Association between poverty exposure during childhood and adolescence, and drug use disorders and drug-related crimes later in life

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ABSTRACT

Aims To examine whether poverty exposure in childhood/adolescence increases the risk of later drug use disorder and drug crime conviction. **Design, Setting and participants** A national cohort study encompassing 634 284 individuals born between 1985 and 1990, residing in Sweden between 5 and 18 years of age, followed-up from January 2004 to December 2016, starting from the age of 19 years until the first visit to inpatient/outpatient care with a diagnosis of a drug use disorder or a drug crime offence. **Measurements** The exposure variable was 'trajectories of poverty' based on household income, assessed through group-based trajectory analysis. Cox regression analysis was used to obtain hazard ratios for drug use disorders and drug crime convictions using age as the underlying time scale. **Findings** We identified five trajectories of childhood/adolescence poverty: (1) 'moving out of poverty in childhood' (8.7%); (2) 'never poverty' (68.9%); (3) 'moving into poverty in adolescence' (11.0%); (4) 'moving out of poverty in adolescence' (5.4%); and (5) 'chronically poor' (5.9%). Compared with the 'never poor' group, almost all trajectory groups had higher risks for drug use problems. Young males 'moving into poverty in adolescence' had the highest risks of drug use disorder [hazard ratio (HR) = 1.48, 95% confidence interval (CI) = 1.40–1.57] and drug crime conviction (HR = 1.50, 95% CI = 1.38–1.62), after adjusting for calendar year, domicile, origin, psychiatric diagnosis and parental psychiatric diagnosis. The results were similar in females moving into poverty in adolescence (HR = 1.63, 95% CI = 1.52–1.76 and HR = 1.89, 95% CI = 1.74–2.05 for drug use disorders and drug crime, respectively). **Conclusion** In Sweden, poverty exposure early in life seems to increase the risk of drug use problems in adulthood. These associations are not explained fully by domicile, origin or other psychiatric disorders. Young males and females moving into poverty in adolescence are at highest risk.

Keywords Childhood/adolescence, drug crime convictions, drug use disorders, poverty, socio-economic conditions, trajectories.

INTRODUCTION

The importance of socio-economic contexts in relation to drug use has been studied, highlighting poor living conditions, limited access to education and employment, poor neighborhoods and housing characteristics which may influence drug-related behaviors [1–5]. In 2016, an estimated 25 million children (26.4%) living in the European Union (EU) Member States were at risk of poverty [6]. The corresponding figure in Sweden is approximately 15%. However, childhood poverty in migrant households is approximately twice as high compared with in native Swedish households [7,8].

There is evidence that poverty throughout childhood is a powerful predictor of poor adolescent and adult health outcomes [3,9,10], although this association is complex. Poverty dynamics—that is, chronic poverty during childhood or moving into or out of poverty, respectively—may affect health outcomes in different ways [11–15]. For instance, a Swedish population-based study showed that persistent poverty or moving into poverty during childhood was associated with a higher risk of common psychiatric

disorders up to age 24 years, including mood disorders, anxiety, substance misuse and attention deficit hyperactivity disorder (ADHD) [15]. Findings from a Danish national cohort study found no association between persistent childhood poverty and later internalizing or externalizing problems or stress, but children moving into poverty had increased risks of conduct problems, psychological problems and stress in adolescence [14].

However, studies on the effect of the timing of poverty during childhood on adult drug use behaviors are lacking. Also, in prior studies, alcohol use disorders and drug use disorders are often combined [15], which might limit the understanding of drug use problems. For example, the use, possession and sale of drugs are criminal offences in Sweden, unlike in the case of alcohol. The proportion of young adults who have been registered for drug-related offences or drug-related mortality or morbidity has increased in Sweden in recent years [16]. At the same time, alcohol consumption has decreased [17]. From a public health perspective, it is crucial to explore the role of trajectories of early poverty exposure in relation to later drug use disorder and drug crime conviction. For one thing, this could help to identify the most vulnerable period, when prevention initiatives may be most needed.

Even if there are signs of a narrowing gender gap in substance use disorders [18], Sweden has reported an increasing gap in the drug-attributed disease burden, which can primarily be explained by more premature deaths in young males than females [19]. This highlights the importance of studying males and females separately. Also, drug use may be influenced by origin, e.g. through the effect of acculturation in shaping patterns in the utilization of psychiatric care in migrants [20]. Furthermore, the acculturation process can be stressful [21], resulting in migrants using drugs as a coping mechanism [22]. Poor parental mental health has also been shown to be associated with offspring's drug use behaviors, e.g. through negative parenting practices and less supervision [23,24]. Moreover, previous studies have shown adolescents' poor mental health to be associated with onset of drug use [25], and shown drug use to be more common in urban than rural areas [16]. From prior studies, we also know that all these factors tend to interact (e.g. [26]). For example, having a migrant background, psychiatric disorders and/or having a parent with psychiatric disorders might exacerbate the effect of childhood poverty on later drug use behaviors.

Given the complexity of these relationships, we used Swedish national health registers to investigate possible associations between trajectories of poverty during childhood and adolescence and drug use disorders and drug-related crimes in young adulthood. We focused upon young adults, because emerging adulthood is a critical developmental period regarding life opportunities in terms of education and occupation, but also a period encompassing peak onset of several types of health risk behaviors [27].

Specifically, we wanted to answer the following questions:

1. To what extent does poverty exposure during childhood and adolescence (ages 5–18 years) increase the risk of drug use disorders and drug crime convictions in young adulthood (ages 19–31 years)?
2. To what extent are these associations explained by origin, domicile, calendar year, other psychiatric disorders, and/or parental psychiatric disorders?
3. To what extent do young males and females differ with regard to these associations?

METHODS

Study population

The study population comprised a cohort of 634 284 individuals who were born between 1985 and 1990 and were alive and residing in Sweden between January 1990 and December 2008—from 5 to 18 years of age—according to the Register of the Swedish Total Population. Individuals who had died before the age of 19 years ($n = 1401$) were coded as missing. Information regarding family income was obtained from Statistics Sweden's Longitudinal Integration Database for Health Insurance and Labor Market Studies (LISA) [28].

The study population was followed-up in the Swedish National Inpatient and Outpatient registers, held by the Swedish National Board of Health and Welfare, and in the register held by the National Council for Crime Prevention, from the ages of 19 to 31 years, i.e. between January 2004 and December 2016. This study adhered to the Reporting of Observational Studies in Epidemiology (STROBE) statement (see Supporting information, Table S1; Appendix). The analysis was not pre-registered and the results should be considered exploratory.

Exposure

We created an indicator of childhood/adolescence poverty with reference to low income, i.e. children living in a household with a disposable income per consumption unit after taxes below 60% of the median value of the national median disposable income. Weights were used to adjust for household composition and size. The individual disposable income was obtained by multiplying the sum of all disposable income from each family member by the individual's consumption weights and divide by the family's total consumption weights [28,29]. This relative measure of poverty is often used by various actors, both in Sweden and in the rest of the EU [30]. Childhood/adolescent poverty (sum of all disposable household income) was measured from

the child's age of 5 years until 18 years. It was classified as being below the poverty threshold (=1) or not (=0) in each year.

Outcome

The first outcome refers to the first visit to inpatient or outpatient care from the age of 19 years, with a diagnosis of a drug use disorder in accordance with the definitions in the 10th edition of the World Health Organization International (WHO) Classification of Disorders, ICD-10 [31]. This was defined as follows: mental and behavioral disorders due to use of opioids (F11), cannabinoids (F12), sedatives or hypnotics (F13), cocaine (F14), other stimulant-related disorders (F15), hallucinogens (F16), volatile solvents (F18) and other psychoactive substance-related disorders and unspecified psychoactive substance-induced disorders (F19).

The second outcome was any drug crime conviction during follow-up; this refers to criminal convictions related to illicit drugs, according to data from the Swedish prosecutors and courts and from the Swedish National Police Authority. This was defined as follows: transferring, manufacturing, acquiring for the purpose of transfer, procuring and processing, packaging, transporting, keeping, offering for sale, possessing or otherwise handling narcotic drugs, as described in the Swedish Penal Law on Narcotics (1968: 64).

Covariates

The study population was categorized into three groups based on the country of origin, as given in the Multi-Generation Register: (i) native Swedish, comprising all youths born in Sweden with both parents born in Sweden; (ii) offspring of migrants, comprising all Swedish-born youths with at least one parent born abroad; and (iii) youth migrants, defined as youths born outside Sweden with both parents also born abroad.

Other covariates, such as calendar year, sex and domicile were retrieved from the LISA register. Domicile was captured at 19 years of age and split into three categories, in accordance with the Swedish Association of Local Authorities and Regions: big city referred to Sweden's three largest cities: Stockholm, Gothenburg and Malmö. Medium-sized town covered other predominately urban municipalities and rural area covered the remainder [32]. Calendar year referred to the first year of follow-up, between 2004 and 2009, and sex referred to female or male sex. Psychiatric diagnosis was captured until 18 years of age, i.e. before follow-up. This was based on history of inpatient/outpatient care with any psychiatric diagnosis other than drug use disorders

(F01–F10, F17 and F20–F99), according to the Swedish national inpatient and outpatient registers. Parental psychiatric diagnosis was based on at least one parental history of inpatient/outpatient care with any psychiatric diagnosis (ICD-9: 290–319; ICD-10: F00-F99) from the child's birth to 18 years of age.

Statistical analyses

First, we modeled group-based developmental trajectories of household poverty using the semi-parametric group-based approach in Stata (version 15) *Traj_program* [33,34]. With binary data, this technique yields the probability of being in poverty at each age in each group. We divided our model selection into the following steps. First, we specified the shape of the trajectory (e.g. polynomial order: zero-order, linear, quadratic or cubic), establishing a rule in which all trajectories should have the same polynomial order (e.g. all trajectories are cubic). We defined this as cubic to be high enough to correspond to the shape that might theoretically emerge from the data [35]. In a second step, we selected the number of groups through competing models, contrasting the Bayesian information criterion (BIC) [36] with the fixed polynomial order established a priori (e.g. cubic: 333 versus 3333 versus 33 333, etc.). The BIC value closest to zero indicated the best model fit. However, in addition to the BIC, further parameters were taken into consideration for the final selection of number of groups: (1) a preference for a parsimonious model with theoretical coherence which fitted the data well; (2) adequate sample numbers in each group; (3) close correspondence between each group's estimated probability and the proportion of study members classified to that group according to the maximum posterior probability assignment rule; (4) an average posterior probability value > 0.7; and (5) the odds of correct classification based on the posterior probabilities of group membership of five or more (see Supporting information, Table S2A, S2B) [35–37].

Secondly, we measured the time-to-event from the age of 19 years to whichever of the following that occurred first: the first recorded hospital admission due to drug use disorder/record of drug crime conviction (separate analyses), death or the end of the follow-up period on 31 December 2016. We compared the incidence of our outcome variables between the identified trajectories and by covariates. The results were stratified by sex and presented as incidence rates (IRs) per 100 000 person-years with 95% confidence intervals (CIs).

Thirdly, we used Cox's regression analyses of person-years, using age as the underlying time scale [38], to estimate the hazard ratios (HRs) of the first visit to inpatient/outpatient care due to drug use disorder and

drug crime conviction respectively, between the identified trajectories of childhood poverty, using 'never poor' as the reference group. Results were presented in four different models, as HRs with 95% CIs—model 1: adjusted for calendar year and domicile; model 2, added origin; model 3, added psychiatric diagnosis; and model 4, adjusted for all aforementioned variables and parental psychiatric diagnosis.

All models were tested for proportional hazards using Schoenfeld residuals [38].We carried out interaction tests of our covariates in relation to the outcome variables using the post-estimate Wald test [39].

Ethical approval and statement

The Regional Ethics Committee in Stockholm approved the study before any records were linked (decision number: 2010–1185-31-5). The Swedish national registers are protected by special legislation, which makes it possible for researchers to collect certain information without personal consent. The data set used in this study is based on multiple-linked data of national Swedish routine registers. The data sets are anonymous, and the researchers have no access to any personal information that could identify individuals included in the data sets. The Regional Ethics Committee in Stockholm approved the study before any records were linked (decision number: 2010–1185-31-5).

Data availability

The data sets analysed during the current study are not publicly available due to the Swedish data protection laws that restrict public sharing of data. However, we are happy to answer any questions about the data used in this study and to share the statistical codes and unpublished results.

RESULTS

A five-group model of trajectories of childhood poverty was chosen: (1) 'moving out of poverty in childhood' (8.7%); (2) 'never poverty (69.2%); (3) 'moving into poverty in adolescence' (11.0%); (4) 'moving out of poverty in adolescence' (5.4%); and (5) 'chronically poor' (5.9%) (Fig. 1).

Among the 634 284 individuals included in the analyses, 49% were female (Table 1). Approximately 82% of the study population were native Swedish, 16% were offspring of migrants and 2% were youth migrants. The majority lived in medium-sized towns (48%). Approximately 6% of the study population had a psychiatric diagnosis before the age of 19 year, and almost 10% had at least one parent with a psychiatric diagnosis.

The IR of drug use disorders was higher among males (IR = 435, 95% CI = 415–457) and females (IR = 262, 95% CI = 246–279) who 'moved into poverty in adolescence' (Supporting information, Table S3; Appendix). In general, the IR of drug use disorders was higher among offspring of migrants living in Sweden's three largest cities. The IR increased with calendar time and was higher among those who were also diagnosed with another psychiatric disorder and had at least one parent with a psychiatric diagnosis.

Similarly, the highest IRs of drug crime conviction were found among males (IR = 823, 95% CI = 794–853) and females (IR = 216, 95% CI = 201–231) 'moving into poverty in adolescence'. The IRs of drug crime increased with calendar time among men and were higher among offspring of migrants, those living in a big city, with a
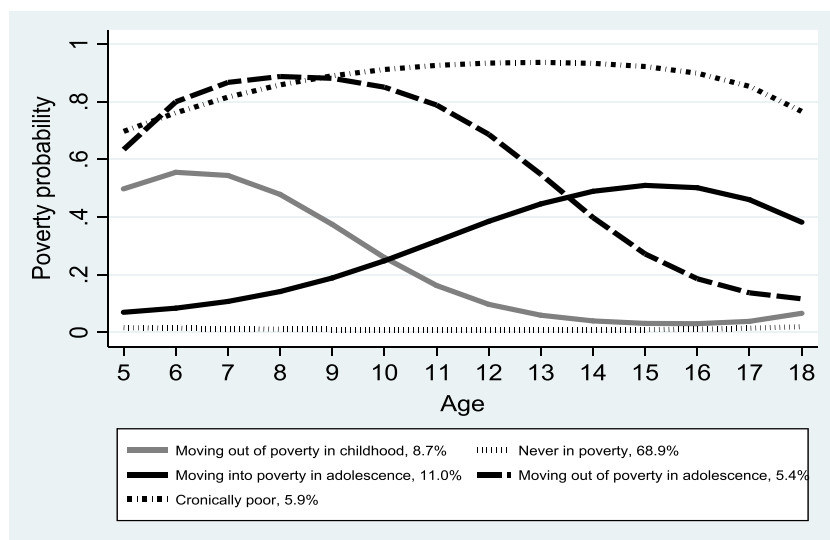

FIGURE 1 Group-based developmental trajectories of childhood and adolescence poverty in ages 5 and 18 years between 1990 and 2008. [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Socio-demographic characteristics of the study population by trajectories of poverty during childhood and adolescence, 2004–2009.

Socio-demographic characteristics	Study population %	Never poverty (n = 439 303) %		Moving out of poverty in childhood (n = 52 332) %		Moving into poverty in adolescence (n = 71 602) %		Moving out of poverty in adolescence (n = 33 464) %		Chronically poor (n = 37 583) %		P-value
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	< 0.126
Origin												< 0.001
Native Swedish	81.6	73.0	73.2	7.7	7.5	10.8	10.7	4.6	4.5	4.0	3.9	
Offspring of migrants	16.1	57.7	57.4	9.8	9.6	14.2	14.3	6.9	7.0	11.4	11.7	
Youth migrant	2.3	15.5	15.3	21.7	20.9	9.5	9.1	19.3	18.3	33.9	36.4	
Calendar year												< 0.001
2004	14.9	70.4	70.8	7.5	7.3	11.4	11.2	5.2	5.0	5.6	5.7	
2005	15.5	69.9	70.3	7.3	7.4	11.5	11.2	5.5	5.4	5.7	5.7	
2006	15.9	69.5	69.7	7.9	7.6	11.4	11.4	5.3	5.4	5.8	5.9	
2007	17.1	68.8	69.1	8.6	8.3	11.1	11.1	5.5	5.3	6.0	6.1	
2008	17.7	68.7	68.3	8.9	8.9	11.2	11.3	5.2	5.4	6.1	6.2	
2009	18.9	68.0	68.8	9.4	9.1	11.3	11.3	5.2	5.0	6.1	6.0	
Domicile												< 0.001
Big city	29.5	72.0	72.1	7.5	7.5	10.4	10.3	4.3	4.2	5.8	5.9	
Medium-sized town	48.1	70.3	70.4	8.1	7.9	11.1	11.0	5.1	5.0	5.4	5.6	
Rural area	22.4	63.3	63.5	9.8	9.5	12.9	13.0	6.9	7.0	7.0	6.8	
Psychiatric diagnosis												< 0.001
No	93.8	69.3	69.5	8.3	8.1	11.2	11.1	5.3	5.2	5.9	5.9	
Yes	6.2	65.6	66.8	9.2	8.6	14.7	14.1	4.7	4.8	5.8	5.7	
Parental psychiatric condition												
No	90.2	70.1	70.3	8.2	8.0	10.5	10.5	5.2	5.2	5.8	6.9	< 0.001
Yes	9.8	60.0	60.4	9.6	9.4	18.5	18.2	5.4	5.6	6.4	6.3	

P-value: χ^2 test; *n* = population size.

psychiatric diagnosis and those with at least one parent with a psychiatric diagnosis.

When compared with those in the 'never poor' group, the hazard ratios (HRs) of drug use disorders were higher among males 'moving into poverty in adolescence' (HR = 1.76, 95% CI = 1.66–1.85), followed by those who were 'chronically poor' (HR = 1.26, 95% CI = 1.16–1.37), after adjusting for calendar year and domicile (Table 2). These estimates were attenuated when also adjusting for origin, psychiatric diagnosis and parental psychiatric diagnosis (HR = 1.48, 95% CI = 1.40–1.57 and HR = 1.16, 95% CI = 1.08–1.25).

The results for the females 'moving into poverty in adolescence' were similar (HR = 1.80, 95% CI = 1.67–1.953) for drug use disorders when compared to the 'never poor', after adjustment for calendar year and domicile. The estimates were further attenuated in the fully adjusted model (HR = 1.50, 95% CI = 1.38–1.62).

The highest risks of drug crime convictions were among males 'moving into poverty in adolescence' (HR = 1.73, 95% CI 1.66–1.80), followed by those 'chronically poor'

(HR = 1.54, 95% CI = 1.45–1.62) after adjustments for calendar year and domicile (Table 3). These risks decreased to HR = 1.48, 95% CI = 1.42–1.55 and HR = 1.20, 95% CI = 1.13–1.27, respectively, in the fully adjusted model.

The risks were approximately twice as high among females 'moving into poverty in adolescence' (HR = 2.07, 95% CI = 1.90–2.24) compared with in the 'never poor' when adjusted for calendar year and domicile. These estimates were somewhat attenuated when adjusting for origin, psychiatric diagnosis and parental psychiatric diagnosis (HR = 1.75, 95% CI = 1.60–1.89).

Sensitivity analyses

Based on significant interaction effects (*P* < 0.05) between poverty exposure and origin and parental psychiatric diagnosis, respectively, in relation to the outcome, we stratified the analyses. Our stratified analyses by showed approximately the same results as in the

TABLE 2 Cox regression models for drug use disorders by trajectories of poverty during childhood and adolescence in males and females 2004–16 (*n* = 634 284).

Trajectory of poverty during childhood and adolescence		HR 95% CI	HR 95% CI	HR 95% CI	HR 95% CI
Males	Drug use disorders	Model 1	Model 2	Model 3	Model 4
Never poverty	5837	Ref	Ref	Ref	Ref
Moving out of poverty in childhood	863	1.27 (1.18–1.36)	1.22 (1.13–1.31)	1.20 (1.13–1.29)	1.16 (1.08–1.25)
Moving into poverty in adolescence	1620	1.76 (1.66–1.85)	1.68 (1.59–1.78)	1.60 (1.52–1.69)	1.48 (1.40–1.57)
Moving out of poverty in adolescence	461	1.07 (0.97–1.18)	1.00 (0.91–1.11)	1.01 (0.92–1.12)	1.00 (0.91–1.10)
Chronically poor	617	1.26 (1.16–1.37)	1.13 (1.03–1.22)	1.13 (1.04–1.24)	1.12 (1.03–1.22)
Females					
Never poverty	3261	Ref	Ref	Ref	Ref
Moving out of poverty in childhood	465	1.24 (1.12–1.37)	1.23 (1.11–1.36)	1.21 (1.09–1.33)	1.17 (1.06–1.29)
Moving into poverty in adolescence	930	1.80 (1.67–1.93)	1.76 (1.63–1.90)	1.63 (1.52–1.76)	1.50 (1.38–1.62)
Moving out of poverty in adolescence	232	0.97 (0.85–1.10)	0.95 (0.83–1.09)	0.97 (0.84–1.10)	0.94 (0.82–1.08)
Chronically poor	299	1.08 (0.96–1.22)	1.05 (0.93–1.18)	1.06 (0.94–1.20)	1.04 (0.93–1.18)

CI = confidence interval; HR = hazard ratio. Model 1 adjusted for calendar year and domicile, model 2 adjusted for origin, model 3 adjusted for psychiatric diagnosis, model 4 adjusted for parental psychiatric diagnosis. Drug use disorders = hospital admission due to any drug use disorder.

TABLE 3 Cox regression models for drug crime convictions by trajectories of poverty during childhood and adolescence in males and females, 2004–16 (*n* = 634 284).

Trajectory of poverty during childhood and adolescence		HR 95% CI	HR 95% CI	HR 95% CI	HR 95% CI
Males	Drug crime conviction	Model 1	Model 2	Model 3	Model 4
Never poverty	10 944	Ref	Ref	Ref	Ref
Moving out of poverty in childhood	1761	1.39 (1.32–1.47)	1.25 (1.19–1.32)	1.24 (1.18–1.31)	1.22 (1.16–1.29)
Moving into poverty in adolescence	2955	1.73 (1.66–1.80)	1.61 (1.55–1.68)	1.57 (1.51–1.64)	1.48 (1.42–1.55)
Moving out of poverty in adolescence	1042	1.31 (1.23–1.40)	1.13 (1.06–1.21)	1.13 (1.06–1.21)	1.13 (1.06–1.20)
Chronically poor	1377	1.54 (1.45–1.62)	1.20 (1.13–1.28)	1.20 (1.14–1.28)	1.20 (1.13–1.27)
Females					
Never poverty	2321	Ref	Ref	Ref	Ref
Moving out of poverty in childhood	367	1.37 (1.23–1.53)	1.33 (1.19–1.49)	1.31 (1.17–1.47)	1.28 (1.15–1.43)
Moving into poverty in adolescence	764	2.07 (1.90–2.24)	1,98 (1.83–2.15)	1.89 (1.74–2.05)	1.75 (1.60–1.89)
Moving out of poverty in adolescence	182	1.06 (0.91–1.23)	1.01 (0.87–1.18)	1.02 (0.88–1.19)	1.00 (0.86–1.17)
Chronically poor	238	1.21 (1.06–1.38)	1.19 (0.97–1.28)	1.13 (0.98–1.29)	1.11 (0.97–1.28)

CI = confidence interval; HR = hazard ratio. Model 1 adjusted for calendar year and domicile, model 2 adjusted for origin, model 3 adjusted for psychiatric diagnosis, model 4 adjusted for parental psychiatric diagnosis.

non-stratified analyses (Supporting information, Tables S4, S5 and S6; Appendix).

The assumption of proportional hazard was not fulfilled in the general test. However, when looking at the risks using within-time stratification analysis, we found that the trend of the effects was consistent with marginal differences. From this, we can draw the conclusion that the associations remained approximately the same during our study period (Supporting information, Tables S7a–c, S8a–c; Appendix).

DISCUSSION

Main findings

We found that almost all trajectories of poverty during childhood and adolescence were associated with a higher risk of drug use disorders and drug crime convictions in young adulthood, the exceptions being males and females moving out of poverty during adolescence and females chronically poor. Regardless of sex, origin and other psychiatric diagnoses, individuals who moved into poverty in adolescence had the highest risks of drug use disorder and drug crime conviction in adulthood when compared with the never poor.

We have not found any previous study that examined associations between trajectories of poverty throughout childhood and adolescence and subsequent drug use disorder and drug crime conviction in adulthood. One Norwegian population-based study showed that those in persistent poverty in childhood were less likely to report substance use from age 16 to 19 years, compared to those moving in and out of poverty [40]. Another Swedish population-based study showed that low and declining family income in childhood increased the risk of substance misuse from age 15 to 24 [15].

Even though any economic instability during childhood may be a risk factor for negative developmental outcomes [41], instability during middle childhood or adolescence seem particularly detrimental [42–46]. Our results corroborate studies highlighting the relevance of exposure to poverty during this developmental period with regard to adverse health outcomes [13,47]. For instance, Lai and colleagues [47] observed that children belonging to a trajectory of accentuated poverty in late childhood/adolescence were at higher risk of mental health problems and long-standing illness when compared with those never in poverty. These results, as well as ours, support the theoretical model of a sensitive period, stating that the effect of early poverty on later health outcome might depend upon the timing of its occurrence (e.g. early childhood versus early or late adolescence) [48].

From the mid-1970s onwards, Sweden has received increasing numbers of non-European migrants, mainly refugees and their families originating from the Middle East and the Horn of Africa [49]. Refugees are the most vulnerable group among the migrant population regarding mental health, substance misuse and labor market outcomes [50]. The socio-economic deprivation which characterizes many migrant households [51,52] has been associated with poor mental health status. For example, a recent cohort study conducted in the United Kingdom found an association between transition into income poverty and deterioration in child and maternal mental health [53]. Poor parental mental health might, in turn, lead to non-supportive parenting, less emotional sensitivity towards the children and difficulties in implementing appropriate parenting practices [23,24]. The lack of supportive parenting might result in less supervision of youths, exposing them to social environments with a greater propensity to engage in drug use behaviors [54,55]. Moreover, participation in the illicit drug market can be one possible response to the economic strains that characterize life for many youths in deprived socio-economic neighborhoods [56]. Consequently, low parental income is likely to entail several risk factors linked to drug use and drug-related criminality.

Low income levels are commonly associated with living in deprived neighborhoods. One possible explanation for the higher risk of criminal convictions in young adults living in deprived neighborhood is the high exposure to drug activities, i.e. drug dealers and drug users [57]. Further, disadvantages and drug activities being concentrated to certain neighborhoods might attract police presence leading to high numbers of drug arrests, i.e. a greater likelihood of being convicted. In fact, a Swedish study showed that, in wealthier districts, young people were less frequently suspected of drug use than in lower–middle-income areas, despite reporting higher drug consumption. It is also six times more common for boys to be suspected of drug-related crimes compared with girls, although self-reported consumption does not differ greatly [58].

Strengths and limitations

A major strength of our study was that it was based on data from a combination of national registers covering the entire youth population living in Sweden. We were able to analyze females and males separately, by origin, and adjust for any other psychiatric diagnosis as well as parental psychiatric diagnosis. Further, we excluded all individuals who had a drug diagnosis or a drug crime conviction before the beginning of the follow-up period, thus reducing the risk of reverse causality.

Our study also had some limitations. First, family poverty and drug use disorders or drug crime convictions in offspring might share many additional overlapping risk factors (family, health, school, neighborhood and so on), on which we had no information in this study. Secondly, we did not consider information about school performance/school failure in adolescence. In a previous study using Swedish registers, school failure was found to be a strong predictor of drug abuse [59]. Thirdly, caution needs to be taken in how these findings are interpreted as the outcome variables—hospital records due to drug-related disorders or drug-related crimes—imply serious problems related to drug use or drug-related behaviors. The proportion of hidden individuals suffering from their drug use is likely to be high. Our register only captures drug use disorders resulting in medical care.

Consequently, this measurement is also a measure of access to and utilization of health-care services. Individuals facing barriers from seeking care for drug use problems are captured neither in the registers nor in our study. However, this may, above all, have led to an underestimation of the actual problems. Moreover, it may be that individuals from a certain socio-economic background are more prone to seek treatment, which would bias our results. However, a Danish study reported patients in low socio-economic position to have relatively lower utilization of mental health services [60]. Lastly, although we examined a large sample—limiting the risk of classification error—our trajectory analysis provides probabilities of individuals belonging to a group, and thus should not be interpreted as confirmed phenotypes [61].

CONCLUSION

This study shows that poverty exposure early in life increases the risk of drug use problems in young adulthood. One implication of our findings is that public health policies aiming at narrowing social inequalities are needed. Such policies should promote parental socio-economic integration and youths' employment opportunities by addressing wider areas of inequalities such as housing, labor market participation, education and access to care. Our findings that males and females moving into poverty in adolescence were particularly vulnerable suggest that targeting this group might also help reduce the risk of them developing later drug use problems.

Declaration of interests

None.

Author contributions

Helio Manhica: Conceptualization; data curation; formal analysis; investigation; methodology. **Viviane S. Straatmann:** Conceptualization; investigation; methodology. **Andreas Lundin:** Conceptualization; data curation; methodology; supervision. **Emilie Agardh:** Conceptualization; investigation; methodology; supervision. **Anna-Karin Danielsson:** Conceptualization; data curation; funding acquisition; investigation; methodology; supervision.

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Supporting Information

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

Table S1. STROBE Statement—checklist of items that should be included in reports of observational studies.

Table S2. Checking the best BIC by number of groups only with cubic order (Max selected order = cubic).

Table S2A. Checking the model fit of posterior probability of group membership for five-group and six-group models (5 groups).

Table S2B. Checking the model fit of posterior probability of group membership for five-group and six-group models (6 groups).

Table S3. Incidence rates (IR) of drug use disorders and drug crime convictions among males and females, 2004–2016 (N=634 284).

Table S4. Cox regression models for drug use disorders by origin and trajectories of poverty during childhood and adolescence, 2004–2016 (N=634 284).

Table S5. Cox regression models for drug crime among youths male and female by origin and childhood trajectories of family poverty, 2004-2016 (N=634 284).

Table S6. Cox regression models for drug use disorder and drug crime among youths male and female by parental psychiatric diagnosis and trajectories of family poverty, 2004-2016 (N=634 284).

Table S7a. Cox regression models for drug use disorders by trajectories of poverty during childhood and adolescence in males and females, 2004–2016 (ages 18–23 years).

Table S7b. Cox regression models for drug use disorders by trajectories of poverty during childhood and adolescence in males and females, 2004–2016 (ages 23-28 years).

Table S7c. Cox regression models for drug use disorders by trajectories of poverty during childhood and adolescence in males and females, 2004–2016 (ages 28-32 years).

Table S8a. Cox regression models for drug crime conviction by trajectories of poverty during childhood and adolescence in males and females, 2004–2016 (ages 18-23 years).

Table S8b. Cox regression models for drug crime conviction by trajectories of poverty during childhood and adolescence in males and females, 2004–2016 (ages 23-28 years).

Table S8c. Cox regression models for drug crime conviction by trajectories of poverty during childhood and adolescence in males and females, 2004–2016 (ages 28-32 years).