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ORIGINAL ARTICLE

The Global Distribution and Epidemiology of Psychoactive Substance Use and Injection Drug Use Among Street-Involved Children and Youth: A Meta-Analysis

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ABSTRACT

Background: Globally, street-involved children and youth (SICY) who work and live on/of the streets are at higher risk of increased psychoactive substances and injecting drug use. *Objectives:* The present study aimed to identify the prevalence, distribution, sociodemographic factors, and risk-taking behaviors associated with psychoactive substances and injecting drug use among SICY. *Methods:* Studies in English published from December 1 1985 to July 1 2022, were searched for on *PubMed, Scopus, Cochrane,* and *Web of Science* to identify primary studies on psychoactive substances and injecting drug use among SICY. The pooled-prevalence estimates were obtained using a robust fixed-effects model. *Results:* The most commonly reported life-time and current psychoactive substance was tobacco followed by cannabis, LSD/ecstasy, cocaine, methamphetamine, heroin and injection drug use. The results showed that life-time and current prevalence of methamphetamine and cannabis use, as well as life-time prevalence of cocaine, LSD/ecstasy, heroin, tobacco, and injecting drug use increased as age rose while current prevalence of cocaine and tobacco use decreased as age rose. SICY who were male, homeless, had parents who had died, had history of substance use among family members or best friends, had experienced violence, had casual sex partners, had a history of working in the sex trade, and had unprotected sex were all related to psychoactive substance use and injecting drug use. *Conclusions:* Research examining this population suffers from lack of studies, therefore, improving the knowledge for interventions aimed at reducing risk behaviors, particularly those related to the transmission of sexually transmitted infections such as HIV is of great importance.

Abbreviations: CIs: Confidence intervals; NOS: Newcastle-Ottawa Scale; OR: Odds ratio; PECOs: Participants, exposures, comparison, outcome and study design; PRISMA: Protocols of systematic reviews and meta-analyses; SICY: Street-involved children and youth; UNICEF: United Nations Children's Fund; WHO: World Health Organization

KEYWORDS
Street-involved children and youth; psychoactive substances; injection drug use; violence; casual sex partner; sex trade; unprotected sex

Introduction

Many children around the world live on the streets and struggle with difficulties to survive (Keeley, 2021). Children living and working on the street are categorized by the United Nations Children's Fund (UNICEF) as follows: 'children *on* the street', 'children *of* the street', and 'children *from* street families' (World Health Organization, 2000). Children on the street work some hours of the day on the street, to contribute to their family financially, but often return home at night, and have familial ties (United Nations Children's Fund [UNICEF], 2006). Children of the street both work and sleep on the streets and do not have a regular contact with family members

(United Nations Children's Fund [UNICEF], 2006). Children from street families live with their families in the street (World Health Organization, 2000).

The phenomenon of street-involved children and youth (SICY) is quite diverse and varies between high-income and low- to middle-income countries (Zarezadeh, 2013). In developed countries, youth become street-involved because of familial conflict and child abuse (Embleton et al., 2016). However, children in low income counties may experience the street life due to abject poverty, child abuse, neglect, familial dysfunction, death of parents, war, and socio-cultural and religious beliefs (Cumber et al., 2015; Woan et al., 2013). In addition, the psychoactive substance use habits usually vary from different countries (Embleton et al., 2013). In high-income countries, youth who live on the streets may be using injection drugs and other psychoactive substances that are not used commonly among children and youth on the streets in low income countries (Chettiar et al., 2010; DeBeck et al., 2013; Tozer et al., 2015).

Several sociodemographic factors and high-risk behaviors associated with psychoactive substance use and injection drug among SICY have been identified previously. Regarding sociodemographic factors, older age (Ayenew et al., 2020), male gender (Ahamad et al., 2014; Hadland et al., 2011), low educational status (Dejman, Vameqhi, et al., 2015), and family substance use (Ayenew et al., 2020) have been positively associated with psychoactive substance use and injection drug, among those attending the fifth grade and above (Ayenew et al., 2020). Presence of family members (Moura et al., 2012) has been negatively associated with psychoactive substance use and injection drug among SICY. Concerning high-risk behaviors domestic violence and peer pressure (de Carvalho et al., 2006), best friend substance users, and staying more than one year on the street (Ayenew et al., 2020) have been positively associated with psychoactive substance use and injection drug among SICY.

To the best of the present authors' knowledge, studies related to street children and their drug use behaviors have mostly focused on investigating the prevalence and types of psychoactive substances used. The reported prevalence estimates are inconsistent and often very diverse within countries and geographical regions. There is only one previous meta-analysis that has been conducted among street children in resource-constrained settings (Embleton et al., 2013). As well as being over a decade old, the study (i) only reported psychoactive substance use among SICY in resource-constrained settings (not all countries all over the world), (ii) only reported lifetime some specific substances such as alcohol, inhalants, and tobacco (i.e., not all psychoactive and injection drug use), (iii) did not report the pooled prevalence of substances per country (they reported the pooled prevalence of substances per continent), and (iv) did not run any subgroup analysis by age and time of publication. Also, there are no reported pooled data on the prevalence and types of psychoactive substances used and injection drug use by categories such as geographical region, or the characteristics associated with SICY's psychoactive substances used and injection drug use and their reasons for use.

In addition, no previous systematic reviews or meta-analyses concerning the prevalence of substance use in terms of age and year of publication year of studies have been conducted. Epidemiological information focusing on psychoactive substance use among SICY as well as its associated factors is required to improve the knowledge regarding the problem. Such data would contribute to programs designed for reintegrating children into communities. Therefore, the present systematic review and meta-analysis aimed to determine the prevalence, distribution, sociodemographic factors and risk-taking associated with psychoactive substances and injecting drug use among SICY.

The present study hypothesized that: (i) psychoactive substance use and injecting drug use would increase as age rose (H_1), (ii) psychoactive substance use and injecting drug use would decrease over time (H_2), and (iii) risky behaviors such as having experienced violence, having casual sex partners, having history of sex trade, and having unprotected sex would be stronger predictors of psychoactive substances and injecting drug use than socio-demographic factors (H_3).

Methods

Search strategy

Scopus, PubMed, Web of Science, and Cochrane library databases were systematically searched for English-language published papers and abstracts from December 1 1985 to July 1 2022. Also, *Google Scholar* was searched to identify any other relevant studies. The search strategy was prepared and modified for the various databases using important Boolean operators (AND/OR) with initial keywords: "(street children), (street youth), (homeless youth), (homeless children), (runaway children), (substance use), (substance abuse), (drug use), (psychoactive substances), (injection drug use)". The bibliographies of the selected full texts were also reviewed to check if there were any other relevant studies. In case more than one study reported on the same sample of SICY, the most detailed data concerning the prevalence of drug use was selected. **Supplementary File 1** presents the details of the search strategy, including the combination of keywords used in the different electronic databases.

Study eligibility, PECOs (participants, exposures, comparison, outcome, and study design) and exclusion criteria

The present systematic review was performed in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al., 2021). The PECOs criteria were used for: (a) participants: 'street-involved children and youth' were defined as any child (aged 0–18 years) or youth (aged 15–24 years) (Embleton et al., 2016) who spend a

proportion or majority of their time living on the streets. Moreover, they may have been defined in studies as 'children on the street', 'children of the street', street children, working children, parking boys, or market children; (b) exposures: sociodemographic factors and risk-taking associated with psychoactive substance use and injecting drug use; (c) comparison: other street-involved children and youth); (d) outcomes: reporting original prevalence data on SICY's psychoactive substances and injecting drug use. Life-time psychoactive substances and injecting drug use including ever using a substance (at least one time) and current drug use (defined as drug use within the past 30 days); and (e) study designs: cross-sectional, cohort, case-control, mixed-methods, and interventions with baseline data were considered. Studies lacking original prevalence data were excluded from the study. Other exclusions included (i) studies which had high heterogeneity or outcome variations from the considered groups, and (ii) unpublished (i.e., non-peer-reviewed) theses (e.g., PhDs, Master's dissertations).

Study selection process and data extraction

Duplicate papers were deleted using *EndNote X7* software. First, two authors (BA and RM) independently reviewed the titles and abstracts according to the study inclusion and exclusion criteria. Any disagreements between the two reviewers were resolved by a third author (RM). In the second step, the full texts of studies were evaluated according to the eligibility study criteria. Data were then independently extracted by two authors (BA and RM) for the final selected studies according to: author, year of publication, country, study design, sample size, population details, associated sociodemographic factors and risk-taking, and psychoactive substances and injecting drug use assessment. If needed, selected study authors were contacted to provide further details. Cohen's Kappa statistic was used for agreement between two authors (**Supplementary File 2)**. The agreement levels of poor, slight, fair, moderate, substantial, and almost perfect were

considered by the values 0, 01–0.02, 0.021–0.04, 0.041–0.06, 0.061–0.08, and 0.081–1.00, respectively (Landis et al., 1977). Disagreements between two authors (less than 10% in total) were resolved by a third author.

Study quality assessment

The Newcastle-Ottawa Scale (NOS) (Peterson et al., 2011) was used to assess the quality of studies, which comprises three criteria: (i) the selection domain, including the representativeness of the exposed group, selection of the non-exposed group, and ascertainment of exposure (three items for cross-sectional studies and four items for cohort); (ii) the comparability domain, including group comparability based on the study design or analysis (one item each for both cross-sectional studies and cohort studies), and (iii) the exposure/outcome domain, including assessment of outcome (one item for of cross-sectional studies and three items for cohort). Studies were categorized as unsatisfactory, satisfactory, good or very good. There is possible maximum score of 8 for cohort and case control studies. Studies that reached a total score of 0-2 were "unsatisfactory," 3-4 were "satisfactory," 5-6 were "good" and 7-8 was "very good" respectively. In total, 26 studies were rated as high quality, 41 were rated as good quality, and 13 were rated as satisfactory quality **(Table 1).**

Table 1 near here

Data synthesis and statistical analysis

Lifetime or current drug use prevalence for psychoactive substances and injecting drug (methamphetamine, , cocaine, LSD/ecstasy,[1] cannabis, heroin, tobacco and injecting drug use) were considered by type of drug. Any reports of overall prevalence without mentioning the specific

[1] A number of studies have reported LSD/ecstasy as a combined category so this grouping has been retained for the present study's meta-analysis

time period in the studies were considered as lifetime use for the purposes of the meta-analysis. The pooled-prevalence estimates were obtained using a robust random-effects model (i.e. the DerSimonian–Laird method) (DerSimonian et al., 1986). In contrast to the more restrictive fixed-effect model such as Mantel–Haenszel method (Mantel et al., 1959), this model allows for obtain samples from heterogeneous populations. It also enables the obtained prevalence estimates to vary not only because of the random error within studies (as in the fixed-effects model), but also because of true variation from one study to another. Heterogeneity between studies was assessed using I^2 statistics, which evaluate the percentage of variation among studies (Langan et al., 2019). The study used fixed-effect model with a smaller number of studies (Borenstein, 2009; Lin et al., 2020). Also, both fixed and random effect models were run. The precision of each model was evaluated, and then the model which had most precision was reported. Mixed effects meta-regression was used to investigate the effects of potential factors (age and year of publication of studies) on the heterogeneity of psychoactive substances and injecting drug use among SICY.

To assess publication bias, Egger's approach was performed both graphically and statistically (Egger et al., 1997). A *p*-value of 0.05 was deemed to be statistically significant. Subgroup analyses was performed by age and year of publication of studies. A sensitivity analysis was conducted on the geographical data to evaluate the possible undue influence on the meta-analysis in each of the geographical categories. To visualize the different prevalence on the world map, the latitude and longitude values related to each country were extracted by geocoding using the *geopandas Python* package and the visualizations were conducted using *folium library* in *python*. All the codes were run on the *Google Collaboratory* research platform. The association between street-involved children and youth's substance use in resource constrained settings and sociodemographic factors and risk-taking were assessed by OR, and 95% CIs. The obtained results

were visualized using forest plots. For data analysis, *R 3.5.1* with the *meta* package was applied to perform the meta-analysis.

Results

Study characteristics

Of the 11,121 papers found, 6,524 were duplicates, 3,706 were screened by title and abstracts, 548 were selected for full text review, and 80 were finally retained for systematic review (**Table 2**). The main reasons for exclusion of studies were: 400 studies did not have a quantitative methodology and did not report odd ratios of relative risks of associated variables related to the study outcomes (85%), and 68 did not qualified according to minimum quality appraisal (15%) (**Figure 1)**. Of the 80 studies, 35 were based on data collected from the America Region (n = 20,016 participants) and 22 from the Africa Region (n = 6,230 participants). Canada was the country with the highest number of included studies (24 studies and 13,672 participants). Considering the World Bank country income level, there were 27 studies from higher income countries (n = 15,328), eight studies from upper middle-income countries (n = 10,345), 41 studies from lower middle-income countries (n = 13,610), and four studies from lower-income countries (n = 1,111).

Study sample sizes ranged from 23 to 5,268 SICY, with 57 studies including both males and females, 10 studies with males only, and 13 studies not reporting gender. SICY were more likely to be male (74.55% on average in the studies, varying from 50% to 100%), and on average were 16.22 years old. Almost two-thirds of studies were published between 2010 and 2022 (58%). Most studies were cross-sectional (64 of 80). More than half of studies (58%) utilized the UNICEF definition of street children for their inclusion criteria. Only 16 studies considered both children and youth on/of the street, 18 studies only considered children and youth of the street, 23 studies

only considered children and youth on the street, and 23 studies did not report their samples in terms of children and youth on/of the street (**Table 2**).

Table 2 near here

Geographical distribution of life-time and current prevalence of psychoactive substances and other drugs use among SICY

Table 3 presents the geographical distribution of life-time and current prevalence of psychoactive substance and other drug use among SICY. There were studies from 24 different countries and considering lifetime and current prevalence rates of psychoactive substance use and other drug use, the majority (93%) were from Canada and (91.56%) and the US respectively **(Table 3) and (Supplementary Files 3-16).**

Table 3 near here

Pooled prevalence of life-time and current psychoactive substances and other drugs use among SICY

Meta-analysis showed that among SICY, the most commonly reported lifetime and current psychoactive substance was tobacco followed by cannabis, LSD/ecstasy, cocaine, methamphetamine, heroin and injection drug use **(Table 4 and Supplementary Files 17-30).**

Table 4 near here

Subgroup analyses of pooled prevalence of life-time and current psychoactive substances and other drugs use by age of participants among SICY

A subgroup analysis was performed based on age of participants, categorizing the participants into three groups: (i) 10-14 years, (ii) 15-18 years, and (iii) >18 years. The results confirmed that life-time and current prevalence of methamphetamine and cannabis use, as well as

life-time prevalence of cocaine, LSD/ecstasy, heroin, tobacco, and injecting drug use increased as age rose while current prevalence of cocaine and tobacco use decreased as age rose **(Table 5** and **Supplementary Files 31-41).** Therefore, H_1 was only partially confirmed (because current prevalence of cocaine and tobacco use decreased as age rose among SICY).

Table 5 near here

Subgroup analyses of pooled prevalence of life-time and current psychoactive substances and other drugs use by time of publication of studies among SICY

A subgroup analysis was performed based on year of study publication and the studies were categorized into three time periods: (i) before 2000, (ii) 2000-2011, and (iii) 2012–2022. It was found that (i) life-time and current prevalence of cannabis use decreased over time, and (ii) life-time prevalence of LSD/ecstasy, heroin, tobacco and injecting drug use decreased over time, (iii) life-time prevalence of methamphetamine and cocaine use increased over time, and (iv) current prevalence of tobacco use increased over time **(Table 6** and **Supplementary Files 42-51).** Therefore, H_2 was only partially confirmed (because life-time prevalence of methamphetamine, cocaine and current prevalence of tobacco increased over time among SICY).

Table 6 near here

Sociodemographic factors and risk-taking associated with life-time or current psychoactive substances and other drugs use among SICY

The analysis indicated that SICY who were males were 6.18 times more likely than females to have life-time or current substance use (OR = 6.18, 95% CI = 3.06, 12.49). Those who were homeless were 1.31 times more likely than those who were not to have life-time or current substance use (OR = 1.31, 95% CI = 1.21, 1.41). SICY whose parents had died were 1.19 times

more likely than those who parents had not to have life-time or current substance use (OR = 1.19, 95% CI = 1.10, 1.29). Participants who had history of imprisonment were 1.32 times more likely than those who were not to have life-time or current substance use (OR = 1.32, 95% CI = 1.10, 1.58). Those who had substance users in their family were 2.48 time more likely than those who did not to have life-time or current substance use (OR = 2.48, 95% CI = 1.83, 3.36). Those who had best friends that were substance users were 4.14 time more likely than those who did not to have life-time or current substance use (OR = 4.14, 95% CI = 2.90, 5.91).

Those who were victims of violence were 1.37 time more likely than those who were not to have life-time or current substance use (OR = 1.37, 95% CI = 1.20, 1.56). Those who had casual sex partners were 2.64 times more likely than those who did not to have life-time or current substance use (OR = 2.64, 95% CI = 1.98, 3.54). Those who had history of working in the sex trade were 1.89 times more likely than those who did not to have life-time or current substance use (OR = 1.89, 95% CI = 1.54, 2.31). Finally, participants who had unprotected sex were 3.27 times more likely than those who did not to have life-time or current substance use (OR = 3.27, 95% CI = 1.83, 5.86) **(Figures 2 and 3).** Therefore, H_3 was confirmed (i.e., risky behaviors were stronger predictors of psychoactive substance use and injecting drug use than socio-demographic factors) on the basis that far more studies show significant associations between risky behaviors and psychoactive substance use than significant associations between socio-demographic factors and psychoactive substance use.

Figures 2 and 3 near here

Meta-regression

In order to investigate the effects of potential contributing factors on the heterogeneity of studies on pooled prevalence of life-time and current psychoactive substances and other drug use, meta-regression was used to study two specific factors (i.e., participants' age, and time of publication of studies). With increasing age of study participants, the pooled prevalence of life-time cannabis, cocaine, heroin, tobacco use and the pooled prevalence of life-time and current injection drug use increased, and was statistically significant ($p < 0.05$) (**Tables 7 and 8**). With increasing time of publication of studies, the pooled prevalence of current tobacco and injection drug use increased, and was statistically significant ($p < 0.05$) (**Table 8**).

Tables 7 and 8 near here

Discussion

The present meta-analysis was conducted to estimate the pooled-prevalence estimates of lifetime and current psychoactive substances and injecting drug use by geographical region as well as psychoactive substances and injecting drug use by age and year of publication. The present systematic review and meta-analysis found a high prevalence of psychoactive substances and injecting drug use among SICY with significant variation by geographical region and study methodology. No pooled prevalence for a majority of these psychoactive substances has previously been reported in relation to SICY. The pooled prevalence rates of cocaine, cannabis, and tobacco use were higher than the percentages reported in a previous meta-analysis (36% vs, 7% for cocaine; 45% vs. 31% for cannabis; and 51% vs. 44% for tobacco) (Embleton et al., 2013). H_1 and H_2 were only partially confirmed.

The type of psychoactive substance used has a significant impact on the mortality and morbidity, and also has a major effect on social reintegration of the users (Lubman et al., 2008).

The estimated pooled-prevalence rates in the present study are much higher than those of the World Health Organization (WHO) regarding life-time psychoactive substance use of non-street youth globally (World Health Organization, 2013). The present study's findings provide insight into the factors associated with psychoactive substance use and injecting drug use. In particular, psychoactive substance use and injecting drug use were associated with being male, being homeless, having parents who have died, having a history of substance use in the family or among best friends, being the victim of violence, having casual sex partners, having a history of working in the sex trade, and having unprotected sex. H_3 (that risky behaviors would be stronger predictors psychoactive substance use and injecting drug use than socio-demographic factors) was confirmed among SICY.

Substance use among males was reported to be 6.24 times more compared to females. The reason may be due to the lack of awareness among the boys about using substances (Kumar et al., 2008), as well as higher peer pressure (Bal et al., 2010) which is an important factor affecting illegal drug use, and other precipitating causes such as pleasure seeking, ways to overcome sadness, and "to get a sense of well-being" (Kumar et al., 2008; Njord et al., 2010; Seth et al., 2005). Peer pressure also results in children not feeling guilty about abusing inhalants (Praveen et al., 2012). According to the findings, homelessness was significantly associated with substance use. This may be due street-involved youth using drugs to stay alert while sleeping on the street (Bungay et al., 2006). This finding is consistent with a longitudinal analysis of adult injection drug users, that reported a significant association between homelessness and initiating methamphetamine injection (Marshall et al., 2011). Another cross-sectional study reported that methamphetamine use (at least daily) was associated with homelessness (Coady et al., 2007).

Deprived SICY are more likely to use psychoactive substances following parental death (Aviad-Wilchek et al., 2017). Children using substances do not typically live with their families therefore the lack of parental guidance and social and family involvement on such behavioral outcomes among juveniles is an important determining factor (Van Leeuwen et al., 2004). Studies have reported that children living with both parents and/or were closely monitored significantly by parents have lower alcohol, tobacco and/or substance use (Ledoux et al., 2002).

Having imprisonment history was associated with drug use among SICY. Previous studies have indicated that high-risk behaviors such as drug abuse among prisoners may cause infections with hepatitis and HIV (Kakchapati et al., 2018; Milloy et al., 2009). Therefore, suitable interventional strategies are recommended for prisoners.

The findings of the present study suggested that family's history of drug use was significantly associated with street children's drug use. This finding concurs with other studies (Hoffmann et al., 2002; Taplin et al., 2014). Therefore, families of street children have a significant effect on their drug use (Dejman, Vameghi, et al., 2015). One study reported that the history of substance use among fathers was associated with psychoactive drug use among children (Seth et al., 2005). Also, several studies indicate that substance use in families has negative outcomes and is significantly associated with children's substance use (Lander et al., 2013; Roshanfekr et al., 2020). Therefore, the wide range of possible outcomes for these children is essential for policymakers who need to address family history of drug use and its consequences (i.e., risky behaviors) in the community. Correspondingly, youth who had best friends as substance users were five times more likely to use substances compared to those that did not. This finding was consistent with other studies (Ayenew et al., 2020; Moura et al., 2012). The reason may be due to

the fact that older children use substances to avoid to avoid being stigmatized by their friends, to impress their friends and/or because of peer pressure.

The findings also suggested a significant association between substance use and being a victim of violence among street-involved youth, which is in line with previous studies (Chermack et al., 2002; Marshall et al., 2008). These studies have reported that violence experienced during adolescence is associated with alcohol-related consequences, and is a risk factor for alcohol use disorders in young adulthood (Grigsby et al., 2016). Also, sexual violence experience during adolescence may cause emotional and social impairments that lead to substance use (Noll, 2008). Such traumatic experiences which are common among street-involved youth, may increase the risk of subsequent hazardous alcohol use. Drug use may cause high-risk behaviors such as commercial sex work, exchanging sex for drugs, and forced sex that could expose individuals to HIV or other sexually transmitted infections and violence. However, little to no knowledge in this population about these behaviors and health outcomes is available.

According to previous studies, there are associations between drug and alcohol use and risky sexual behaviors (Baskin-Sommers et al., 2006). Therefore, it is very important to determine their impact upon HIV and mortality risks. According to the results there is an independent association between substance use and having a steady sexual partner which may be the sign of unsafe sex, which may be a potential intervention opportunity in this young group. The reason might be because that having a steady partner is associated to lack of condom use due to the general belief about emotional commitment in relationships (de Carvalho et al., 2006; Silva, 2002) which may lead to the having unprotected sex (Silveira et al., 2002). Therefore, to reduce the sexual risk, interventions to increase condom use, better condom negotiation skills, and increasing the access to condoms are necessary. In the present study, substance use among street-involved youth was

associated with sex work involvement which is in line with previous studies from various settings reporting the association between injection drug use and sex work among street-involved youth (Haley et al., 2004; Shakarishvili et al., 2005). Also, previous studies have indicated that involving in injection drug use and sex work places increase the risk of HIV infection and other sexually transmitted infections among street-involved youth (DeBeck et al., 2013; Stoltz et al., 2007). The finding is also consistent with previous research reporting that injection drug users frequently engage in high-risk activities such as sex work to increase their income, and support their drug use or needs (DeBeck et al., 2007), and the sex work is often related to drug scene exposure (Stoltz et al., 2007).

Methodological considerations and limitations related to results

The studies included in the present systematic review and meta-analysis have some methodological concerns. First, two-thirds of the included studies were of a cross-sectional design, preventing the delineation of a causal/temporal association between the research variables under study. Second, most studies focus on the type and prevalence of drug use with limited statistical analysis. Further longitudinal studies are essential to determine the risk and protective factors of substance use among this susceptible population. The factors affecting street children's initiation, ongoing use and ceasing of substances are recommended to be more investigated. Third, the reports of females in these studies were limited or did not include them at all. Therefore, more knowledge about street-involved girls and young women is necessary to avoid gender-based selection bias in this field of research.

Fourth, there is also a lack of available information on the physical and mental health outcomes that street children and youth can experience due to their misuse of multiple substances. Fifth, a number of studies did not follow the UNICEF definition for inclusion criteria regarding

street children and included other children in their studies such as ‘street-involved children and youth’ which may reduce the comparability of the studies. This reveals the need for a universal and standardized definition of the ‘street-involved child or youth’. Sixth, many studies did not use a unified definition of substance use as well as a definition of life-time or current substance use. Therefore, developing a clear definition of the burden of substance use and abuse in this population, life-time use from abuse and dependency, as well as current using patterns is needed. Improving reporting and defining variables more clearly would likely ensure more interpretable and effective conclusions. The creation of an updated valid and reliable substance use data collection tool to apply with SICY would ameliorate data collection and increase the comparability between studies.

Seventh, some variables included in the studies were not retained in the meta-analysis simply there were data from no more than two studies (i.e., educational status, HIV infection, unable to access services, having mental health disorders). Eighth, the selected number of studies was arguably limited to the variables examined. Ninth, due to the sensitive nature of questions regarding substance use, the sampling and prevalence estimates may have been affected by social desirability biases and the relationship between the children and the interviewer and/or the questions asked. Due to the substance use habits, children may have mistrusted the interviewers and not answered correctly if it prevented their participation at a drop-in center or expulsion from a shelter/ institution. Tenth, the search was restricted from 1985 to July 2022. Eleventh, grey literature including dissertations, research and committee reports, government reports, conference papers, and ongoing research, manuscripts and unpublished studies were not included. This is because the research team were unable to evaluate the quality of these studies adequately. Finally,

only English language publications were included in the study, therefore some relevant studies may have been missed.

Conclusions

The present study documented the evidence regarding substance use among SICY. It demonstrated the risk for psychoactive substance use and injection among SICY tended to increase with age. Research in this population suffers from lack of studies, therefore, improving the knowledge for interventions aimed at reducing risk behaviors, particularly those related to the transmission of sexually transmitted infections such as HIV is of great importance. Intervention should focus on the medical model (i.e., early intervention should not be directed at any one cause but should be multipronged) as well as improving the services including legal, administrative, social, and educational services for adolescent street children, their families, and communities. Also, various social support strategies should be applied to support and help these populations through living facilities, and education.

Since many of the youth living on the street do not have access to traditional services, strategies must be established for these participants in their natural environments. Street outreach programs could engage SICY into more intensive prevention and health services. However, the programs should provide not only condom distribution, bleach, and referrals but gender-specific techniques for decreasing both sexual risks and drug using risks. These approaches should complement the prevention services including a wider range of housing, healthcare, drug treatment, guidance, and employment facilities.

Abbreviations

CIs: Confidence intervals

NOS: Newcastle-Ottawa Scale

OR: Odds ratio

PECOs: Participants, exposures, comparison, outcome and study design

PRISMA: Protocols of systematic reviews and meta-analyses

SICY: Street-involved children and youth

UNICEF: United Nations Children's Fund

WHO: World Health Organization

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Table 1. Risk of bias assessment of the included studies using the Newcastle-Ottawa Scale

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Table 8. Meta-regression of the pooled prevalence of current psychoactive substances and other drugs use by age of participants and time of publication of studies among street-involved children and youth

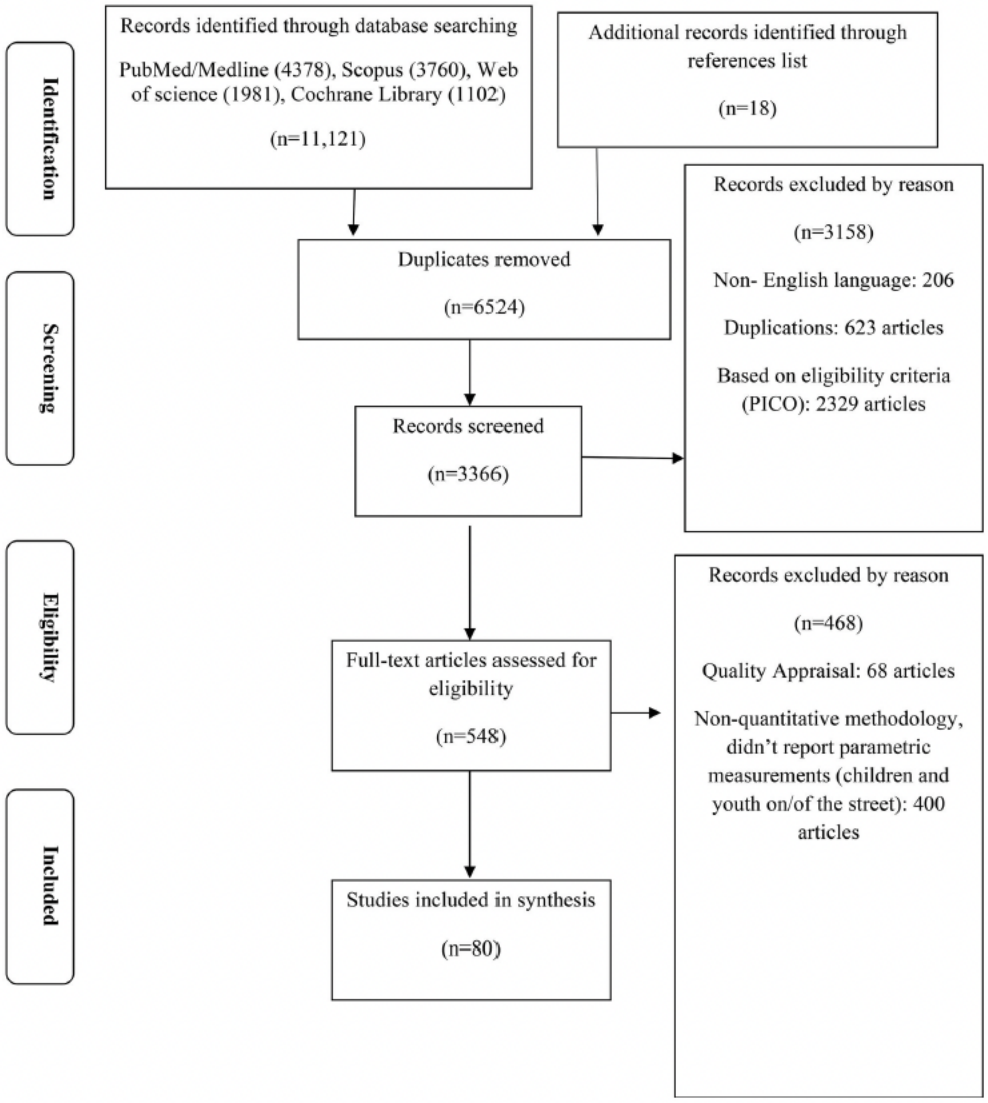

Figure 1. PRISMA flow diagram.

Table 1. Risk of bias assessment of the included studies using the Newcastle-Ottawa Scale.

Study	Selection (***●)	Comparability (*)	Exposure/ outcome (*●●)	Method of assessment	Quality assessment	Quality assessment score
Mabouopda et al. (2022)	**		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Shanthi and Eljo (2022)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Asante and Nefale (2021)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Dhawan et al. (2020)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Tonmoy et al. (2020)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Ayenew et al. (2020)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Lake et al. (2019)	***	*	**	Newcastle-Ottawa Scale adapted for cohort studies	Good	6
Reddon et al. (2018)	***	*	*	Newcastle-Ottawa Scale adapted for cohort studies	Very good	5
Gaddis et al. (2018)	***		*	Newcastle-Ottawa Scale adapted for cohort studies	Good	4
Masud et al. (2018)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Yahya Muhammed Bah (2018)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Kakchapati et al. (2018)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Fairbairn et al. (2017)	**●	*	**	Newcastle-Ottawa Scale adapted for cohort studies	Good	6
Bhattacharjee et al. (2016)	**	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	3
Cumber and Tsoka-Gwegweni (2016)	*	*	*	Newcastle-Ottawa Scale adapted for cohort studies	Satisfactory	3
Tyler et al. (2016)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Kautilya et al. (2015)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Dejman et al. (2015)	**	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	3
Meshram et al. (2015)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Phillips et al. (2015)	**	*	*	Newcastle-Ottawa Scale adapted for cohort studies	Satisfactory	4
Reddy et al. (2014)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Oppong Asante et al. (2014)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Islam et al. (2014)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Uhlmann et al. (2014)	**●	*	**	Newcastle-Ottawa Scale adapted for cohort studies	Good	6
Auerswald et al. (2013)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Gupta et al. (2013)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Embleton et al. (2013)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Chami et al. (2013)	**●	*	**	Newcastle-Ottawa Scale adapted for cohort studies	Good	6
Werb et al. (2013)	**	*	*	Newcastle-Ottawa Scale adapted for cohort studies	Satisfactory	4
DeBeck et al. (2013)	***●	*	*●	Newcastle-Ottawa Scale adapted for cohort studies	Very good	7
Moura et al. (2012)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Praveen et al. (2012)	**	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	3
Embleton et al. (2012)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Roy et al. (2011)	***	*	*●	Newcastle-Ottawa Scale adapted for cohort studies	Good	6
Kirst et al. (2011)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Hadland et al. (2011)	***	*	*●●	Newcastle-Ottawa Scale adapted for cohort studies	Very good	7
Salaam (2011)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Elkoussi and Bakheet (2011)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Hadland et al. (2010)	***●	*	*●	Newcastle-Ottawa Scale adapted for cohort studies	Very good	7
Bal et al. (2010)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Paquette et al. (2010)	***●	*	*●	Newcastle-Ottawa Scale adapted for cohort studies	Very good	7
Njord et al. (2010)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Ataei et al. (2010)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Ahmadkhaniha et al. (2010)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Robbins et al. (2010)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Marshall et al. (2010)	***	*	*●	Newcastle-Ottawa Scale adapted for cohort studies	Good	6
Nada and Suliman (2010)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Abdulmalik et al. (2009)	**		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Kirst et al. (2009)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Kerr et al. (2009)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Kayembe et al. (2008)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Adebiyi et al. (2008)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Kudrati et al. (2008)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Gaidhane et al. (2008)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Kissin et al. (2007)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4

Tiwari (2007)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Roy et al. (2007)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Torres de Carvalho et al. (2006)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Brands et al. (2005)	**	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	3
Sherman et al. (2005)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Obando et al. (2004)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Pagare et al. (2004)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Khurana et al. (2004)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Morakinyo and Odejide (2003)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Roy et al. (2003)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Salem and Abd el-Latif (2002)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Roy et al. (2002)	***	*	*●	Newcastle-Ottawa Scale adapted for cohort studies	Good	7
Ayaya and Esamai (2001)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Othieno et al. (2000)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Baron (1999)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Gleghorn et al. (1998)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Roy et al. (1998)	***●	*	*●	Newcastle-Ottawa Scale adapted for cohort studies	Very good	7
Clements et al. (1997)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Whitworth et al. (1997)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Noto et al. (1997)	*	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Satisfactory	3
Kipke et al. (1996)	**	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	3
Adlaf et al. (1996)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Pinto et al. (1994)	***	*	*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Very good	5
Campos et al. (1994)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4
Porto et al. (1994)	***		*	Newcastle-Ottawa Scale adapted for cross-sectional studies	Good	4

*For cross-sectional studies.
● For cohort studies.

Table 2. Characteristics of the 80 studies identified in the systematic review.

First author [reference no]	Year of publication	Country	Design	Mean/ range of age	N	Male N (%)	Female N (%)	OF the street	ON the street	Prevalence (male) %	Prevalence (female) %	Prevalence (overall) %	Response rate %
Mabouopda et al.	2022	Cameroon	Cross-section	16.1	159	159 (100)	0 (0)	159 (100)[a]	0 (0)	60	0	60	100
Shanthi and Eljo	2022	India	Cross-section	13.87	23	14 (61)	9 (39)	23 (100)[a]	0 (0)	NR	NR	8.7	100
Asante and Nefale	2021	Ghana	Cross-section	8-19	326	250 (61)	126 (39)	0 (0)	326 (100)[c]	74.7	75.9	74.7	100
Dhawan et al.	2020	India	Cross-section	N/A	766	NR	NR	766 (100)[a]	0 (0)	NR	NR	32.1	NR
Tonmoy et al.	2020	Bangladesh	Cross-section	NR	50	NR	NR	50 (100)[a]	0 (0)	NR	NR	16	NR
Ayenew et al.	2020	Ethiopia	Cross-section	12-24	312	281 (90)	31 (10)	312 (100)[a]	0 (0)	NR	NR	30.8	100
Lake et al.	2019	Canada	Cohort	14-26	483	334 (69)	149 (30)	NR	NR	70.2	29.8	63.4	70.7
Reddon et al.	2018	Canada	Cohort	14-26	481	NR	NR	NR	NR	NR	NR	47.4	70.3
Gaddis et al.	2018	Canada	Cohort	21.7	1208	829 (69)	379 (31)	NR	NR	NR	NR	49.6	100
Masud et al.	2018	Bangladesh	Cross-section	12-18	80	61 (76)	19 (24)	0 (0)	80 (100)[a]	NR	NR	3	100
Yahya Muhammed Bah	2018	Gambia	Cross-section	7-17	117	NR	NR	0 (0)	117 (100)[a]	NR	NR	27	NR
Kakchapati et al.	2018	Nepal	Cross-section	N/A	350	288 (82)	62 (18)	350 (100)[a]	0 (0)	43.5	59.7	NR	100
Fairbairn et al.	2017	Canada	Cohort	14-26	1149	790 (61)	359 (31)	1149 (100)[a]	0 (0)	NR	NR	34	100
Bhattacharjee et al.	2016	India	Cross-section	14.3	159	NR	NR	0 (0)	159 (100)[a]	NR	NR	61	100
Cumber and Tsoka-Gwegweni	2016	Cameroon	Cross-section	12-17	399	320 (80)	79 (20)	399 (100)[a]	0 (0)	NR	NR	28.8	100
Tyler et al.	2016	Zambia	Cross-section	14-24	250	179 (71)	71 (29)	0 (0)	250 (100)[a]	47	5	35	100
Kautilya et al.	2015	India	Cross-section	N/A	30	30 (100)	0 (0)	NR	NR	NR	0	63.3	100
Dejman et al.	2015	Iran	Cross-section	15-18	259	192 (74)	67 (26)	259 (100)[a]	0 (0)	NR	NR	25.6	100
Meshram et al.	2015	India	Cross-section	8-18	305	NR	NR	305 (100)[a]	0 (0)	NR	NR	42	NR
Phillips et al.	2015	Canada	Cohort	14-26	1017	698 (61)	319 (31)	NR	NR	NR	NR	52	100
Reddy et al.	2014	India	Cross-section	11-14	603	603 (100)	0 (0)	NR	NR	NR	0	14.9	NR
Oppong Asante et al.	2014	Ghana	Cross-section	12.58	227	122 (54)	105 (46)	0 (0)	227 (100)[a]	NR	NR	16.2	100
Islam et al.	2014	Nigeria	Cross-section	5-18	215	NR	NR	0 (0)	215 (100)[a]	NR	NR	80.9	100
Uhlmann et al.	2014	Canada	Cohort	14-26	1019	699 (69)	320 (31)	0 (0)	1019 (100)[a]	NR	NR	44.6	100
Auerswald et al.	2013	Kenya	Cross-section	13-21	300	299 (99)	1 (1)	300 (100)[c]	0 (0)	NR	NR	24	100
Gupta et al.	2013	India	Cross-section	5-19	502	390 (76)	122 (24)	NR	NR	NR	NR	11.6	100
Embleton et al.	2013	Kenya	Cross-section	10-19	146	114 (78)	32 (22)	98 (67)[a,b]	48 (33)	NR	NR	74	100
Chami et al.	2013	Canada	Cohort	14-26	422	289 (68)	133 (32)	0 (0)	422 (100)[a]	NR	NR	90	100
Werb et al.	2013	Canada	Cohort	14-26	395	NR	NR	395 (100)[a]	0 (0)	NR	NR	98.5	100
DeBeck et al.	2013	Canada	Cohort	14-26	405	274 (68)	131 (32)	0 (0)	405 (100)[a]	NR	NR	63	100
Moura et al.	2012	Brazil	Cross-section	10-18	2807	2120 (75)	687 (25)	0 (0)	2807 (100)[b]	NR	NR	19.5	100
Praveen et al.	2012	India	Cross-section	5-18	174	106 (61)	68 (39)	NR	NR	NR	NR	10.5	NR
Embleton et al.	2012	Kenya	Cross-section	10-19	146	114 (78)	32 (22)	98 (67)[a,b]	48 (33)	NR	NR	74	100
Roy et al.	2011	Canada	Cohort	19.35	946	574 (60)	243 (40)	0 (0)	946 (100)[a]	25	31	NR	86.4
Kirst et al.	2011	Canada	Cross-section	16-21	150	75 (50)	75 (50)	0 (0)	150 (100)[c]	NR	NR	16	100
Hadland et al.	2011	Canada	Cohort	14-26	559	389 (68)	179 (32)	0 (0)	559 (100)[a]	NR	NR	43.7	100
Salaam	2011	Nigeria	Cross-section	19.3	173	NR	NR	NR	NR	NR	NR	53.2	100
Elkoussi and Bakheet	2011	Egypt	Cross-section	10-18	120	117 (98)	2 (3)	NR	NR	NR	NR	91	100
Hadland et al.	2010	Canada	Cohort	14-26	560	381 (68)	179 (32)	0 (0)	560 (100)[a]	NR	NR	70.5	100
Bal et al.	2010	India	Cross-section	11-15	554	362 (65)	192 (35)	NR	NR	NR	NR	25	97
Paquette et al.	2010	Canada	Cohort	14-23	203	62 (30)	142 (70)	0 (0)	203 (100)[a]	NR	NR	47.8	92.1
Njord et al.	2010	Philippines	Cross-section	13-17	311	182 (59)	129 (41)	141 (45)[a,b]	171 (55)	NR	NR	76.7	70.8
Ataei et al.	2010	Iran	Cross-section	12.74	399	271 (68)	128 (32)	NR	NR	NR	NR	91.7	100
Ahmadkhaniha et al.	2010	Iran	Cross-section	10-19	576	491 (85)	88 (16)	NR	NR	39	23.9	36.7	100
Robbins et al.	2010	Ukraine	Cross-section	15-24	929	706 (76)	233 (24)	NR	NR	NR	NR	33.7	92
Marshall et al.	2010	Canada	Cohort	14-26	162	106 (65)	56 (35)	0 (0)	162 (100)[a]	NR	NR	28.9	100
Nada and Suliman	2010	Egypt	Cross-section	12-17	857	727 (85)	130 (15)	857 (100)[a]	0 (0)	NR	NR	3	100
Abdulmalik et al.	2009	Nigeria	Cross-section	5-16	340	340 (100)	0 (0)	NR	NR	NR	NR	66.2	100
Kirst et al.	2009	Canada	Cross-section	16-20	150	75 (50)	75 (50)	131 (87)[a,b]	19 (13)	NR	NR	16	100
Kerr et al.	2009	Canada	Cross-section	21.9	560	429 (67)	131 (23)	560 (100)[a]	0 (0)	41.1	32	NR	100
Kayembe et al.	2008	Congo	Cross-section	17.5	880	692 (79)	188 (21)	880 (100)	0 (0)	NR	NR	81.5	97.5

Adebiyi et al.	2008	Nigeria	Cross-section	16.2	360	210 (58)	150 (42)	51 (14)[a,c]	309 (86)	NR	NR	25.4	100
Kudrati et al.	2008	Sudan	Cross-section	11-18	432	397 (92)	35 (8)	330 (76)[c]	102 (24)	NR	NR	63	100
Gaidhane et al.	2008	India	Cross-section	10-19	163	163 (100)	0 (0)	83 (51)[a,b]	80 (49)	NR	0	49.6	100
Kissin et al.	2007	Russia	Cross-section	15-19	313	198 (63)	115 (37)	NR	NR	NR	NR	75.6	91.8
Tiwari	2007	India	Cross-section	6-16	402	402 (100)	0 (0)	0 (0)	402 (100)[a,c]	NR	0	26	99
Roy et al.	2007	Canada	Cross-section	20	1633	1110 (68)	523 (32)	1633 (100)[a]	0 (0)	NR	NR	44	100
Torres de Carvalho et al.	2006	Brazil	Cross-section	10-18	161	128 (80)	33 (20)	NR	NR	NR	NR	34.2	98.3
Brands et al.	2005	Canada	Cross-section	12-19	49	25 (51)	24 (49)	NR	NR	NR	NR	79	100
Sherman et al.	2005	Pakistan	Cross-section	13	347	333 (96)	14 (4)	261 (75)[c]	41 (12)	NR	NR	3.9	NR
Obando et al.	2004	Costa Rica	Cross-section	12-20	5268	NR	NR	NR	NR	NR	NR	60	100
Pagare et al.	2004	India	Cross-section	6-16	115	115 (100)	0 (0)	NR	NR	NR	0	26.4	100
Khurana et al.	2004	India	Cross-section	10-16	150	150 (100)	0 (0)	NR	NR	NR	0	49.6	NR
Morakinyo and Odejide	2003	Nigeria	Cross-section	18	180	174 (97)	6 (3)	0 (0)	180 (100)[a]	NR	NR	15.6	100
Roy et al.	2003	Canada	Cross-section	19.5	415	284 (69)	131 (31)	0 (0)	415 (100)[a]	NR	NR	25.4	89
Salem and Abd el-Latif	2002	Egypt	Cross-section	7-16	100	100 (100)	0 (0)	94 (94)[a]	6 (6)	NR	0	75	100
Roy et al.	2002	Canada	Cohort	14-25	980	325 (64)	179 (36)	0 (0)	980 (100)[a]	NR	NR	54	88
Ayaya and Esamai	2001	Kenya	Cross-section	5-21	141	NR	NR	47 (33)[a]	38 (27)	NR	NR	8.3	47.7
Othieno et al.	2000	Kenya	Cross-section	10-19	50	36 (72)	14 (28)	NR	NR	11.1	21.4	14	NR
Baron	1999	Canada	Cross-section	18.86	200	NR	NR	200 (100)[a]	0 (0)	NR	NR	28	90
Gleghorn et al.	1998	USA	Cross-section	>18	1121	717 (64)	404 (36)	0 (0)	1121 (100)[a]	NR	NR	91.7	72
Roy et al.	1998	Canada	Cohort	14-25	459	NR	NR	0 (0)	459 (100)[a]	NR	NR	26	89
Clements et al.	1997	USA	Cross-section	19.2	429	292 (68)	137 (32)	429 (100)[a]	0 (0)	NR	NR	90	73
Noto et al.	1997	Brazil	Cross-section	12-17	526	410 (73)	154 (27)	414 (73)[c]	148 (27)	NR	NR	53.1	NR
Whitworth et al.	1997	Honduras	Cross-section	13	1244	722 (58)	522 (42)	160 (13)[a,b]	1084 (87)	NR	NR	56.7	NR
Adlaf et al.	1996	Canada	Cross-section	N/A	217	160 (74)	57 (26)	NR	NR	NR	NR	83	NR
Kipke et al.	1996	USA	Cross-section	16-24	106	57 (54)	49 (46)	77 (73)[b,c]	29 (27)	NR	NR	93	70
Pinto et al.	1994	Brazil	Cross-section	10-18	398	279 (70)	119 (30)	195 (49) b	199 (51)	NR	NR	27	NR
Campos et al.	1994	Brazil	Cross-section	9-18	376	289 (77)	87 (23)	200 (53)[b]	176 (47)	NR	NR	10.6	NR
Porto et al.	1994	Brazil	Cross-section	9-20	496	463 (93)	33 (7)	395 (80)[a,b]	101 (20)	NR	NR	15	NR

Note: "Children ON the street": work some hours of the day on the street, to contribute to their family financially, but often return home at night, and have familial ties and "children OF the street": both work and sleep on the streets and do not have a regular contact with family members.

[a]Utilized the UNICEF ON/OF classifications for street children's inclusion.

[b]Reported UNICEF ON/OF classifications in results.

[c]Review derived ON/OF classifications based on study results indicating sleeping at 'home' or in streets/public places.

NR: Not Reported.

Table 3. Pooled prevalence of life-time and current prevalence of psychoactive substances and other drugs use by geographical region among street-involved children and youth.

Geographic distribution (countries)	Type of psychoactive substances and other drug use	Number of studies	N	Life-time pooled prevalence rate %	Number of studies	N	Current pooled prevalence rate %
Canada	Methamphetamine	10	5201	39.96	2	683	23
	Cocaine	10	4642	44.25	3	567	27.33
	LSD/ecstasy[a]	6	1777	61.25	1	217	81
	Cannabis	11	4854	69.19	3	567	65.66
	Heroin	12	5413	22.96	3	567	8.5
	Tobacco	2	199	93	NR[b]	NR[b]	NR[b]
	Injection drug use	10	7303	40.42	1	459	26
USA	Cocaine	3	1656	70.89	2	1227	14.2
	LSD/ecstasy[a]	2	1227	67.28	3	1656	28.24
	Cannabis	3	1656	91.56	2	1227	74.3
	Heroin	3	1656	59.13	3	1656	26.86
	Injection drug use	3	1656	31.66	1	1121	21
Costa Rica	Cocaine	1	5268	38	NR[b]	NR[b]	NR[b]
	LSD/ecstasy[a]	1	5268	10	NR[b]	NR[b]	NR[b]
	Cannabis	1	5268	60	NR[b]	NR[b]	NR[b]
	Tobacco	1	5286	70	NR[b]	NR[b]	NR[b]
Honduras	Tobacco	1	1244	56.7	NR[b]	NR[b]	NR[b]
Brazil	Methamphetamine	1	398	27	NR[b]	NR[b]	NR[b]
	Cocaine	2	924	21.1	1	526	10.4
	Cannabis	4	3895	41.95	1	526	33.5
	Tobacco	2	2698	43.15	NR[b]	NR[b]	NR[b]
	Injection drug use	4	1431	8.45	NR[b]	NR[b]	NR[b]
Russia	Cannabis	1	313	75.6	1	313	29.6
	Heroin	1	313	34.4	1	313	23.3
	Injection drug use	1	313	50.7	1	313	32.9
Ukraine	Injection drug use	1	929	37.8	NR[b]	NR[b]	NR[b]
Nigeria	Methamphetamine	3	693	39.5	2	353	12
	Cocaine	1	173	32.9	1	173	15
	Cannabis	4	783	28.19	3	713	38.23
	Heroin	1	173	35.3	1	173	11.6
	Tobacco	5	1123	59.21	2	540	25.7
	Injection drug use	2	430	1.15	NR[b]	NR[b]	NR[b]
Kenya	Methamphetamine	2	600	24	NR[b]	NR[b]	NR[b]
	Cocaine	2	191	6.3	NR[b]	NR[b]	NR[b]
	Cannabis	4	733	27.34	2	196	7.5
	Tobacco	3	337	39.77	2	196	15.5
Congo	Cocaine	1	880	3.8	NR[b]	NR[b]	NR[b]
	Cannabis	1	880	81.5	NR[b]	NR[b]	NR[b]
Cameroon	Cocaine	1	159	10.69	NR[b]	NR[b]	NR[b]
	Cannabis	2	558	23.39	NR[b]	NR[b]	NR[b]
	Tobacco	2	558	32.19	NR[b]	NR[b]	NR[b]
Gambia	Cocaine	1	35	11.95	NR[b]	NR[b]	NR[b]
	Cannabis	2	152	24.91	NR[b]	NR[b]	NR[b]
	Heroin	1	117	5	NR[b]	NR[b]	NR[b]
Ghana	Cannabis	1	227	66	2	553	45.45
	Tobacco	1	227	62	1	326	71.25
Zambia	Cannabis	1	250	35	NR[b]	NR[b]	NR[b]
Ethiopia	Tobacco	1	312	46.7	1	312	43.8
South Africa	Tobacco	NR[b]	NR[b]	NR[b]	1	326	92.25
	Cannabis	NR[b]	NR[b]	NR[b]	1	326	92
Egypt	Cannabis	1	120	20.8	NR[b]	NR[b]	NR[b]
	Heroin	1	100	1	NR[b]	NR[b]	NR[b]
	Tobacco	1	100	75	NR[b]	NR[b]	NR[b]
	Injection drug use	NR[b]	NR[b]	NR[b]	1	857	3
Sudan	Tobacco	1	432	63	NR[b]	NR[b]	NR[b]
India	Methamphetamine	2	318	1	NR[b]	NR[b]	NR[b]
	Cocaine	1	502	3.3	NR[b]	NR[b]	NR[b]
	Cannabis	8	2903	31.47	1	766	7.3
	Heroin	3	1822	1.73	1	766	1.1
	Tobacco	8	2437	37.82	1	766	29
	Injection drug use	2	925	1.46	1	766	0.3
Bangladesh	Cannabis	2	130	9.5	NR[b]	NR[b]	NR[b]
	Tobacco	2	130	28	NR[b]	NR[b]	NR[b]
Pakistan	Injection drug use	1	347	3.9	NR[b]	NR[b]	NR[b]
Nepal	Injection drug use	1	350	6.6	NR[b]	NR[b]	NR[b]
Philippines	Tobacco	1	311	78.7	NR[b]	NR[b]	NR[b]
Iran	LSD/ecstasy[a]	1	259	10.2	NR[b]	NR[b]	NR[b]
	Tobacco	2	658	60.5	NR[b]	NR[b]	NR[b]

[a]A number of studies have reported LSD/ecstasy as a combined category so this grouping has been retained for the present study's meta-analysis.
[b]Not reported.

Table 4. Pooled prevalence of life-time and current prevalence of psychoactive substances and other drugs use by type of drug use among street-involved children and youth.

Type of drug use	Number of studies	N	Life-time pooled prevalence (95% CI)	Number of studies	N	Current pooled prevalence (95% CI)
Methamphetamine	16	6601	18% (17-19%)	4	1036	9% (8-11%)
Cocaine	24	14430	27% (27-28%)	7	2493	14% (12-15%)
LSD/ecstasy[a]	12	9115	47% (46-48%)	4	1873	29% (28-31%)
Cannabis	50	23253	57% (56-57%)	16	5237	46% (45-46%)
Heroin	22	9590	10% (9-10%)	9	3475	4% (4-5%)
Tobacco	36	17629	58% (57-58%)	7	2140	50% (48-51%)
Injection drug use	26	14244	7% (7-7%)	5	3516	1% (1–2%)

[a]A number of studies have reported LSD/ecstasy as a combined category so this grouping has been retained for the present study's meta-analysis.

Table 5. Subgroup analyses of pooled prevalence of life-time and current psychoactive substances and other drugs use by age of participants among street-involved children and youth.

Pooled prevalence (95% CI)	Type of drug use	10-14 years	15-18 years	>18 years
Life-time pooled prevalence (95% CI)	Methamphetamine	5% (4-6%)	15% (13-16%)	36% (35-37%)
	Cocaine	9% (8-11%)	20% (19-21%)	46% (45-47%)
	LSD/ecstasy[a]	NR[b]	11% (10-12%)	86% (86-87%)
	Cannabis	22% (21-23%)	56% (55-57%)	86% (85-87%)
	Heroin	2% (1-3%)	60% (58-62%)	15% (15-16%)
	Tobacco	50% (49-51%)	66% (65-67%)	93% (90-96%)
	Injection drug use	3% (2-3%)	NR[b]	40% (39-41%)
Current pooled prevalence (95% CI)	Methamphetamine	NR[b]	6% (3-11%)	10% (8-11%)
	Cocaine	10% (8-13%)	24% (17-32%)	12% (10-13%)
	LSD/ecstasy[a]	NR[b]	NR[b]	NR[b]
	Cannabis	51% (50-53%)	25% (23-28%)	71% (69-73%)
	Heroin	NR[b]	NR[b]	NR[b]
	Tobacco	74% (72-76%)	32% (29-35%)	NR[b]
	Injection drug use	NR[b]	NR[b]	NR[b]

[a]A number of studies have reported LSD/ecstasy as a combined category so this grouping has been retained for the present study's meta-analysis.
[b]Not reported.

Table 6. Subgroup analyses of pooled prevalence of life-time and current psychoactive substances and other drugs use by time of publication of studies among street-involved children and youth.

Pooled prevalence (95% CI)	Type of drug use	Before 2000	2000-2011	2012-2022
Life-time pooled prevalence (95% CI)	Methamphetamine	8% (6-11%)	25% (24-26%)	16% (15-17%)
	Cocaine	39% (38-40%)	24% (23-24%)	27% (25-28%)
	LSD/ecstasy[a]	91% (90-92%)	16% (15-17%)	NR[b]
	Cannabis	80% (79-81%)	50% (49-51%)	54% (54, 55%)
	Heroin	22% (20-23%)	12% (11-12%)	5% (5-5%)
	Tobacco	NR[b]	61% (60-61%)	47% (46-49%)
	Injection drug use	20% (19-22%)	25% (24-26%)	3% (2-3%)
Current pooled prevalence (95% CI)	Methamphetamine	NR[b]	NR[b]	NR[b]
	Cocaine	13% (12-14%)	18% (104-23%)	NR[b]
	LSD/ecstasy[a]	NR[b]	NR[b]	NR[b]
	Cannabis	73% (72-75%)	27% (25-29%)	34% (32-35%)
	Heroin	NR[b]	NR[b]	NR[b]
	Tobacco	NR[b]	21% (19-24%)	61% (59-63%)
	Injection drug use	NR[b]	NR[b]	NR[b]

[a]A number of studies have reported LSD/ecstasy as a combined category so this grouping has been retained for the present study's meta-analysis.
[b]Not reported.

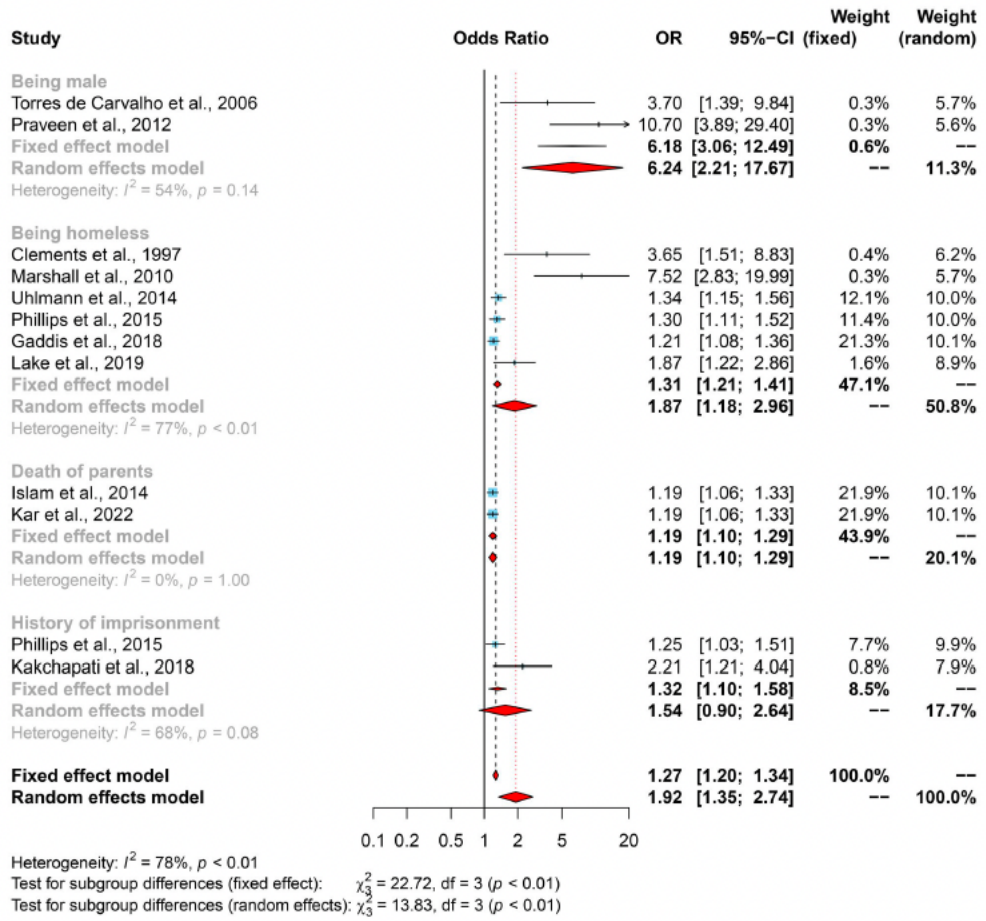

Figure 2. Pooled odds ratio of sociodemographic characteristics associated with psychoactive substances and injecting drug use among street-involved children and youth.

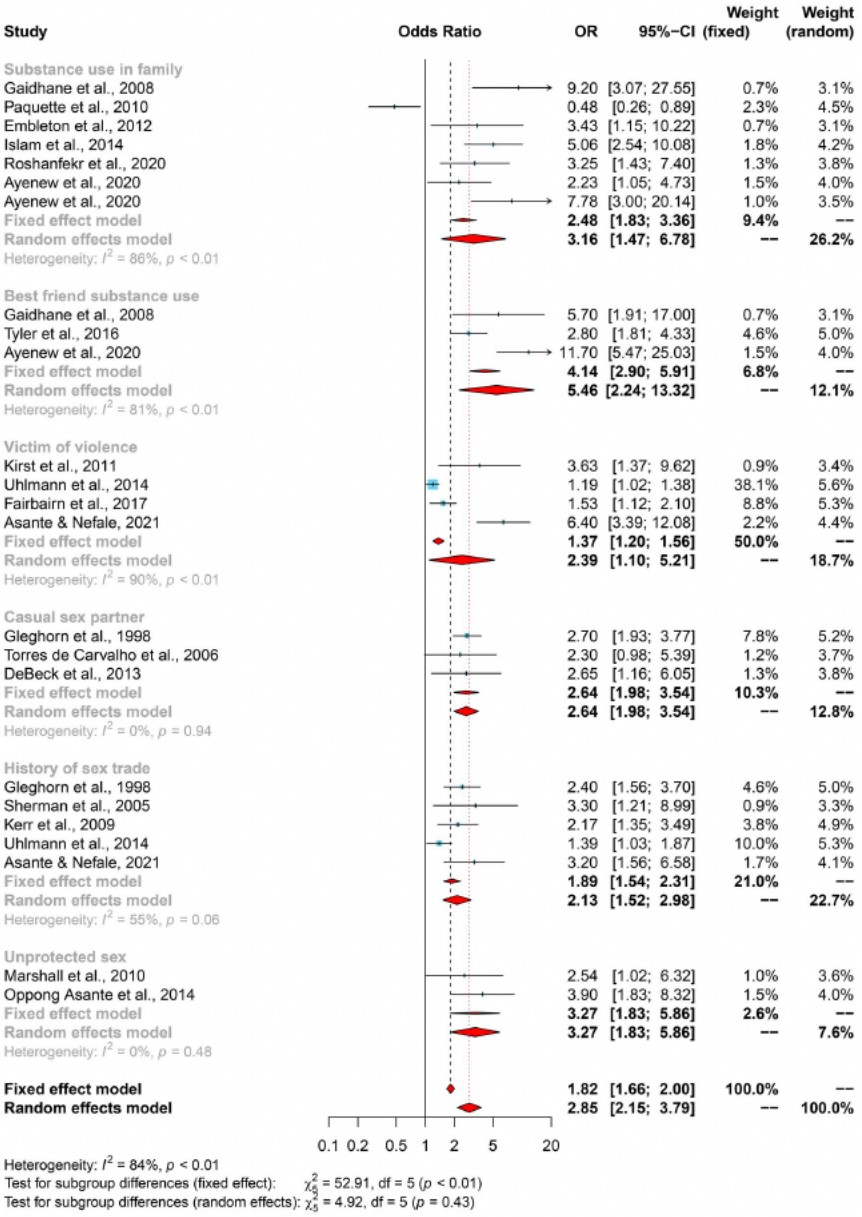

Figure 3. Pooled odds ratio of risk-taking associated with psychoactive substances and injecting drug use among street-involved children and youth.

Table 7. Meta-regression of the pooled prevalence of life-time psychoactive substances and other drugs use by age of participants and time of publication of studies among street-involved children and youth.

Type of drug use	Age and time of publication	β coefficient	SE[a]	*p*-value	Heterogeneity I^2%	Adj. R^2%[b]
Methamphetamine	10-14 years (reference)	–	–	–	99.21	15.08
	15-18 years	−0.0581	0.15	0.69		
	>18 years	0.2022	0.13	0.12		
	Before 2000 (reference)	–	–	–		
	2000-2011	0.2751	0.17	0.12		
	2012-2022	0.1608	0.17	0.34		
Cocaine	10-14 years (reference)	–	–	–	99.40	22.87
	15-18 years	0.2280	0.15	0.13		
	>18 years	0.3474	0.11	0.001**		
	Before 2000 (reference)	–	–	–		
	2000-2011	−0.0659	0.11	0.57		
	2012-2022	−0.0813	0.12	0.50		
LSD/ecstasy[c]	10-14 years (reference)	–	–	–	99.68	2
	>18 years	0.1846	0.24	0.45		
	Before 2000 (reference)	–	–	–		
	2000-2011	−0.0626	0.24	0.79		
Cannabis	10-14 years (reference)	–	–	–	99.41	33.78
	15-18 years	0.2276	0.09	0.01*		
	>18 years	0.4026	0.09	0.001**		
	Before 2000 (reference)	–	–	–		
	2000-2011	−0.1393	0.11	0.23		
	2012-2022	−0.2011	0.11	0.07		
Heroin	10-14 years (reference)	–	–	–	99.69	18.71
	15-18 years	0.4371	0.19	0.02*		
	>18 years	0.2072	0.14	0.15		
	Before 2000 (reference)	–	–	–		
	2000-2011	−0.1880	0.18	0.23		
	2012-2022	−0.1974	0.14	0.17		
Tobacco	10-14 years (reference)	–	–	–	98.80	16.17
	15-18 years	0.0572	0.08	0.50		
	>18 years	0.4202	0.16	0.001**		
	Before 2000 (reference)	–	–	–		
	2012-2022	−0.0579	0.07	0.45		
Injection drug use	10-14 years (reference)	–	–	–	97.91	76.96
	>18 years	0.3440	0.04	0.001**		
	Before 2000 (reference)	–	–	–		
	2000-2011	−0.0008	0.04	0.98		
	2012-2022	−0.0403	0.04	0.38		

[a]SE: Standard Error.
[b]Adj.R^2: Adjusted R squared.
[c]A number of studies have reported LSD/ecstasy as a combined category so this grouping has been retained for the present study's meta-analysis.
*$p < 0.05$.
**$p < 0.01$.

Table 8. Meta-regression of the pooled prevalence of current psychoactive substances and other drugs use by age of participants and time of publication of studies among street-involved children and youth.

Type of drug use	Age and time of publication	β coefficient	SE[a]	*p*-value	Heterogeneity I^2%	Adj. R^2%[b]
Cocaine	10-14 years (reference)	–	–	–	90.42	88.81
	15-18 years	0.0949	0.10	0.37		
	>18 years	0.0051	0.06	0.93		
	Before 2000 (reference)	–	–	–		
	2000-2011	0.0406	0.0667	0.54		
Cannabis	10-14 years (reference)	–	–	–	99.63	0
	15-18 years	0.0998	0.29	0.73		
	>18 years	0.2446	0.29	0.39		
	Before 2000 (reference)	–	–	–		
	2000-2011	−0.2132	0.29	0.46		
	2012-2022	0.0085	0.30	0.97		
Heroin	10-14 years (reference)	–	–	–	98.45	0
	>18 years	−0.0271	0.16	0.87		
	Before 2000 (reference)	–	–	–		
	2000-2011	−0.0881	0.15	0.56		
	2012-2022	−0.1785	0.19	0.35		
Tobacco	10-14 years (reference)	–	–	–	98.25	49.32
	15-18 years	−0.1408	0.13	0.31		
	Before 2000 (reference)	–	–	–		
	2012-2022	0.4212	0.13	0.001**		
Injection drug use	10-14 years (reference)	–	–	–	77.01	95.32
	>18 years	0.2987	0.05	0.001**		
	Before 2000 (reference)	–	–	–		
	2000-2011	0.0974	0.04	0.04*		
	2012-2022	0.0696	0.06	0.28		

[a]SE: Standard Error.
[b]Adj.R^2: Adjusted R squared.
*$p < 0.05$.
**$p < 0.01$.