

Early life influences on the risk of injecting drug use: case control study based on the Edinburgh Addiction Cohort

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ABSTRACT

Aims To investigate childhood influences on onset of injection drug use. **Design** Matched case-control study. **Setting** Edinburgh, Scotland. **Participants** A total of 432 individuals presenting at a community health facility with injection drug use and 432 age- and sex-matched non-injecting controls recruited through the same facility. **Measurements** Main exposures considered were family structure and experience of public care, carer substance use, physical and sexual victimization and conduct problems, all measured at personal interview. The outcome was history of adult injection drug use recorded in medical records corroborated at personal interview. **Findings** Compared to two-parent families all other family structures were associated with increased risk of injection drug use, the greatest increased risk being associated with public care. Violence, criminality and financial problems in the family were also associated with increased risk, as were all types of carer substance use. The greatest increased risk was associated with markers of early conduct problems, particularly school exclusion and childhood contact with the criminal justice system. In multivariable analyses the strongest risk factors for later injecting were always having lived with a relative or family friend (not always a parent) and in care/adopted/foster home at any point [odds ratio (OR) = 2.66, 95% confidence interval (CI): 1.02–6.92 and OR = 2.17, 95% CI: 0.91–5.17, respectively], experienced violence from parent or carer (OR = 2.06, 95% CI: 1.26, 3.38) and early evidence of conduct problems [ever excluded from school (OR = 2.73, 95% CI: 1.68, 4.45); childhood criminality (ever arrested by police pre-adult OR = 3.05, 95% CI: 1.90, 4.89, ever been in borstal/young offenders/list D school OR = 4.70, 95% CI: 2.02, 10.94)]. After adjustment for family structure and conduct problems, sexual victimization was associated weakly with injecting onset (OR = 1.29, 95% CI: 0.76–2.19). More than 70% of injection drug use onset appeared attributable to the risk factors identified. **Conclusions** Injection drug use in adults is associated strongly with prior childhood adversity, in particular not living with both parents and early conduct problems. Prevention initiatives should also consider these risk factors.

Keywords Attributable risk, childhood adversity, conduct disorder, injection drug use.

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INTRODUCTION

Injection opiate use causes the greatest health and social harm related to illicit drug use, is most common in disadvantaged communities and appears to be increasing [1–5]. Problem drug use may be influenced by many antecedent factors, including those acting in childhood [6]. Some evidence suggests that family circumstances in

early life, parental substance use, the experience of public care, early victimization and childhood educational difficulties and conduct problems may increase the risk of later injection drug use [6–10].

The association between drug injection and disadvantage contributes to health inequality and is likely to reflect several considerations, including the concentration of childhood adversity in disadvantaged areas [3,11].

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Prospective studies of risk factors for injection drug use have, to date, proved unfeasible. The outcome is relatively rare, and both recruitment in early life and retention until adulthood of individuals who will experience this outcome is difficult. Three previous case-control studies have focused on individual risk factors (child maltreatment, early 'misbehaviour' and school problems) [8-10]. No empirical evidence has been published previously on the relative importance of different childhood risk factors or the magnitude of population risk attributable to these factors.

We conducted a matched case-control study to investigate possible childhood influences on adult injection drug use in a community-based general population sample. Cases and controls were recruited from a large primary care facility serving a disadvantaged community in Edinburgh.

METHODS

The Edinburgh Addiction Cohort has been described elsewhere [4,12]. Cases were recruited between 1980 and 2006 when they presented in primary care with a history of injection drug use, and were followed-up from October 2005 to November 2007. In this locality almost all interventions for drug injectors are accessed through primary care. The cohort comprised 794 participants, of whom 571 were still alive at the start of follow-up, and 432 (76%) were interviewed. Drug injection history, including age of onset, was confirmed at interview. In addition, we were able to follow-up 655 (82%) using primary care records, including for 182 (82%) of those who had died. One hundred and thirty-nine (18%) participants were lost to follow-up.

Sex- and age (± 2 years)-matched controls with no recorded history of injection drug use were recruited opportunistically among patients attending the same primary care facility between January 2008 and December 2009. UK primary care is organized on a small area basis, and we assumed that cases and controls were sampled from the same population. Of the patients invited, 97% agreed to participate and were interviewed using the 'life grid' approach to minimize recall bias [13]. The same interview schedule was used for controls and cases. Controls reporting previously undisclosed injection drug use were eligible to be included as cases; however, no controls reported this. We collected information on a range of exposures, including family structure and experience of public care, carer substance use, physical and sexual victimization and indicators of conduct problems. Cases and controls were not matched on individual social position; however, as they were recruited from the same community, social position was very similar in cases

compared to controls and was not considered as an explanatory variable.

The above exposures were grouped according to hypothesized areas of influence. These groups included aspects of care experience (whether the individual always lived with both parents during childhood compared to at least one parent, neither parent but a relative or family friend, in foster care or adopted) and housing stability (moved house more than once, not by choice); family problems (witnessed violence in the family, family in trouble with the police, financial problems); other significant life events (death or serious injury/illness in family, family member victim of assault or robbery); and carer substance use (tobacco, alcohol, illicit drugs, drug injecting). Participants were asked if they had experienced physical violence from a parent, carer or family member and if they had experienced sexual abuse. We also considered evidence of serious antisocial behaviour or conduct problems. Participants were asked if they had ever been excluded from school; ever been referred to a psychologist or similar for school problems; ever been arrested by the police; or ever been institutionalized as the result of an offence.

Timing of exposures

We attempted to ensure that all causal exposures considered preceded the onset of injecting; mean age of onset was 20 years and no case reported injecting prior to secondary school [12]. For exposures related to care experience, housing stability and family problems, only reports of exposure prior to secondary school were considered. Carer substance use was recorded as ever/never and could not be related to a particular time-period. We included reports of physical or sexual abuse at any point in childhood or adolescence. Of individuals who reported physical or sexual abuse, 88 and 80%, respectively, indicated that this occurred first prior to secondary school. Conduct problems at all ages were included in the analyses. Age at first occurrence was recorded only for arrests and periods of institutionalization, and indicated that these problems predominantly occurred first while at secondary school. Where data indicated that an individual was first arrested or received a custodial disposal after first injecting drugs they were re-coded as not arrested/no custodial disposal. Such recoding was not possible with the small number of participants where age of first arrest/custodial disposal or age of first injection was not recorded.

A series of conditional logistic regressions was used to model the relationship between the various exposures and the outcome (injecting). We followed a conceptual framework analysis, adjusting first for those exposures acting (as far as was possible to ascertain) earlier in child-

Table 1 Exposure prevalences and univariate associations with injecting drug use in later life.

	<i>Exposure</i>	<i>Cases prevalence</i>	<i>Controls prevalence</i>	<i>Univariate OR (95% CI)</i>
Care experience and housing stability	Care group 1: always lived with both parents	53% (<i>n</i> = 229)	71% (<i>n</i> = 308)	1.00 (baseline)
	Care group 2: always lived with at least one parent (not always both)	30% (<i>n</i> = 130)	23% (<i>n</i> = 101)	1.92 (1.36, 2.71)
	Care group 3: always lived with a relative or family friend (not always a parent)	8% (<i>n</i> = 33)	3% (<i>n</i> = 12)	4.46 (2.14, 9.26)
	Care group 4: in care/adopted/foster home at any point	9% (<i>n</i> = 40)	3% (<i>n</i> = 11)	5.42 (2.67, 11.00)
	Instability of housing (moved house more than once)	23% (<i>n</i> = 100)	16% (<i>n</i> = 67)	1.72 (1.19, 2.47)
Family problems	Witnessed violence in the family	40% (<i>n</i> = 171)	26% (<i>n</i> = 114)	1.77 (1.33, 2.35)
	Family involved with police/court	22% (<i>n</i> = 97)	11% (<i>n</i> = 46)	2.34 (1.60, 3.42)
	Financial problems	39% (<i>n</i> = 168)	27% (<i>n</i> = 116)	1.87 (1.36, 2.55)
	Family or close friend died or was seriously ill/injured	48% (<i>n</i> = 207)	51% (<i>n</i> = 221)	0.88 (0.68, 1.15)
	Family member was attacked, mugged or burgled	20% (<i>n</i> = 86)	22% (<i>n</i> = 93)	0.90 (0.65, 1.26)
Carer substance use	Carer smoked	93% (<i>n</i> = 400)	89% (<i>n</i> = 382)	1.67 (1.03, 2.69)
	Carer had alcohol problems	55% (<i>n</i> = 239)	35% (<i>n</i> = 150)	2.29 (1.73, 3.04)
	Carer took drugs	13% (<i>n</i> = 56)	3% (<i>n</i> = 15)	3.93 (2.18, 7.06)
	Carer injected	2% (<i>n</i> = 9)	1% (<i>n</i> = 3)	3.00 (0.81, 11.08)
Experience of victimization	Experienced violence from parent or carer	30% (<i>n</i> = 129)	13% (<i>n</i> = 58)	2.69 (1.89, 3.83)
	Experienced sexual victimization	19% (<i>n</i> = 81)	13% (<i>n</i> = 54)	1.69 (1.14, 2.51)
Conduct problems	(1) Ever excluded from school	55% (<i>n</i> = 239)	21% (<i>n</i> = 90)	6.73 (4.46, 10.16)
	(2) Ever sent to see psychologist/similar for problems at school	30% (<i>n</i> = 129)	14% (<i>n</i> = 62)	2.40 (1.71, 3.36)
	(3) Ever arrested by police pre-adult	53% (<i>n</i> = 230)	14% (<i>n</i> = 60)	7.07 (4.76, 10.50)
	(4) Ever been in Borstal/young offenders/list D school	27% (<i>n</i> = 116)	2% (<i>n</i> = 10)	16.14 (7.52, 34.64)

CI: confidence interval; OR: odds ratio.

hood, and subsequently for those acting later [14]. Thus, we adjusted first for family structure and problems and carer substance use (model 1), then for physical and sexual victimization (model 2) and finally for conduct problems (model 3).

To evaluate the possible public health importance of these childhood influences on adult injection drug use, we estimated the population attributable risk fraction (PARF) associated with the factors associated most strongly and substantially with this outcome [15]. We further estimated the PARF associated with exposure to any of the factors apparently conferring greatest risk and the PARF associated with exposure to all these factors.

We compared the main exposures of interest in patient notes of both living cases and in the 182 dead cases with available case-notes in order to investigate whether the selected childhood exposures were likely to be under-recorded in patient notes compared to interview, and whether there was any evidence of survival bias (as indicated by differences in exposures reported in notes of living and dead cases).

Ethical approval was obtained from the Lothian Research Ethics Committee 04 for cases (LREC/2003/7/12) and controls (LREC/07/S1104/20).

RESULTS

Table 1 shows the prevalence of various early life factors in the cases and matched controls, with univariable odds ratios which take account of the matching. There were substantial differences between controls and cases in most of the risk factors.

Approximately half the cases had grown up in two-parent families compared to almost three-quarters of controls; 9% of cases compared to 3% of controls had experienced public care [unadjusted odds ratio (OR) = 5.4, 95% confidence interval (CI): 2.7–11.0] and 8% of cases compared to 3% of controls had mainly received care from relatives or family friends (unadjusted OR = 4.5, 95% CI: 2.1–9.3). Other family-based risk factors were more prevalent among cases including instability of housing, witnessing violence in the family, family

Table 2 Results from a series of conditional logistic regressions.

<i>Exposure</i>		<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>
Care experience	Care group 1: always lived with both parents	1.00 (baseline)	1.00 (baseline)	1.00 (baseline)
	Care group 2: always lived with at least one parent (not always both)	1.65 (1.14, 2.38)	1.55 (1.07, 2.26)	1.49 (0.96, 2.33)
	Care group 3: always lived with a relative or family friend (not always a parent)	4.22 (1.94, 9.21)	4.31 (1.93, 9.63)	2.66 (1.02, 6.92)
	Care group 4: in care/adopted/foster home at any point	4.67 (2.22, 9.83)	4.43 (2.08, 9.47)	2.17 (0.91, 5.17)
Family problems	Family involved with police/court	1.83 (1.21, 2.78)	1.72 (1.12, 2.63)	1.25 (0.73, 2.12)
Carer substance misuse	Carer smoked	1.48 (0.86, 2.54)	1.41 (0.81, 2.45)	1.35 (0.70, 2.59)
	Carer had alcohol problems	1.84 (1.34, 2.51)	1.67 (1.21, 2.30)	1.30 (0.88, 1.94)
	Carer took drugs	2.47 (1.24, 4.89)	2.23 (1.11, 4.46)	2.04 (0.90, 4.64)
	Carer injected	1.48 (0.32, 6.82)	1.31 (0.28, 6.03)	1.71 (0.29, 9.92)
Experience of victimization	Experienced violence from parent or carer	–	1.89 (1.27, 2.82)	2.06 (1.26, 3.38)
	Experienced sexual victimization	–	1.25 (0.79, 1.97)	1.29 (0.76, 2.19)
Conduct problems	Ever excluded from school	–	–	2.73 (1.68, 4.45)
	Ever arrested by police pre-adult	–	–	3.05 (1.90, 4.89)
	Ever been in Borstal/young offenders/list D school	–	–	4.70 (2.02, 10.94)

Odds ratios with 95% confidence intervals.

involvement with police and financial problems. There was little evidence of differences between cases and controls in their experience of adverse life events such as death or serious assault of a family member or close friend, and these were therefore dropped from further analyses.

Carer substance use during childhood was high among both cases and controls. Prevalence of these risk factors was still, however, consistently higher among cases (unadjusted OR for alcohol problems and illegal drug taking were 2.3, 95% CI: 1.7–3.0 and 3.9, 95% CI: 2.2–7.1). Experience of physical and sexual abuse was higher among cases compared to controls with unadjusted OR = 2.7 (95% CI: 1.9–3.8) and unadjusted OR = 1.7 (95% CI: 1.1–2.5), respectively. Sexual abuse was more prevalent among girls compared to boys; 35% of female cases compared to 23% of female controls reported past sexual abuse, with these proportions in boys being 10 and 7%, respectively.

Each of the conduct problems was substantially more common among cases compared to controls: 55% of cases compared to 21% of controls had been excluded from school (unadjusted OR = 6.7, 95% CI: 4.5–10.2); 53% of cases compared to 14% of controls reported police arrest while at primary school (unadjusted OR = 7.1, 95% CI: 4.8–10.5) and 27% of cases compared to 2% of controls had experienced institutionalization within the child justice system (unadjusted OR = 16.1, 95% CI: 7.5–34.6); 74% of cases compared to 35% of controls had experienced at least one of the four conduct problems.

Risk of injecting onset

The results from the three multivariable regressions are shown in Table 2.

Model 1 adjusted for family structure and problems and carer substance use, which removed any strong evidence of an association between instability of housing, witnessing violence in the family and financial problems and injecting onset. These covariates were therefore removed in the final version of model 1, which we report. Family structure remained associated with injecting onset (adjusted OR for participants receiving mainly single-parent care 1.55, 95% CI: 1.1–2.3) and especially for those experiencing public care or 'kinship' care with family relatives or friends (adjusted ORs 4.3, 95% CI: 1.9–9.6 and 4.4, 95% CI: 2.1–9.5, respectively) compared to children living with two parents in both model 1 after adjustment for other family care covariates and in model 2 after introducing adjustment for physical and sexual victimization. After adjustment for family structure and physical victimization (model 2) there was no longer strong evidence for an effect of sexual abuse on injecting onset (adjusted OR = 1.3, 95% CI: 0.8–2.0). The effects of carer alcohol and drug problems on the risk of injecting remained, but were weakened after adjustment for other variables in models 1 and 2 (adjusted OR = 1.7, 95% CI: 1.2–2.3 and adjusted OR = 2.2 95% CI: 1.1–4.5).

Model 3 introduced adjustment for conduct problems as well as adjustment for early life care and family structure and physical and sexual victimization. In multivariable analyses the covariate referral to a psychologist for

Table 3 Population attributable risk fractions of adult injection drug use for selected childhood risk factors.

Risk factor	OR	ARF (OR-1/OR)	Prevalence in cases (%)	PARF ^a (%)
Kinship or public care (care groups 3 or 4)	3.94	0.75	17	13
Parental drug taking/alcohol problems	2.48	0.60	58	35
Any of the 4 conduct problems	6.15	0.84	74	62
Experienced violence	2.69	0.63	30	19
Experienced sexual victimization	1.69	0.41	19	8
Any of the above exposures	6.21	0.84	91	77
All the above exposures	4.00	0.75	1	1

^aPARF: attributable risk fraction \times prevalence in cases; OR: odds ratio.

Table 4 Primary care case note evidence for main childhood exposures in living and dead cases.

Exposure domain	Risk	Primary care records		Interview records (n = 432)
		(n = 432) Interview	(n = 182) Dead	
Carer substance use	Carer alcohol problems	8%	15%	55%
	Carer took drugs	2%	2%	13%
	Carer injected	0%	0%	2%
Experience of victimization	Experienced violence from parent or carer	3%	5%	30%
	Experienced sexual victimization	6%	7%	19%
Family problems/family structure	Family involved with police/court	1%	2%	22%
	Note of social services referral	4%	19%	44%
	Note of living with other family member	1%	4%	8%
	Ever in care/fostered/adopted	7%	13%	9%
	Note of financial problems	0%	1%	39%
Conduct problems	Note of exclusion from school	2%	5%	55%
	Note of psychologist or similar referral	7%	12%	30%
	Trouble with police during childhood	3%	7%	53%
	Ever borstal/List D/young offenders	4%	12%	27%

problems at school was dropped, as after adjustment for other conduct problems its association with injecting status was weak and estimated imprecisely. The effects of the indicators of conduct problems remained relatively strong and substantial (school exclusion, adjusted OR = 2.7, 95% CI: 1.7–4.5; history of arrest, adjusted OR = 3.1, 95% CI: 1.9–4.9; history of custodial disposal, adjusted OR = 4.7, 95% CI: 2.0–10.9). Adjustment for conduct problems in model 3 also attenuated apparent effects of family structure and carer substance use, whereas the effect of physical victimization remained strong (adjusted OR = 2.1, 95% CI: 1.3–3.8).

Table 3 presents population-attributable risk fraction estimates, given the adjusted risks of injecting onset and exposure in the cases. These provide an indicator of the aetiological force of specific risks assuming a causal relation and no residual confounding. Of the risk of injection onset, 62% appeared attributable to exposure to any of the conduct problems considered. The attributable risk for other exposures was lower, but still substantial;

13% appeared attributable to exposure to public care (kinship care, fostering or adoption) and 35% to exposure to carer alcohol problems or drug-taking during early childhood. Exposure to any of these aspects of early adversity accounted potentially for 77% of the cases; however, very few cases could be attributed to people with all such exposures.

Table 4 presents a comparison of evidence for the main exposures recorded in primary care notes for all living cases, and dead cases where notes were available, and the interview records. For most exposures prevalence in 'dead' cases is higher than in 'living' cases, suggesting that these aspects of early life adversity may also be risk factors for mortality among injectors and that an element of survivor bias may be present in our analyses. The most likely effect of such bias is an underestimation of the effect of these exposures on risk of injection onset. Unfortunately, we could not address this bias by including dead cases and using primary care records as a source of exposure information as, with the exception of exposure to

public care, all these factors appeared to be substantially higher in interview records than in primary care records.

DISCUSSION

Main findings

Compared to non-injecting controls from the same disadvantaged community, injecting drug users (IDU) were more likely to have evidence of serious conduct problems during childhood and to have suffered physical victimization in early life. In addition, IDU were less likely to have lived with both parents during childhood and more likely to have received kinship or public care; and were also more likely to have had a carer or parent with substance use problems. Sexual victimization in childhood was also associated with later risk of IDU in our study, although this association was weaker and less substantial than that seen with physical victimization. As far as it was possible for us to ascertain, these factors generally preceded conduct problems. Their apparent effect on risk of drug injection was generally attenuated after adjustment for conduct problems, suggesting that at least part of this effect was mediated through conduct problems. There are no statistical approaches available to test formally for such mediation in matched case-control designs. Case-control data may be re-analysed for evidence of effects of the risk factors considered on outcomes other than those on which case selection was based originally [16]. Undertaking such a weighted logistic regression with our own data, we confirmed that the early factors considered in models 1 and 2 were themselves risk factors for conduct problems (see Appendix S1, online supporting information). This provides further evidence that the effect of these factors on injection risk was mediated partly through conduct problems. In our cohort, children who subsequently became drug injectors were highly identifiable in early life. More than 70% of risk of injecting was estimated to be attributable to problems that would normally ensure that a child was 'known' to social services.

Strengths and limitations

The key strengths of our study are that both cases and controls were recruited from the same community and that cases were recruited early in their injecting careers, thus reducing the potential for selection and other bias. Moreover, through collecting information on multiple risk factors, we were able to consider their relative importance and attributable risk.

Our study has limitations. Cases were IDU presenting for treatment who may be different from other 'hidden' IDU in the population. All epidemiological studies of IDU are, of necessity, confined to individuals identifiable as injectors and most recruit cases through treatment

settings. There may be 'survivor bias' as, from clinical records, dead cases had higher exposure to most risk factors considered than living cases. It is likely that we have underestimated the effect of these factors on injection risk by excluding dead cases. These exposures appeared under-recorded in clinical records, making an analysis including dead cases, using exposure information from records, potentially misleading. We investigated other possible administrative sources of early life exposure information, such as social services records, but accessing these proved unfeasible [12]. Bias may have been introduced through control selection. An historical sampling frame could not be constructed in order to select a control from the same time as case recruitment [12]. Controls were selected conditional on their attendance at a primary health-care facility; given the typical population frequency of attendance in primary care, it is likely that most potential controls attended during the recruitment period; however, individuals with poorer health probably attended at a higher frequency and may be over-represented among our controls. As many of the childhood factors we examined are associated with poorer health in adulthood, this may have led to an underestimate of their effect on risk of injection drug use. Our measurement of conduct problems was different from that used in some previous studies that have measured 'conduct disorder' according to diagnostic criteria [17,18]. Our measures were based on self-reported serious problems chosen because we felt these would be recalled more reliably, more amenable to corroboration in linked administrative data, and possibly more amenable to use in targeting interventions. Case-control studies based on self-report are subject to recall bias. We attempted to minimize this using the life-grid interview technique [13]. Using more objective exposure information from records was constrained by lack of accessibility of relevant administrative data and under-recording in data that were accessible [12]. Reverse causation, where onset of injecting may have influenced some of the exposures under investigation, is possible. We tried to reduce this possibility by excluding exposures known to have occurred after injection onset. Finally, our study was based in a single centre. While this is also true of many important epidemiological investigations, and brought advantages related to the long-standing relationship between the investigative team and the community, it may have introduced issues of external validity.

Comparison with existing evidence

We are aware of no previous studies able to consider the relative contribution of as wide a range of possibly causal exposures on risk of injection drug use.

Tomas and colleagues investigated the influence of conduct problems on injection risk in a case-control

study in Baltimore [9]. Their results were similar to our own. Dinwiddie and colleagues also reported a dose–response relationship between conduct problems and injecting [19]. In another US-based case–control study, Obot & Anthony found an approximate doubling of the risk of injection drug use among individuals who had ‘dropped out’ of high school [10]. Our study was larger than the above investigations and confirmed similar effects in a non-US setting.

In a clinical sample, Conroy and colleagues reported a doubling of the odds of opiate dependence among women with a history of sexual abuse [8]. General population studies have also shown an increased risk of any drug use with a history of sexual abuse, but have not considered injection drug use specifically [20]. Studies based on clinical samples suggest a higher prevalence of exposure to childhood sexual abuse among female injectors than that found typically in the general population [21]. Among injectors recruited through specialist treatment agencies in Australia, 22% of men and 52% of women reported past sexual abuse, a higher prevalence than we found in our community-based sample [22].

A high prevalence of mental disorder, including substance abuse disorder and conduct disorder, has been noted previously both among children within the public care system and those entering the system [23–25]. We are unaware of any previous studies examining specifically the influence of care experience on risk of injection drug use. Taussig and colleagues found that children remaining in longer-term foster care had a lower risk of later substance use problems than those in shorter-term foster placements who returned to their birth families [26].

CONCLUSIONS

A substantial proportion of adult injecting drug use may be causally attributable to the childhood adversity and problems considered in our study. This supports a policy of targeting prevention interventions at children in these risk categories [27]. Primary prevention is challenging; there is some evidence that early interventions for disadvantaged children may reduce the risk of both conduct problems and some of their sequelae [28,29]. It has also been argued that earlier intervention is likely to be more cost-effective in this regard [30].

Declarations of interest

All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare no support from any organization for the submitted work; no financial relationships with any organiza-

tions that might have an interest in the submitted work in the previous 3 years; and no other relationships or activities that could appear to have influenced the submitted work.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1 Risk factors for conduct problems amongst cases and controls in the Edinburgh Addiction Cohort: weighted logistic regression.

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