

Health, behavior, and social outcomes among offspring of parents with criminal convictions: a register-based study from Sweden

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Background: There is currently insufficient understanding of the health and behavior of children whose parents engage in criminal behavior. We examined associations between parental criminal convictions and wide range of offspring health, behavioral, and social outcomes by age 18 in a large, national sample, aiming to get a comprehensive picture of the risks among children of offending parents. **Methods:** We studied 1,013,385 individuals born in Sweden between 1987 and 1995, and their parents. Using data from several longitudinal nationwide registers, we investigated parental convictions and 85 offspring outcomes until the end of 2013, grouped into birth-related conditions, psychiatric and somatic disorders, accidents and injuries, mortality, school achievement, violent victimization, and criminality. Cox proportional hazards regression and logistic regression models were used to examine the associations. The role of genetic factors in intergenerational associations was studied in children-of-siblings analyses. We also examined the co-occurrence of multiple outcomes using Poisson regression. **Results:** A total of 223,319 (22.0%) individuals had one parent convicted and 31,241 (3.1%) had both parents convicted during the first 18 years of their life. The strongest associations were found between parental convictions and offspring behavioral problems, substance use disorders, poor school achievement, violent victimization, and criminality, with an approximately 2 to 2.5-fold increased risk in children with one convicted parent and 3- to 4-fold increased risk in children with two convicted parents. The risks were particularly elevated among children of incarcerated parents with a history of violent convictions. The associations appeared to be at least partly explained by genetic influences. Parental convictions were also associated with an increased likelihood of experiencing multiple outcomes. **Conclusions:** Our findings help to calibrate the risks of a wide range of adverse outcomes associated with parental convictions and may be used to guide prevention efforts and identify key areas for future research. **Keywords:** Criminality; epidemiology; family factors; longitudinal studies; psychopathology.

Introduction

Parental antisocial behavior is likely to have wide-ranging links with offspring health, behavior, and well-being. Research in the area has mainly focused on parental incarceration, which has been associated with elevated risks for adverse outcomes such as illicit drug use, mental health disorders, and antisocial behavior (e.g., Austin, White, & Kim, 2022; Murray, Farrington, & Sekol, 2012; Rowell-Cunsolo, Bellerose, & Borbely, 2022). However, findings on parental incarceration may not generalize to parental criminality more broadly, as most sentences do not lead to imprisonment.

Associations between parental criminality and offspring health and behavioral outcomes have been studied to varying degrees. Intergenerational transmission of criminal behavior is well established (Besemer, Ahmad, Hinshaw, & Farrington, 2017), whereas knowledge of the mental and somatic health of children of parents with criminal offending is more varied. In a systematic review of 19 studies, parental

offending was associated with an increased risk of poor physical health and drug use in offspring, whereas evidence on mental health problems was more inconsistent (Whitten, Burton, Tzoumakis, & Dean, 2019). Comparisons between studies were challenging due to considerable variation in outcome measures, leaving the overall picture of the health and behavior of children exposed to parental criminality unclear. Moreover, generalizability of the review's findings was limited because most studies were based on selected samples of disadvantaged offspring or conducted in the United States. Further, many previous studies based on small samples have not been able to examine maternal offending reliably due to its low prevalence, leading to mixed findings (Laurens et al., 2017; Lee, Fang, & Luo, 2013; Wildeman, Goldman, & Turney, 2018). As a response to these methodological limitations in previous work, researchers have called for the use of large and representative samples, longitudinal data, and objective measures (Laurens et al., 2017; Murray et al., 2012; Whitten, Burton, et al., 2019; Wildeman et al., 2018).

Recently, the need for interdisciplinary research examining the associations of parental criminality with

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a wide range of offspring psychiatric, somatic, behavioral, and social outcomes has also been stressed (Boch et al., 2021; Whitten, Burton, et al., 2019; Wildeman et al., 2018). To our knowledge, only one study has simultaneously examined a wide range of outcomes among children affected by the correctional system. This US study of 2.3 million youth aged 0–21 years (Boch et al., 2021), based on electronic health record data, found an increased risk of multiple psychiatric and somatic diagnoses and adverse social outcomes, such as being taken into welfare custody, among children and youth who had either personal or family involvement with the criminal justice system. However, the study was limited by being unable to distinguish offspring's own criminal justice involvement from that of family members.

Associations between parental offending and offspring health and behavior could arise due to several mechanisms. First, parental offending could have a direct impact on offspring; for example, by affecting family relationships, causing stress and social stigma, and reducing household income, all of which can result in poorer health for family members (e.g., Austin et al., 2022; Jackson, Testa, Semenza, & Vaughn, 2021; Murray et al., 2012; Turney, 2014, 2017). Second, there also is likely to be pre-existing environmental stressors accumulated in families with parental offending, potentially leading to unmet health care needs, delayed treatment, and poor somatic health in offspring (Jackson et al., 2021; Murray et al., 2012; Turney, 2017; van de Weijer, Besemer, & Dennison, 2021; Whitten, Burton, et al., 2019). Finally, genetics plays a role in intergenerational associations (Murray et al., 2012; van de Weijer et al., 2021; Whitten, Burton, et al., 2019); for example, antisocial behavior, externalizing disorders, and other psychiatric disorders share genetic liabilities (Baselmans, Yengo, van Rheenen, & Wray, 2021). To better understand the underlying mechanisms, the need for genetically informative research designs has been emphasized (Murray et al., 2012; Whitten, Burton, et al., 2019).

We conducted a comprehensive study on the intergenerational links between parental criminal convictions and offspring outcomes using longitudinal Swedish population register data. We studied associations of convictions of one or both parents with a wide range of outcomes in offspring followed up from birth to age 18 years, including birth-related conditions, psychiatric and somatic disorders, psychotropic medication use, substance use disorders, accidents, school achievement, victimization, criminality, and mortality, expecting offspring of convicted parents to have poorer overall health and higher risk of harmful behavior compared to children of non-convicted parents. To better understand these associations and to examine different aspects of parental offending in more detail, we conducted further analyses for selected outcomes by distinguishing between violent and non-violent convictions, separating parental incarceration from other sanctions, and analyzing maternal and paternal

convictions separately. We examined the plausible role of genetic factors accounting for part of the intergenerational associations in genetically informative children-of-siblings analyses. We also examined the co-occurrence of multiple adverse outcomes.

Methods

Study population

We conducted a population-based cohort study using data from several Swedish longitudinal registers available until the end of 2013. Data from different registers were linked using the personal identity number, issued for all people residing in Sweden.

We identified people born in Sweden between January 1, 1987, and December 31, 1995, as the offspring ($N = 1,040,980$), using information from the Total Population Register of Statistics Sweden (Ludvigsson et al., 2016). The selection of the study cohort allowed register coverage until the age of 18 years for all offspring. The Multi-Generation Register (Ekbom, 2011) was used to identify biological parents of each individual. Those with missing information on father's or mother's identity were excluded ($N = 14,841$). Information on parental convictions was available from 1973 onwards; to minimize missingness in the exposure, we excluded children whose parents were born before January 1, 1943 ($N = 12,754$). The final study population included 1,013,385 children and their parents ($N = 1,298,573$).

The use of register linkages has been approved by the Regional Ethical Review Board of Stockholm (Dnr 2013/862–31/5). Personal consent was not required for this register-based study, and all data have been anonymized prior to research use.

Measures

Exposure. The National Crime Register (Brottsförebyggande rådet, 2023) includes information on all criminal convictions from district courts to individuals aged 15 years (the legal age of criminal responsibility in Sweden) and above from 1973 onwards. The register contains information on the timing and type of offense and the sanction imposed. The types of offenses are described in the Supporting Information (Table S1). We studied parental convictions registered between the child's birth and turning 18 years in order to account for the possibility of a direct effect of exposure. For analyses of birth-related outcomes, parental offending was defined as convictions before the child's birth, regardless of whether the parents committed offenses afterwards. Child's age at the time of exposure was derived from the date of conviction, as information on the timing of offenses was often missing.

We used five different definitions of parental offending, described in detail in Appendix S1. Briefly, we defined parental offending (1) as a three-level variable indicating criminal convictions of none, one, or two parents, (2) as violent vs. non-violent convictions, separately for fathers and mothers, (3) as violent vs. non-violent convictions further stratified by parental imprisonment, separately for fathers and mothers, (4) as convictions of violent, drug, property, and white-collar crimes, separately for fathers and mothers, and (5) as any parental conviction.

Outcomes. We studied a total of 85 offspring outcomes, grouped into ten subcategories: mental and developmental disorders (27 outcomes), substance use disorders (3), psychotropic medication (8), somatic disorders (19), birth and perinatal period conditions (5), violent victimization (1), accidents, injuries, and suicide attempts (5), mortality (5), criminal convictions and suspicions (10), and school

achievement (2). The outcomes were derived from the National Patient Register (Ludvigsson et al., 2011), the Cause of Death Register (Brooke et al., 2017), the Prescribed Drug Register (Wallerstedt, Wettermark, & Hoffmann, 2016), the Medical Birth Register (Cnattingius et al., 2023), the National Crime Register, the Register of Persons Suspected of Offenses (Brottsförebyggande rådet, 2023), and the Year 9 Register. We used information on the first occurrence of each outcome in the analyses, except for school achievement and birth-related outcomes, which were binary variables. The outcome variables are described in detail in the Supporting Information (Appendix S1, Table S2, and Table S3).

Covariates. We included child's sex, offspring and parental birth years, and parental immigration status as demographic covariates. Birth year variables were treated as categorical. Dichotomous variables for maternal and paternal immigration status indicated the parent's country of birth (Sweden vs. other countries), obtained from the Total Population Register. Missing values for immigration status were coded as a separate category. In further analyses, we also adjusted for highest parental education and parental psychiatric disorders (described in Appendix S1).

Statistical analysis

We used Cox proportional hazards regression models to examine the associations between parental convictions and all time-to-event outcomes. Separate models were fitted for each outcome, using age as the underlying time scale. Individuals were followed up from birth until the first occurrence of each outcome (i.e., first diagnosis of each disorder and other health-related condition, first prescription of each drug, and first conviction for each offense), emigration, death, or 18 years of age, whichever occurred first. For criminal convictions and suspicions, follow-up started when the offspring turned 15 years (the legal age of criminal responsibility in Sweden). Information on offspring emigration and death dates was obtained from the Migration Register and the Cause of Death Register, respectively. The Cox models provided hazard ratios (HR) estimating the relative hazard of the occurrence of each outcome during the follow-up period among children with convicted parents compared to those of non-convicted parents. We fitted logistic regression models for school achievement and birth-related outcomes. The models provided odds ratios (OR) estimating the odds of each outcome occurring in children with convicted parents relative to the children of parents without convictions.

We conducted more detailed analyses to examine the associations of parental violent and non-violent convictions with a selection of key outcomes, stratified by parental imprisonment in order to see whether parental prison sentence moderated the associations. These key outcomes were chosen to represent different domains of health and behavior, the selected variables being representative of the whole domain or being the most prevalent outcome. We also conducted children-of-siblings analyses for the key outcomes by comparing cousins who were differentially exposed to parental convictions (D'Onofrio et al., 2003; D'Onofrio, Lahey, Turkheimer, & Lichtenstein, 2013; McAdams et al., 2014). We fitted separate Cox regression/logistic regression models for different types of extended families, that is, children of half-siblings and children of full-siblings or dizygotic twins. Models for children of monozygotic twins produced highly imprecise estimates and were not carried forward. The models were conducted separately for paternal and maternal convictions and adjusted for child's sex and child's and parent's birth years. These family-based models account for all measured and unmeasured environmental and genetic factors that are constant across extended family members. As children in these different types of families differ in their genetic relatedness to

their uncle or aunt, comparing the risk of each outcome between different family types (e.g., children of half-siblings versus full-siblings/dizygotic twins) provides information on the extent to which genetic influences explain the association between parental convictions and the outcomes.

We further examined how paternal/maternal violent and non-violent convictions were associated with the accumulation of different outcomes using Poisson regression. The outcome was defined as a count variable indicating the number of outcomes (0, 1, 2, 3, 4, 5 or more) that occurred during the first 18 years of the child's life using the nine outcome subcategories of the study (treating psychiatric disorders and psychotropic medication as a single category, and excluding mortality). Differences in follow-up time were taken into account by defining an offset variable based on death, emigration, turning 18 years, or end of register coverage in December 31, 2013, whichever occurred first. The models provided incidence rate ratios (IRR) indicating how exposure to parental convictions was associated with the rate of outcomes.

We conducted several additional analyses. First, we examined the associations of parental violent, drug, property, and white-collar convictions with children's psychiatric outcomes and criminal convictions, described in detail in Appendix S1. Second, to account for the timing of parental convictions in relation to offspring outcomes, we conducted a sensitivity analysis for seven time-to-event key outcomes using parental convictions as a time-varying exposure. Third, we conducted a sensitivity analysis restricting the sample to offspring whose parents had no missing information on criminal convictions (parents born after 1957). Fourth, we conducted an additional analysis for the key outcomes defining exposure as parental convictions at any time before the age of 18 years, including convictions that occurred before the birth of the child. Finally, to account for possible effects of the parent coresiding with the child vs. not, we conducted analyses stratified by the number of years the offspring lived in the same neighborhood with their parents (Appendix S1).

Precision of the estimates was assessed using 95% confidence intervals in both Cox regression and logistic regression models. In the main analysis of 85 outcomes, we also provide multiple testing corrected statistical significance, incorporated by controlling the false discovery rate at 5% level using the Benjamini-Hochberg procedure. To account for the dependence between siblings sharing common parents, cluster-robust standard errors were used in analyses. Analyses were performed using Stata, versions 17 and 18 (StataCorp, 2021, 2023).

Results

The study population consisted of 1,013,385 children (51.3% males, 48.7% females) and their parents. The number of children with a father and a mother who had criminal convictions was 223,695 (22.1%) and 62,106 (6.1%), respectively. Of offspring of convicted fathers and mothers, 19.7% and 6.8%, respectively, experienced parental imprisonment. A total of 223,319 (22.0%) individuals had one parent convicted and 31,241 (3.1%) had both parents convicted during the first 18 years of their life. Descriptive information on parental characteristics is presented in Table 1.

Figure 1 displays HRs and 95% confidence intervals (CI) for health, behavioral, and social outcomes during the follow-up among children whose one or both parents had been convicted as compared to children of non-convicted parents. For school achievement and birth-related outcomes, ORs and

Table 1 Characteristics of offspring with fathers and mothers with and without criminal convictions in the first 18 years of the child's life

	Fathers		Mothers	
	Offspring with paternal convictions (<i>N</i> = 223,695)	Offspring without paternal convictions (<i>N</i> = 789,690)	Offspring with maternal convictions (<i>N</i> = 62,106)	Offspring without maternal convictions (<i>N</i> = 951,279)
Parent's highest education, <i>N</i> (%)				
Compulsory	54,563 (24.4)	120,991 (15.3)	14,711 (23.7)	90,931 (9.6)
Upper secondary	125,109 (55.9)	404,596 (51.2)	32,997 (53.1)	482,342 (50.7)
Post secondary	42,739 (19.1)	260,524 (33.0)	14,093 (22.7)	374,200 (39.3)
Missing data	1,284 (0.6)	4,579 (0.6)	305 (0.5)	3,806 (0.4)
Parent's psychiatric disorder, <i>N</i> (%)	63,873 (28.6)	75,836 (9.6)	25,145 (40.5)	137,845 (14.5)
Parent's immigration status, <i>N</i> (%)				
Born in Sweden	116,721 (74.5)	696,085 (88.2)	45,150 (72.7)	827,273 (87.0)
Immigrant	56,947 (25.5)	93,477 (11.8)	16,950 (27.3)	123,971 (13.0)
Missing data	27 (0.01)	128 (0.02)	6 (0.01)	35 (0.00)
Parent's birth year, median (1st and 3rd quartiles)	1961 (1956, 1965)	1960 (1955, 1964)	1964 (1960, 1968)	1963 (1959, 1966)
Parental convictions, <i>N</i> (%)				
Violent conviction ^a	53,042 (23.7)	–	7,844 (12.6)	–
Drug conviction	18,287 (8.2)	–	4,656 (7.5)	–
Property conviction	44,889 (20.1)	–	21,452 (34.5)	–
White-collar conviction	223,695 (15.7)	–	11,526 (18.6)	–
Traffic conviction	132,181 (59.1)	–	24,803 (39.9)	–
Other conviction	93,616 (41.9)	–	16,344 (26.3)	–
Parent's number of convictions, median (1st and 3rd quartiles)	2 (1, 5)	–	2 (1, 3)	–
Parental imprisonment, <i>N</i> (%)	44,060 (19.7)	–	4,246 (6.8)	–

^aIncludes violent and sexual convictions.

95% CIs are presented. Overall, having two convicted parents was associated with more elevated risks of different outcomes than having one convicted parent. Convictions of one and both parents were associated with a 45% (HR, 1.45 [95% CI, 1.43–1.47]) and 112% (HR, 2.12 [95% CI, 2.06–2.18]) increased risk for any mental disorder in offspring, respectively, with the strongest associations found for conduct disorder (HRs, 2.24 and 4.28), PTSD (HRs, 1.90 and 3.53), personality disorders (HRs, 1.63–1.84 and 3.16–3.87), and ADHD (HRs, 1.85 and 3.06). The results for psychotropic medication were in line with those for psychiatric disorders. We found associations between parental convictions and offspring substance use disorders, with HRs between 1.75 and 2.29 in offspring with one convicted parent, and between 3.02 and 4.22 in offspring with two convicted parents. Among somatic outcomes, the risks of sexually transmitted diseases and obesity were clearly elevated in both children with one convicted parent (HRs, 1.52 and 1.42, respectively) and two convicted parents (HRs, 2.36 and 1.84, respectively), while for other conditions the associations were weaker or non-existent. Parental convictions before the birth of the child were associated with a modestly increased risk for all offspring birth-related conditions in both groups of children, with slightly higher risks typically seen in children

with two convicted parents. We found convictions of one and both parents to be associated with an increased risk for offspring suicide attempts (HRs 1.85 and 3.15, respectively), violent victimization (HRs 1.97 and 3.29, respectively), and all forms of criminal convictions (HRs between 1.84 and 2.62, and between 3.10 and 5.64, respectively) and suspicions (HRs between 1.62 and 2.29, and between 2.23 and 4.45, respectively). Convictions of one or both parents were also associated with an elevated risk for offspring's death from external causes (HRs, 1.44 and 2.06, respectively) and offspring's suicide (HRs, 1.59 and 2.55, respectively). We also found children with one or two convicted parents to have increased odds for low school grades (ORs, 1.99 and 3.80, respectively), and reduced odds of eligibility to apply for upper secondary education (ORs, 0.51 and 0.27, respectively). Results from the more adjusted models are shown in the Supporting Information (Figure S1). The results of these models showed similar patterns to those of less adjusted models, although the associations were generally weaker.

The cumulative incidence of each outcome by age 18 years among individuals with none, one or two convicted parents is presented in Table S4. Of all outcomes, the highest cumulative incidences were observed for accidents (37.8%–45.0%), injuries

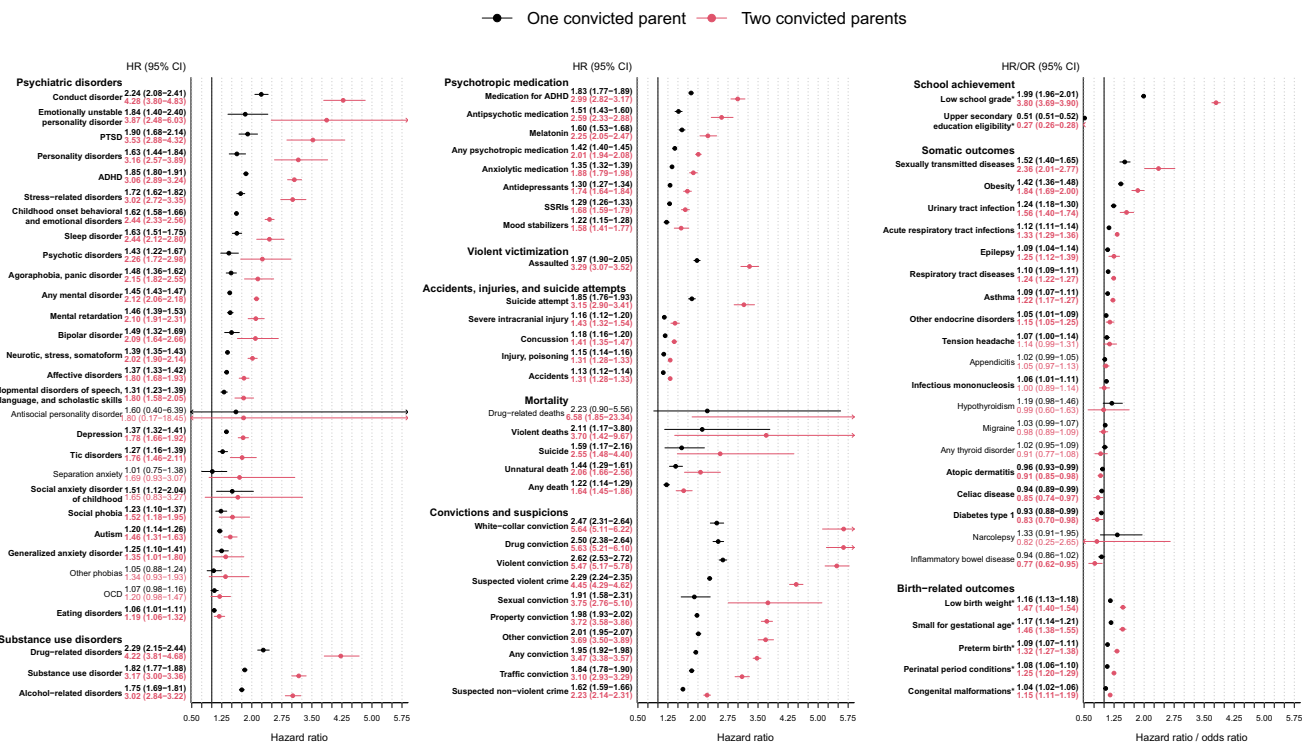


Figure 1 Associations between parental convictions and offspring health, behavior, and social outcomes. Parental convictions were registered between the child's birth and turning 18 years. For birth-related outcomes, parental convictions before the child's birth were registered (number of children with none, one, and two convicted parents before their birth was 630,048, 338,564, and 44,733, respectively). All models were adjusted for child's sex, child's birth year, parents' birth years, and parental immigration status. Hazard ratios (HR) or odds ratios* (OR) with 95% confidence intervals (CI) are presented. Statistically significant results after multiple testing corrections using the FDR method (with 5% FDR value) are in bold. The sample size was 960,589 in the analyses for school achievement outcomes due to missing data

(44.2%–52.9%), respiratory diseases (27.4%–33.1%), and any mental disorder (9.0%–18.5%) in all groups of children, while the cumulative incidence of specific psychiatric diagnoses, victimization, and mortality was generally very low. Kaplan–Meier curves for selected key outcomes are presented in the Supporting Information (Figures S2–S8).

Table 2 shows the associations of paternal and maternal violent and non-violent convictions with a selection of eight offspring outcomes, stratified by parental incarceration. Paternal violent and non-violent convictions were both associated with an elevated risk for most of these outcomes, with higher risks typically seen for violent convictions. The risks tended to be higher if the father was sentenced to prison. The associations for convicted mothers were generally stronger than for convicted fathers, but confidence intervals were wider, and in general the results with respect to type of offending and sanction were not quite as systematic as seen in fathers.

The children-of-siblings analyses, presented in Table 3, found that the associations between paternal and maternal convictions and offspring key outcomes generally attenuated toward models that accounted for more genetic factors. For example, the association between paternal convictions and offspring substance use disorder was strongest in the

full population model (HR, 1.94 [95% CI, 1.88–2.00]), reduced in the children of half-siblings model (HR, 1.47 [95% CI, 1.17–1.84]) and was weakest in the children of full-siblings model (HR, 1.27 [95% CI, 1.01–1.60]). The overall pattern was generally quite similar for paternal and maternal convictions.

The Poisson regression models, presented in Table 4, found that both paternal and maternal non-violent and violent convictions were associated with an increased rate of outcomes. Exposure to maternal violent convictions, for example, was associated with an 8.11-fold (1.52⁵) increased risk of experiencing five or more adverse outcomes compared to non-exposed children.

Table S5 presents HRs for eight psychiatric disorders associated with paternal violent, drug, property, and white-collar convictions. Both paternal violent and different types of non-violent convictions were associated with the outcomes; however, when the models for paternal non-violent convictions were adjusted for paternal violent convictions, the HRs were somewhat reduced. The results for maternal convictions and offspring psychiatric disorders showed similar patterns to those for fathers, but the associations were stronger for many outcomes (Table S6). The same pattern was also seen in the associations between different types of paternal/maternal convictions and offspring convictions, and

Table 2 Associations of paternal and maternal violent and non-violent convictions with offspring health and behavioral outcomes, stratified by paternal/maternal imprisonment

	Paternal convictions				Maternal convictions			
	Violent convictions		Non-violent convictions only		Violent convictions		Non-violent convictions only	
	Imprisonment HR (95% CI)	No imprisonment HR (95% CI)	Imprisonment HR (95% CI)	No imprisonment HR (95% CI)	Imprisonment HR (95% CI)	No imprisonment HR (95% CI)	Imprisonment HR (95% CI)	No imprisonment HR (95% CI)
Any mental disorder	2.37 (2.29–2.44)	1.92 (1.86–1.98)	1.77 (1.71–1.85)	1.26 (1.24–1.28)	2.45 (2.20–2.73)	2.39 (2.26–2.52)	1.87 (1.70–2.05)	1.55 (1.51–1.59)
Substance use disorder	3.25 (3.06–3.46)	2.41 (2.26–2.57)	2.50 (2.32–2.70)	1.54 (1.49–1.60)	3.34 (2.71–4.12)	2.91 (2.61–3.25)	3.19 (2.72–3.73)	2.01 (1.91–2.11)
Assaulted	4.00 (3.74–4.29)	2.71 (2.51–2.92)	2.42 (2.20–2.67)	1.65 (1.58–1.73)	3.96 (3.12–5.03)	3.31 (2.92–3.75)	2.86 (2.34–3.51)	1.93 (1.81–2.05)
Any death	1.55 (1.35–1.79)	1.16 (1.00–1.34)	1.42 (1.20–1.67)	1.20 (1.12–1.28)	3.07 (2.13–4.44)	1.43 (1.08–1.89)	1.25 (0.82–1.93)	1.38 (1.25–1.52)
Any conviction	3.45 (3.34–3.55)	2.41 (2.33–2.49)	2.77 (2.67–2.88)	1.74 (1.71–1.77)	4.40 (3.98–4.87)	2.87 (2.71–3.05)	3.26 (3.01–3.54)	2.08 (2.03–2.13)
Asthma	1.27 (1.21–1.33)	1.19 (1.14–1.24)	1.17 (1.11–1.24)	1.06 (1.03–1.08)	1.18 (0.98–1.41)	1.26 (1.16–1.38)	1.12 (0.98–1.28)	1.11 (1.07–1.15)
Obesity	1.94 (1.77–2.13)	1.66 (1.52–1.82)	1.79 (1.61–2.00)	1.29 (1.22–1.35)	1.10 (0.71–1.70)	1.54 (1.28–1.85)	1.63 (1.24–2.15)	1.57 (1.47–1.69)
Low school grade*	4.05 (3.93–4.17)	2.90 (2.82–2.99)	3.08 (2.98–3.19)	1.71 (1.68–1.74)	4.54 (4.02–5.13)	3.53 (3.32–3.74)	4.14 (3.80–4.52)	2.18 (2.13–2.23)

Paternal convictions were registered between the child's birth and turning 18 years. All models were adjusted for child's sex, child's birth year, parent's birth year, and parent's immigration status. Hazard ratios (HR) or odds ratios* with 95% confidence intervals (CI) are presented.

the associations for mothers were similarly stronger than those for fathers (Tables S7 and S8).

In the sensitivity analyses, we found that treating parental convictions as a time-varying exposure produced highly similar results compared to analyses that did not consider the temporal ordering of exposure and outcomes (Table S9). In analysis where the sample was restricted to offspring of parents without missing information on convictions (Table S10), there was little difference in the associations compared to those of analyses that included the full sample. We found no systematic differences in the strength of associations when exposure was defined as parental convictions between the child's birth and turning 18 years (Table 2) vs. when exposure also included convictions that occurred before the child's birth (Table S11). Finally, we found that the associations between parental convictions and many offspring outcomes were often stronger in cases where the child and parent lived in the same neighborhood for most of the first 13 years of the child's life, compared to living in different neighborhoods (Table S12), but the absolute risks of outcomes were higher for those who lived in a different neighborhood from their parents (Figure S9).

Discussion

This nationwide study of more than one million individuals helps shed light on the health and behavioral outcomes of children of convicted parents. To our knowledge, no similar studies on this scale have been conducted. We found parental convictions to be associated with a wide range of adverse health and behavioral outcomes in children during their first 18 years of life. The highest risks were found in children whose both parents had been convicted, consistent with previous evidence (e.g., Bell, Bayliss, Glauert, & Ohan, 2018). The strongest associations were found between parental offending and offspring behavioral problems, substance use disorders, poor school achievement, violent victimization, and criminal convictions and suspicions, with an approximately 2- to 2.5-fold increased risk in children with one convicted parent and 3- to 4-fold increased risk in children with two convicted parents. To put the results into perspective, the absolute risks of many outcomes, such as conduct disorder (0.6%–1.2%) and ADHD (3.2%–5.2%), remained relatively low among children of convicted parents, while criminal convictions (12.0%–21.7%) and poor school grades (28.5%–44.7%) were more common.

Our findings are in line with previous studies linking parental offending and imprisonment to offspring externalizing problems and antisocial behavior (Besemer et al., 2017; Luk, Hui, Tsang, Fung, & Chan, 2022; Murray et al., 2012), use of drugs and other substances (Boch et al., 2021;

Table 3 Children-of-siblings analysis. Associations between paternal and maternal convictions and offspring outcomes in the full population and the within-family models with two types of sibling parents with increasing genetic relatedness

	Paternal criminal convictions			Maternal criminal convictions		
	Full population <i>N</i> = 1,013,385 HR (95% CI)	Within-family models		Full population <i>N</i> = 1,013,385 HR (95% CI)	Within-family models	
		Children of half-siblings <i>N</i> = 90,212 HR (95% CI)	Children of full-siblings <i>N</i> = 184,466 HR (95% CI)		Children of half-siblings <i>N</i> = 103,563 HR (95% CI)	Children of full-siblings <i>N</i> = 190,406 HR (95% CI)
Any mental disorder	1.50 (1.47–1.52)	1.28 (1.15–1.42)	1.20 (1.08–1.35)	1.66 (1.62–1.69)	1.32 (1.14–1.53)	1.28 (1.10–1.49)
Substance use disorder	1.94 (1.88–2.00)	1.47 (1.17–1.84)	1.27 (1.01–1.60)	2.19 (2.10–2.29)	1.62 (1.20–2.19)	1.51 (1.13–2.03)
Assaulted	2.20 (2.12–2.28)	1.42 (1.07–1.88)	1.59 (1.18–2.15)	2.25 (2.13–2.37)	1.72 (1.18–2.51)	1.29 (0.89–1.87)
Any death	1.27 (1.20–1.34)	0.87 (0.53–1.43)	0.71 (0.45–1.14)	1.45 (1.33–1.59)	1.81 (0.95–3.47)	0.87 (0.45–1.68)
Any conviction	2.19 (2.16–2.22)	1.74 (1.54–1.97)	1.23 (1.10–1.39)	2.36 (2.31–2.41)	1.30 (1.12–1.50)	1.25 (1.08–1.46)
Asthma	1.09 (1.07–1.11)	1.04 (0.91–1.19)	0.93 (0.81–1.07)	1.11 (1.07–1.14)	0.98 (0.80–1.20)	1.05 (0.86–1.29)
Obesity	1.56 (1.50–1.62)	1.01 (0.71–1.42)	1.20 (0.86–1.68)	1.67 (1.57–1.77)	0.79 (0.49–1.27)	0.78 (0.51–1.18)
Low school grade*	2.20 (2.18–2.23)	1.71 (1.62–1.80)	1.51 (1.46–1.57)	2.46 (2.42–2.51)	1.86 (1.73–2.00)	1.75 (1.65–1.85)

Paternal/maternal convictions were registered between the child's birth and turning 18 years. All models were adjusted for child's sex, child's birth year, and father's/mother's birth year. Hazard ratios (HR) or odds ratios* with 95% confidence intervals (CI) are presented.

Table 4 Poisson regression models predicting accumulation of outcomes. The outcome is defined as a count variable indicating the number of outcomes (0, 1, 2, 3, 4, 5 or more) that occurred during the first 18 years of the child's life

	Paternal convictions		Maternal convictions	
	Violent convictions	Non-violent convictions only	Violent convictions	Non-violent convictions only
IRR (95% CI)	1.45 (1.44–1.46)	1.19 (1.19–1.20)	1.52 (1.50–1.54)	1.29 (1.28–1.30)

Parental convictions were registered between child's birth and turning 18 years. All models were adjusted for child's sex, child's birth year, parent's birth year, and parent's immigration status. Incidence rate ratios (IRR) and 95% confidence intervals (CI) are presented.

Rowell-Cunsolo et al., 2022; Whitten, Burton, et al., 2019), and poorer educational attainment (Kailaheimo-Lonnqvist, Kuja-Halkola, Larsson, Lichtenstein, & Latvala, 2022; Luk et al., 2022). In addition to replicating previous findings in the Nordic context, we found parental convictions to be associated with less studied outcomes such as obesity, sexually transmitted diseases, and mortality. We also investigated several outcomes which have previously been studied rarely or not at all in the context of parental offending, such as accidents and injuries, violent victimization, many somatic outcomes, and birth-related conditions, thus providing new insights into the health and behavior of children of convicted parents. Interestingly, we also reported parental convictions to be associated with slightly reduced risks for some somatic outcomes. The mechanisms underlying these associations remain unclear, and further investigation and replication of the findings is clearly needed.

There were some outcomes for which no clear evidence of association with parental convictions was found, such as many somatic conditions. This was particularly noticeable in the more adjusted

models. This is somewhat in odds with some previous research evidence. For example, in the review by Whitten, Burton, et al. (2019), parental offending was associated with children's poor physical health. A descriptive US study also found that many somatic conditions were overrepresented in children with personal or family criminal justice involvement (Boch et al., 2021). The inclusion of all types of parental convictions is likely to explain some of the weaker or non-existent associations in our main analysis and may also explain the discrepancy with the results of other studies, as previous work has focused mainly on the most severe forms of crimes rather than on parental convictions more generally. For example, in the aforementioned US study (Boch et al., 2021), only 2% of the study population had either personal or family justice involvement, while in our study one in four children had one or both parents convicted. Further, it is possible that differences in health-related outcomes may not be as significant in the Nordic countries as in some other Western countries, due to universal access to healthcare in all socioeconomic groups (Wettergren, Blennow, Hjern, Soder, & Ludvigsson, 2016).

We found slightly stronger associations for maternal than paternal convictions for most outcomes. Consistent with our study, prior research has found maternal offending to be more strongly associated with offspring criminality compared to paternal offending (Besemer et al., 2017), and there are similar indications for offspring educational outcomes (Kailaheimo-Lonnqvist et al., 2022). However, previous research on health-related outcomes is less consistent with some studies finding maternal offending to be the most detrimental (Laurens et al., 2017), other studies finding no clear differences between maternal and paternal offending (Bell et al., 2018; Whitten et al., 2019), and some studies reporting stronger associations for paternal offending (Coley, Carrano, & Lewin-Bizan, 2011; Whitten et al., 2019). We also did not find systematic differences for some health-related outcomes, such as somatic conditions. Further, the low rates of maternal convictions and incarceration resulted in wide confidence intervals for many outcomes. To clarify the role of maternal offending for offspring health-related outcomes, further studies with larger and multi-national samples are needed.

We further found that the risks were particularly elevated among children of incarcerated parents. This is in line with previous studies showing that the more serious the parent's contact with the criminal justice system, the poorer the child's well-being (Bell et al., 2018; Whitten, Laurens, et al., 2019). However, our findings cannot distinguish the mechanisms behind this pattern as parental imprisonment per se does not necessarily increase the risk, but rather may reflect the fact that families with parental imprisonment are a particularly selected group with pre-existing environmental and genetic vulnerabilities (Murray et al., 2012; Wildeman et al., 2018). With regard to offense types, we found that parental violent convictions in particular were associated with an increased risk of several adverse outcomes in offspring. This finding is consistent with a number of previous studies on, for example, offspring's early childhood development (Laurens et al., 2017), internalizing and externalizing problems (Whitten, Laurens, et al., 2019), criminal behavior (Kendler, Ohlsson, Morris, Sundquist, & Sundquist, 2015), educational attainment (Kailaheimo-Lonnqvist et al., 2022), and sons' cognitive ability (Latvala, Kuja-Halkola, Langstrom, & Lichtenstein, 2015). There is still a need to better understand the factors that explain the particularly strong intergenerational associations between violent offending and offspring outcomes.

Interestingly, parental convictions were particularly strongly associated with many offspring outcomes if the offspring had mostly lived in the same neighborhood as their parents during their childhood. However, as we also found that the absolute risks of outcomes were higher for children who lived in a different neighborhood from their parents for most of their childhood, it is likely that these

children are a particularly selected group exposed to a wide range of adverse conditions and risk factors, resulting in a relatively lower risk to offspring health and behavior compared to children with fewer pre-existing vulnerabilities.

We applied a genetically informative children-of-siblings design to examine the role of genetic factors in intergenerational associations. We found that the associations gradually weakened the more genetically related the cousins were, suggesting that genetic influences play a role in the associations. The results are in line with the findings of the few intergenerational studies in the field that have used similar family-based models; for example, the associations between parental offending and offspring's poor educational attainment (Kailaheimo-Lonnqvist et al., 2022) and poor cognitive development (Latvala et al., 2015) appear to be explained in part by genetic influences. However, as the design did not account for all unmeasured genetic and environmental influences, further research with formal model-fitting (Kuja-Halkola, D'Onofrio, Larsson, & Lichtenstein, 2014), other quasi-experimental designs (e.g., adoption studies), and more extensive assessment of confounding factors, is needed to better understand the extent to which the associations are causal.

In addition to the increased risks of a number of individual outcomes, we found that parental offending was associated with an increased risk of experiencing multiple outcomes across a range of health and behavioral domains by the age of 18 years. This indicates that the situation of children of convicted parents is often impaired not only in individual areas of their lives but more comprehensively. These results are in line with an Australian study that found that children exposed to parental offending were more likely to have challenges across multiple domains of early childhood development than in a single domain (Laurens et al., 2017).

This study has several limitations to be considered. In the main analysis, we did not require parental convictions necessarily to have occurred before the outcome, except for birth-related outcomes, but sensitivity analyses with time-varying exposure produced highly similar results, suggesting no bias in the main results. Further, our focus on the first 18 years of life may have contributed to the modest or non-significant associations, as some of the health differences may only become apparent in adulthood, reflecting an increase in health inequalities over time (Turney, 2014). Information on parental offending was limited to officially recorded data, and thus we were unable to capture parental crimes which did not lead to criminal convictions. Information on parental imprisonment and other sanctions was obtained from district court convictions, but not all imprisonment sanctions imposed by district courts ultimately materialize as a prison sentence. Our sanction data are therefore best seen

to reflect the severity of the offense rather than the sanction itself. As we only had access to diagnoses from specialized care, it remains unclear whether the associations would have been different if we also had data on primary care diagnoses, especially for disorders that are highly diagnosed at the first level of care, such as respiratory tract infections, asthma, depression, and anxiety-related conditions (Wandell et al., 2013). We also had no information on important related factors, such as child protection services, which is considered a limitation given the clear overlap between parental offending and offspring involvement in child protection services and the overrepresentation of mental disorders among children in child protection (Whitten et al., 2021). Further, the prevalence of some outcomes, such as violent and drug-related deaths, was low in the current sample, leading to wide confidence intervals and preventing reliable conclusions from being drawn. As the incidence of some outcomes, such as personality disorders and post-traumatic disorder, was very low, the observed differences cannot be considered clinically impactful. Finally, the results of this study have limited generalizability to other countries with markedly different health care and social welfare practices, legal systems, and correctional policies from Sweden.

Conclusions

Taken together, the outcome-wide approach of this study allowed for a comprehensive picture of the health, behavior, and social outcomes of the children of parents with criminal convictions. In addition to confirming the most robust findings of previous studies, we found that offspring outcomes of convicted parents are impaired in several other less-studied areas of health and behavior. The associations appeared to be at least partly explained by genetic influences rather than parental offending itself. Parental convictions were also associated with an increased likelihood of experiencing multiple adversities in the first 18 years of life. A broader understanding of the risks among children of parents with criminal convictions can be used to guide and better target preventive efforts and identify key areas for future research.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Supporting methods.

Figure S1. Associations between parental convictions and offspring health, behavior, and social outcomes.

Figures S2–S8. Kaplan–Meier curves for selected key outcomes.

Figure S9. Kaplan–Meier curve for psychiatric morbidity.

Table S1. Convictions for different types of offenses.

Table S2. Offspring health-related outcomes with corresponding ICD-9 and ICD-10 codes.

Table S3. Psychotropic medication outcomes with corresponding Anatomical Therapeutic Chemical (ATC) codes.

Table S4. Cumulative incidence of each time-to-event outcome by age 18 in offspring with none, one or two convicted parents.

Table S5. Associations between paternal convictions and offspring psychiatric disorders.

Table S6. Associations between maternal convictions and offspring psychiatric disorders.

Table S7. Associations between paternal convictions and offspring convictions.

Table S8. Associations between maternal convictions and offspring convictions.

Table S9. Associations between parental convictions (registered at any time between 0 and 18 years vs. as a time-varying exposure) and offspring health and behavioral outcomes.

Table S10. Associations between parental convictions and offspring health and behavior in the full sample and in the sample restricted to offspring whose parents had no missing information on criminal convictions.

Table S11. Paternal and maternal violent and non-violent convictions (exposure at any time before age of 18 years) and offspring health and behavioral outcomes, stratified by paternal/maternal imprisonment.

Table S12. Paternal and maternal convictions and offspring health and behavioral outcomes, stratified by whether the offspring lived with their father/mother in the same neighborhood for most of their childhood.

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Data availability statement

Due to the nature of the data, they cannot be made publicly available. Researchers interested in accessing the data can apply for permission to access the register data.

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Key points

- The overall picture of the children of offending parents is currently unclear. This study, the first of its kind on this scale, examined associations between parental convictions and a wide range of offspring outcomes by age 18 years.
- Parental convictions were associated with several adverse outcomes, such as externalizing disorders, substance misuse, poor school achievement, and criminality. The risks were particularly elevated among children with two convicted parents and children of incarcerated parents with a history of violent offending. Parental convictions were associated with an increased likelihood of experiencing multiple adversities.
- The associations are partly due to genetic influences, but further research is needed.
- The findings may be used to guide prevention efforts and identify key areas for future research.

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