapping, illegal restraint, illegal coercion or threats, robbery, threats or violence against an officer, arson, gross violation of a person's integrity, harassment, and sexual crimes (excluding selling of sexual services, which is not a criminal offence in Sweden). All other suspicions were categorized as "non-violent" crimes. The most common non-violent offences were theft, property damage, traffic offences, and possession of illicit drugs.

ICD-10 diagnoses of substance use disorders and anxiety and depressive disorders (codes: F10-F16, F18-F19, F32-F34, F38-F41, F44-F45, F48) were retrieved from the National Patient Register, which covers all inpatient (1973–) and outpatient (2001–) diagnoses with data available until December 31, 2013 (Ludvigsson et al., 2011). Thus, the maximum age at the end of follow-up was 21 years. To ensure that the study design was prospective, we included substance use, anxiety, and depressive disorder diagnoses beginning from the age of 13 years.

### *2.2.6. Covariates*

Analyses were adjusted for several demographic and family-related covariates. Information on parental education level was retrieved from the Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA). Both mothers' and fathers' education level was defined as the highest educational level they each had completed between 1990 and 2013 (level 1: primary school; level 2: secondary school/high school; level 3: college/university; level 4: graduate school/doctoral). If data on education was unavailable, the variable was coded as "unknown". Parental migration status was retrieved from the Total Population Register (categorized: both parents born in Sweden; one parent not born in Sweden; both parents not born in Sweden). Parental history of psychiatric disorders was defined as either parent having any psychiatric diagnosis in the National Patient Register (yes/no).

### *2.3. Statistical analyses*

We used linear regression models to estimate the association of psychopathic personality traits with self-reported delinquency, problematic alcohol use, and anxiety/depressive symptoms. The association with dichotomous measure of drug use was estimated with logistic regression. Cox proportional hazards regression models were used to estimate the associations between psychopathic personality traits and the register-based outcomes. The register-based outcomes were obtained from the Swedish nationwide registers,

and the twins were followed up from their 13<sup>th</sup> (ICD-10 diagnoses) or 15<sup>th</sup> (suspicions of crime) birthday until the date of the outcome, emigration, death, or December 31, 2013, whichever occurred first. We accounted for the non-independence of observations in families by using a cluster-robust sandwich estimator for standard errors in all models.

For all outcomes, we estimated five different models with increasing levels of adjustment. In the minimally adjusted model, only sex and birth year were included as covariates. In the second model, we included parental education level, immigration background and history of psychiatric disorders as additional covariates. Models three and four adjusted for all the previous covariates and ADHD and CD symptoms, respectively. In the final, fully adjusted model, ADHD and CD symptoms as well as all covariates were included. We also tested for sex-differences in all of the outcome variables by including an interaction term between sex and the CPTI total score.

To complement the main analyses, and to facilitate comparison with prior work (Andershed et al., 2018; Colins et al., 2018; Frogner et al., 2016), we investigated associations of high psychopathic personality traits, CD symptoms, or a combination of both with being suspected of crime using Cox regression models. Models were estimated for any type of crime (i.e., violent or non-violent) to increase statistical power. The “normative” group was used as the reference category. The high CD symptoms only, high psychopathic personality traits only, and high psychopathic personality traits and CD symptoms groups were compared to the normative group in terms of their rates of being suspected of crime. The first model adjusted for sex and birth year, and the second model for all covariates and ADHD symptoms. We also estimated the cumulative incidence of being suspected of crime for the groups using Kaplan-Meier survival estimates under the assumption of no competing risks (estimated as 1 minus the Kaplan-Meier estimate of survival function).

### *2.3.1. Sensitivity analyses*

We estimated the models of the group-based analyses using alternative cut-off points at 95<sup>th</sup> percentile (psychopathic personality traits: 2 SD above the mean, CD symptoms: 0.99 SD above the mean) and 90<sup>th</sup> percentile (psychopathic personality traits: 1.22 SD above the mean, CD symptoms: 0.98 SD above the mean).

Further, since only 40% of the original sample was retained in the CATSS age 18 follow-up, we investigated whether the main predictor variables and sociodemographic characteristics at baseline were associated with nonresponse using logistic regression.

### **3. Results**

#### *3.1. Descriptive statistics*

Table 1 shows the descriptive statistics and the distributions of psychopathic personality traits, CD, and ADHD total scores, and self-reported and register-based outcomes. The median age of first suspicion of any crime was 16.3 (SD=1.4) years. The median age of first registered diagnosis was 16.9 (SD=1.8) and 16.7 (SD=1.9) years for substance use disorders and anxiety or depressive disorders, respectively. Correlations between the main exposure and outcome variables are shown in Table S3.

#### *3.2. Association of psychopathic personality traits with self-report outcomes at age 18*

Psychopathic personality traits at age 9/12 were associated with an increased risk of delinquency, problematic alcohol use, drug use, and anxiety and depressive symptoms at age 18 in the minimally adjusted model (Table 2). The associations attenuated only slightly when adjusted for parental education level, immigration background, and history of psychiatric disorders. Compared to the model adjusted for covariates, the association of psychopathic personality traits with delinquency, problematic alcohol use, and drug use attenuated further when CD and ADHD symptoms were mutually adjusted for. The estimates remained elevated, but were statistically significant only for delinquency. Based on the attenuation in the estimates, both ADHD and CD symptoms explained a large proportion of the association between psychopathic personality traits and delinquency, but only CD symptoms appeared to explain the association with substance use. The association of psychopathy with anxiety and depressive symptoms was explained by both CD and ADHD symptoms. The interaction term between sex and psychopathic personality traits was not statistically significant in any of the models.

### *3.3. Association of psychopathic personality traits with register-based outcomes*

Psychopathic personality traits at age 9/12 were associated with an elevated risk of violent and non-violent crimes, substance use disorders, and anxiety and depressive disorders during the follow-up in the minimally adjusted model (Table 3). Similar to the self-report outcomes, the associations attenuated only slightly after adjustment for demographic and family-related covariates. In the fully adjusted model including CD and ADHD symptoms, the estimate for the association of psychopathic personality traits with violent crimes attenuated markedly compared to the covariate adjusted model, but remained elevated and statistically significant. Compared to the model adjusted for covariates, the association with non-violent crimes attenuated and became statistically non-significant, although the estimate for the association remained slightly elevated. The estimate for substance use disorders also remained elevated but became statistically non-significant. The association between psychopathy and anxiety and depressive disorders was mainly explained by CD and ADHD symptoms. The interaction term between sex and psychopathic personality traits was not statistically significant in any of the models.

### *3.4. Risk of being suspected of crime in individuals with high levels of psychopathic personality traits, conduct disorder symptoms, or both*

As shown in Table 4, having high levels of both psychopathic personality traits and CD symptoms was associated with an elevated risk of being suspected of crime, but the CIs were overlapping with the high CD symptoms only estimate, and the difference was not statistically significant ( $p=.140$ ). Further, having high CD symptoms only was associated with a higher risk of suspicions than having high psychopathic personality traits alone, and the estimate for the high psychopathic personality traits only group was elevated when compared to the normative group. The associations attenuated when ADHD symptoms and covariates were included in the

model, and the estimate for the high psychopathic personality traits and high CD symptoms group was similar to those with high CD symptoms only.

We estimated the cumulative incidence of being suspected of crime in different groups and found that by age 21, the cumulative incidence was nearly 40% in both the high psychopathic personality traits and CD symptoms group, and the high CD symptoms only group (Figure 1). The accumulation of suspicions seemed to increase earlier in the high psychopathic personality traits and CD symptoms group, but the CIs of the two groups were overlapping for most of the follow-up period.

### 3.5. Sensitivity analyses

As a sensitivity analysis, we estimated the models for the groups of high psychopathic personality traits and CD symptoms using alternative cut-off points at the 95<sup>th</sup> and 90<sup>th</sup> percentiles, shown in Table S4. There was slight variation in the estimates in different models, but overall the pattern of results was similar to the main results.

We investigated if the main predictor variables and sociodemographic characteristics at baseline were associated with nonresponse at CATSS age 18 follow-up, and found that psychopathic personality traits (Odds Ratio [OR]=1.03, 95% CI: 1.02-1.04), CD (OR=1.38, 95% CI: 1.22-1.56), and ADHD (OR=1.09, 95% CI: 1.07-1.10) symptoms were associated with a higher risk of dropping out of the study. Being male (OR=1.85, 95% CI: 1.70-2.01), having both parents born outside of Sweden (OR=1.39, 95% CI: 1.13-1.71), low parental education level (OR=1.27, 95% CI: 1.12-1.44), and higher rates of parental psychopathology (OR=1.34, 95% CI: 1.19-1.49) were also associated with nonresponse.

## 4. Discussion

Using a large, prospective sample of Swedish twins, we investigated the longitudinal associations of childhood psychopathic personality traits (combination of callous-unemotionality, grandiose-deceitfulness, and impulsivity-need for stimulation) with both self-reported delinquency and register-based criminality, substance use problems, and anxiety and depression. We found a similar pattern regardless of whether the outcomes were measured using self-reports or derived from population-based registers of health and crime records: psychopathic personality traits at age 9/12 were associated with an increased risk of all outcomes, but the associations with substance use problems and anxiety/depression appeared to be mainly explained by childhood CD and ADHD symptoms. The association of psychopathic personality traits with delinquency and violent crime persisted after accounting for CD and ADHD symptoms, and demographic and family-related covariates. Our findings support the notion that childhood psychopathic personality traits do predict later antisocial behavior even when other important risk factors are accounted for (Frick et al., 2014), although their independent associations were rather modest. For example, one standard deviation increase in psychopathic personality traits was associated with a 12% increase in the risk of violent crime, an estimate consistent with earlier studies (Kennealy et al., 2010; Walters, 2003).

As we found no evidence of sex differences, the association of psychopathic personality traits with criminality and psychiatric outcomes seems similar in both males and females, which is in line with earlier meta-analyses investigating the association of psychopathic personality traits with conduct problem severity and delinquency in children and adolescents (Asscher et al., 2010; Geerlings, 2020; Longman et al., 2016). On the other hand, studies using adult forensic samples have found evidence for sex-differences, specifically, that the affective-interpersonal domain of psychopathy performs better at predicting antisocial behavior in women, whereas the behavioral domain appears to have a more important role in men (Cale & Lilienfeld, 2002; Thomson, Bozgunov, Psederska, & Vassileva, 2019).

In a further analysis, we found children with high levels of both psychopathic personality traits and CD symptoms to have a 4-fold increased risk of being suspected of crime when compared to the “normative” group (i.e., those without high psychopathic personality traits and CD symptoms). Our findings are similar to previous community-based studies showing that the combination of high levels of both psychopathic personality traits and conduct problems in childhood was strongly associated with subsequent antisocial outcomes, such as conduct problems and aggression (Andershed et al., 2018; Frogner et al., 2016; Colins, et al., 2018; López-Romero et al., 2012). However, the estimates for those with high psychopathic personality traits and CD symptoms and those with high CD symptoms only were similar and had overlapping confidence intervals, and thus strong conclusion regarding the difference in the risk of being suspected of crime in these groups cannot be made. In both of these groups, criminal suspicions started accumulating quite early, reaching a cumulative incidence of nearly 40% by the age of 21. The risk of being suspected of crime in children with high psychopathic personality traits only was lower than in the other two groups, but still slightly elevated when compared to the normative group.

Taken together, it seems that psychopathic personality traits *per se* are not a strong predictor of future criminality, when compared to CD symptoms. The combination of both high psychopathic personality traits and high CD symptoms is clearly associated with an elevated risk of subsequent criminality, but based on our results it remains inconclusive whether the association is stronger than for high CD symptoms only. Although the findings from group-based analyses seem to contradict with the results based on the full distribution of psychopathic personality traits, it should be noted that also in the main analysis, the independent association of psychopathic personality traits with non-violent crimes was weak and statistically non-significant.

Childhood psychopathic personality traits were not associated with substance use outcomes or anxiety and depression once we adjusted for CD and ADHD symptoms. However,

the association of psychopathic personality traits with substance use problems was ambiguous, as the estimates remained elevated after the adjustment, but were imprecise and statistically non-significant. Other community-based studies suggest that the association is likely explained by co-occurring antisocial behavior (Loney et al., 2007; Wymbs et al., 2012). Further, psychopathic personality traits do not appear to be independently related to anxiety and depression, because the associations attenuated almost entirely once ADHD symptoms were accounted for. Hervey Cleckley's (1941) original clinical description of the adult psychopath includes the absence of "nervousness and psychoneurotic manifestations" as one of the core characteristics of psychopathy, but we find no support for a negative correlation between psychopathic traits and anxiety/depression at least during the developmental period from childhood to late adolescence. Studies using community samples of adolescents have also indicated that psychopathic personality traits are not associated with an increased risk of internalizing psychopathology (Hyde et al., 2015; Pardini & Fite, 2010), while some studies report contradicting results (Moran et al., 2009; Fontaine et al., 2011). There is growing evidence of a subtype of psychopathic personality, so-called "secondary psychopathy", which is characterized by anxiety and emotion regulation problems in addition to psychopathic traits (Yildirim & Derksen, 2015), although research on this topic in children and adolescents is still unsystematic and inconclusive (Colins, Fanti, Salekin, Mulder, & Andershed, 2018). As we did not study this subtype specifically, our findings on anxiety/depression may not apply to this subgroup of individuals with psychopathic personality traits.

Our study had several limitations, which should be addressed. First, a large proportion of the sample was lost to follow-up during the CATSS age 18 phase. Higher levels of psychopathic personality traits, CD, and ADHD symptoms at baseline were associated with dropping out of the study, which could potentially bias our estimates. To counterbalance this limitation, we also studied register-based outcomes, with data available for the entire sample. Register-based data have different types of limitations, as the national registers only include diagnosed cases among

the treatment-seeking population in inpatient and outpatient care, and individuals suspected by the police of a crime. Common psychiatric disorders are often treated at the primary care level in Sweden (Sundquist, Ohlsson, Sundquist, & Kendler, 2017), and some individuals do not seek treatment. Thus, individuals with more severe psychopathology and circumstances that allow for seeking help may be overrepresented in the register data. Further, since a large number of crimes remain unrecorded by the police (Kirk, 2006), part of the individuals who had committed crimes are likely to have no criminal suspicions in our data. Then again, our findings were generally similar regardless of how the outcome was measured, which increases the confidence that the observed associations were not merely a product of selection bias.

Second, while the CATSS constitutes a large sample, the register-based outcomes were, as expected, relatively rare. Due to a small number of individuals suspected of crime in some of the CD and psychopathic personality traits groups, we conducted the group-based analyses only for any crime (i.e., violent and non-violent crime). Future studies could expand on our analyses to investigate whether high psychopathic personality traits and CD are associated with different types of crimes: for instance, psychopathy and CD may be differentially correlated with offences such as white-collar and property crimes. Confidence intervals in the group-based analyses were also wide and overlapping due to the size of some of the groups. This prevented us from drawing strong conclusions on whether having high psychopathic personality traits in combination with high levels of CD symptoms was associated with a higher risk of being suspected of crime than high CD symptoms only, even if the point estimate was slightly higher in the combined group.

Third, in the CATSS study, psychopathic personality traits were measured with a short version of the CPTI. The CPTI is a well-validated scale (Colins et al., 2014; Colins et al., 2017; López-Romero et al., 2019; Somma et al., 2016; Wang et al., 2018), but the psychometric properties of the short version of the CPTI have not yet been examined. We decided not to examine specific psychopathic personality dimensions due to the limited number of items on

each factor. Thus, we cannot exclude the possibility that the associations in our study are driven by specific CPTI items, such as items referring to impulsivity-need for stimulation (Vincent et al., 2008).

Finally, while we were able to control for several potential confounders, we did not have access to information on mediating factors such as affiliation with delinquent peers, which may contribute to the observed associations.

#### *4.1. Conclusions*

We conclude that childhood psychopathic personality traits are modestly associated with subsequent criminality even after accounting for CD and ADHD symptoms. The combination of high levels of psychopathic personality traits and CD symptoms is associated with an elevated risk of being suspected of crime, but it remains unclear whether the risk is higher than in children displaying high levels of CD symptoms only. Further, psychopathic personality traits are not associated with substance use problems or anxiety/depression once CD and ADHD symptoms are accounted for.

Psychopathic personality traits in childhood constitute a risk marker for subsequent criminality, but given their relatively weak independent association with criminality, they are unlikely to be an efficient target for a large-scale community-based prevention program. More research is needed to investigate whether children with both psychopathic personality traits and conduct problems would benefit from similar interventions as those with CD only, or if individuals with psychopathic personality traits require a specialized intervention to mitigate the risk of future criminality and psychiatric outcomes (Hawes, Price & Dadds, 2014). Interventions that address the multiple components involved in increasing the risk of antisocial behavior (i.e., psychopathic personality traits, CD, ADHD) have shown promising results: they often involve comprehensive modular treatment including medication for ADHD and cognitive behavioral therapy in conjunction with parenting training (Hawes et al., 2014). Further, we found that the

records of being suspected of crime started accumulating rapidly after age 15 (the age of criminal responsibility in Sweden) in individuals with high levels of CD symptoms and psychopathic personality traits compared to the “normative” group. This suggests that an intervention aiming to reduce the risk of criminality may be the most beneficial earlier in childhood. Other studies support this conclusion by indicating that treatment programs for conduct problems in individuals with callous-unemotional traits are more effective in children than in adolescents (Hawes et al., 2014).

From a risk assessment perspective, similarly to what is often found in studies using adult and forensic samples, the modest independent contribution of psychopathic personality traits to subsequent antisocial behavior keeps raising concerns whether the measurement of psychopathy should be included in the risk prediction of antisocial behavior in applied settings.

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## Tables

**Table 1**  
Descriptive statistics

	At baseline			CATSS age 18 follow-up sample <sup>a</sup>		
	Mean (SD)	Range	n (%)	Mean (SD)	Range	n (%)
<u>Age 9/12 measures</u>						
Psychopathic personality traits	4.4 (3.8)	0-36		4.1 (3.5)	0-28	
CD symptoms	0.1 (0.4)	0-9		0.1 (0.3)	0-4	
ADHD symptoms	1.8 (2.8)	0-18		1.4 (2.4)	0-18	
<u>Psychopathic traits and CD groups</u>						
Normative			10,618 (85.7)			
High CD symptoms only			236 (1.9)			
High psychopathic traits only			1,230 (9.9)			
High psychopathic traits + CD			310 (2.5)			
<u>Covariates</u>						
<u>Father's education level</u>						
Primary school			1,592 (12.8)			573 (11.5)
Secondary school			6,259 (50.5)			2,392 (47.8)
University			4,265 (34.4)			1,909 (38.1)
Doctoral			218 (1.8)			108 (2.2)
Unknown			60 (0.5)			22 (0.4)
<u>Mother's education level</u>						
Primary school			666 (5.3)			231 (4.6)
Secondary school			6,009 (48.5)			2,288 (45.7)
University			5,549 (44.8)			2,417 (48.3)
Doctoral			122 (1.0)			50 (1.0)
Unknown			48 (0.4)			18 (0.4)
<u>Parental immigration status</u>						
Both parents born in Sweden			10,486 (84.6)			4,380 (86.1)
One parent immigrant			1,186 (9.6)			455 (9.1)
Both parents immigrants			722 (5.8)			241 (4.8)
<u>Parental psychopathology</u>						
			2,821 (22.8)			990 (19.8)
<u>Self-report outcomes (age 18)</u>						
Delinquency				5.9 (6.4)	0-93	
Alcohol use problems				4.8 (4.3)	0-34	
Ever used drugs						279 (5.6)
Anxiety/depression				2.0 (3.2)	0-24	
<u>Register-based outcomes</u>						
Suspicion of any crime			1,072 (8.7)			
Suspicion of violent crime			402 (3.2)			
Suspicion of non-violent crime			897 (7.2)			
Substance use disorder			296 (2.4)			
Anxiety/depressive disorder			538 (4.3)			

Note: <sup>a</sup> Descriptive statistics reported for variables that were used in analyses of CATSS-18 sample; <sup>b</sup> Groups are mutually exclusive; CD = Conduct disorder

**Table 2**

Associations (95% CIs) of childhood psychopathic personality traits with self-reported delinquency, alcohol use problems, drug use, and anxiety/depressive symptoms at age 18

	Delinquency (coef.)	Alcohol use problems (coef.)	Drug use (OR)	Anxiety and depressive symptoms (coef.)
Minimally adjusted	<b>0.65</b> (0.41-0.90)	<b>0.19</b> (0.03-0.34)	<b>1.18</b> (1.04-1.34)	<b>0.40</b> (0.27-0.53)
Adjusted for covariates	<b>0.63</b> (0.39-0.88)	<b>0.17</b> (0.02-0.32)	<b>1.19</b> (1.04-1.35)	<b>0.38</b> (0.25-0.51)
Adjusted for ADHD	<b>0.41</b> (0.17-0.66)	<b>0.19</b> (0.03-0.36)	<b>1.18</b> (1.02-1.37)	0.10 (-0.04-0.23)
Adjusted for CD	<b>0.35</b> (0.12-0.57)	0.12 (-0.03-0.28)	1.11 (0.96-1.27)	<b>0.28</b> (0.14-0.41)
Fully adjusted	<b>0.24</b> (0.01-0.48)	0.16 (-0.01-0.32)	1.13 (0.97-1.31)	0.06 (-0.08-0.19)

Note: Coef.= Standardized coefficient from linear regression model; OR = Odds Ratio from logistic regression model; Minimally adjusted = adjusted for birth year and sex; Adjusted for covariates = adjusted for birth year, sex, parental immigration status, parental education, and parental history of psychopathology; Adjusted for ADHD = Adjusted for covariates and ADHD symptoms; Adjusted for CD = Adjusted for covariates and CD symptoms; Fully adjusted = Adjusted for covariates, conduct disorder symptoms, and ADHD symptoms; Bolded estimates indicate the 95% CI does not include 1 (ORs) or 0 (coefficients)

**Table 3**

Hazard ratios (95% CIs) for the association of childhood psychopathic personality traits with register-based criminality and psychiatric outcomes

	Violent crimes	Non-violent crimes	Substance use disorders	Anxiety and depressive disorders
Minimally adjusted	<b>1.33</b> (1.23-1.45)	<b>1.28</b> (1.22-1.36)	<b>1.29</b> (1.18-1.41)	<b>1.21</b> (1.12-1.31)
Adjusted for covariates	<b>1.27</b> (1.17-1.38)	<b>1.23</b> (1.17-1.30)	<b>1.24</b> (1.13-1.36)	<b>1.17</b> (1.08-1.27)
Adjusted for ADHD	<b>1.19</b> (1.07-1.31)	<b>1.12</b> (1.05-1.20)	<b>1.16</b> (1.01-1.32)	1.03 (0.93-1.13)
Adjusted for CD	<b>1.15</b> (1.05-1.27)	<b>1.13</b> (1.05-1.20)	<b>1.18</b> (1.06-1.32)	<b>1.11</b> (1.01-1.21)
Fully adjusted	<b>1.12</b> (1.00-1.25)	1.06 (0.99-1.14)	1.13 (0.98-1.30)	1.00 (0.90-1.11)

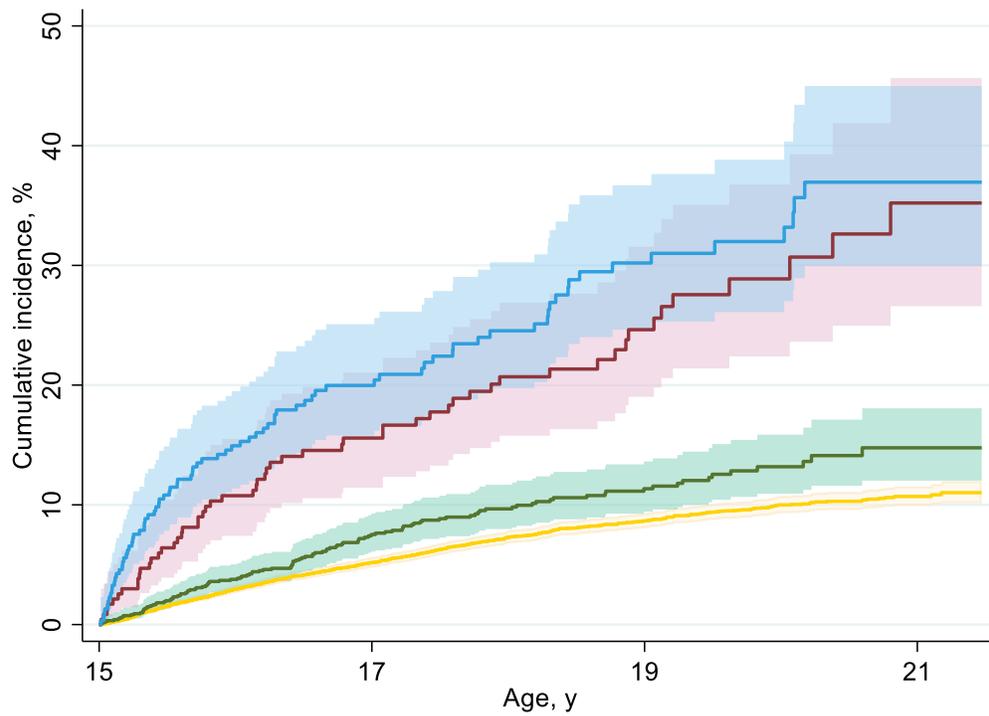
Note: Minimally adjusted = adjusted for birth year and sex; Adjusted for covariates = adjusted for birth year, sex, parental immigration status, parental education, and parental history of psychopathology; Adjusted for ADHD = Adjusted for covariates and ADHD symptoms; Adjusted for CD = Adjusted for covariates and CD symptoms; Fully adjusted = Adjusted for covariates, conduct disorder symptoms, and ADHD symptoms; Bolded estimates indicate the 95% CI does not include 1

**Table 4**

Prevalence and the relative risk of being suspected of any crime in individuals with high levels of psychopathic personality traits, conduct disorder symptoms, or both

	Suspicion of any crime, no. (%)		Minimally adjusted	Fully adjusted
	No	Yes	HR (95% CI)	HR (95% CI)
Normative	9,809 (92.4)	809 (7.6)	ref.	ref.
High CD symptoms only	179 (75.9)	57 (24.1)	<b>2.86</b> (2.18-3.76)	<b>2.14</b> (1.60-2.84)
High psychopathic traits only	1,108 (90.1)	122 (9.9)	<b>1.31</b> (1.07-1.61)	1.07 (0.85-1.34)
High psychopathic traits + CD symptoms	226 (72.9)	84 (27.1)	<b>3.72</b> (2.92-4.75)	<b>2.23</b> (1.67-2.97)

Note: Minimally adjusted = Adjusted for sex and birth year; Fully adjusted = Adjusted for all covariates and ADHD symptoms; CD = Conduct disorder; Bolded estimates indicate the 95% CI does not include 1



**Fig. 1.** Cumulative incidence (with 95% CIs) of being suspected of any crime in individuals with high levels of psychopathic personality traits, conduct disorder symptoms, or both. Blue = High psychopathic personality traits and conduct disorder symptoms; Red = High conduct disorder symptoms only; Green = High psychopathic personality traits only; Yellow = Normative