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High prevalence of non-fatal overdose among people who inject drugs in Malaysia: Correlates of overdose and implications for overdose prevention from a cross-sectional study

Alexander R. Bazazi, B.A.[1,2], **Alexei Zelenev, Ph.D.**[2], **Jeannia J. Fu, Sc.B.**[1,2,3], **Ilias Yee, M.B., B.Ch., B.A.O.**[3], **Adeeba Kamarulzaman, MBBS, FRACP**[2,3,4], and **Frederick L. Altice, M.D., M.A.**[1,2,3]

[1]Department of Epidemiology of Microbial Diseases, Yale School of Public Health, New Haven, CT, USA

[2]Department of Internal Medicine, Section of Infectious Diseases, AIDS Program, Yale School of Medicine. 135 College St., Suite 323, New Haven, CT, 06510, USA

[3]Centre of Excellence for Research in AIDS (CERiA), Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia

[4]Infectious Diseases Unit, Faculty of Medicine, University of Malaya. Lembah Pantai, 50603 Kuala Lumpur, Malaysia

Abstract

Background—Overdose is the leading cause of death among opioid users, but no data are available on overdose among people who inject drugs in Malaysia. We present the first estimates of the prevalence and correlates of recent non-fatal overdose among people who inject drugs in Malaysia.

Methods—In 2010, 460 people who inject drugs were recruited using respondent-driven sampling (RDS) in Klang Valley to assess health outcomes associated with injection drug use. Self-reported history of non-fatal overdose in the previous 6 months was the primary outcome. Sociodemographic, behavioral and structural correlates of non-fatal overdose were assessed using multivariable logistic regression.

Results—All 460 participants used opioids and nearly all (99.1%) met criteria for opioid dependence. Most injected daily (91.3%) and were male (96.3%) and ethnically Malay (90.4%).

Corresponding Author Contact: Alexander R. Bazazi, AIDS Program, Yale School of Medicine, 135 College St., Suite 323, New Haven, CT 06510, Phone: 203.737.2883, Fax: 203.737.4051, alexander.bazazi@yale.edu.

Contributors

ARB, FLA and AK designed the study. ARB conducted statistical analysis and wrote the first draft of the manuscript. All authors contributed to and critically revised the manuscript and approved the final version.

Conflict of Interest

All authors declare they have no conflict of interest.

Overall, 20% of participants had overdosed in the prior 6 months, and 43.3% had ever overdosed. The RDS-adjusted estimate of the 6-month period prevalence of overdose was 12.3% (95% confidence interval [CI] 7.9–16.6%). Having injected for more years was associated with lower odds of overdose (adjusted odds ratio [AOR] 0.6 per 5 years of injection, CI 0.5–0.7). Rushing an injection from fear of the police nearly doubled the odds of overdose (AOR 1.9, CI 1.9–3.6). Alcohol use was associated with recent non-fatal overdose (AOR 2.1, CI 1.1–4.2), as was methamphetamine use (AOR 2.3, CI 1.3–4.6). When adjusting for past-month drug use, intermittent but not daily methadone use was associated with overdose (AOR 2.8, CI 1.5–5.9).

Conclusion—This study reveals a large, previously undocumented burden of non-fatal overdose among people who inject drugs in Malaysia and highlights the need for interventions that might reduce the risk of overdose, such as continuous opioid substitution therapy, provision of naloxone to prevent fatal overdose, treatment of polysubstance use, and working with police to improve the risk environment.

Keywords

Non-fatal overdose; opioids; injection drug use; Malaysia; harm reduction

1. Background

Worldwide, opioids contribute greatest to drug-related morbidity, mortality and age-adjusted disability (Degenhardt, et al., 2013b). Mortality among opioid users is 14-fold greater than among those in the general population. In Asian countries, mortality rates among opioid users are estimated to be at least double those found in other parts of the world (Degenhardt, et al., 2011; Quan, et al., 2011). Overdose is responsible for approximately one third of all deaths among regular opioid users, making it the leading cause of death in this population (Degenhardt, et al., 2011). While the majority of opioid overdoses do not result in death (Darke, Mattick, & Degenhardt, 2003; Neale, 2003), non-fatal overdose may cause significant morbidity (Warner-Smith, Darke, & Day, 2002) and strongly predicts future fatal overdose (Stoové, Dietze, & Jolley, 2009).

Risk for opioid overdose is influenced by factors related to individual biology and behavior as well as social and structural factors. Pharmacologically, other central nervous system depressants, such as alcohol or benzodiazepines, can interact synergistically with opioids to depress respiration, resulting in overdose (Brugal, et al., 2002; Darke & Hall, 2003; Darke, Ross, & Hall, 1996; Dietze, Jolley, Fry, & Bammer, 2005; Kinner, et al., 2012). Biological risk, however, is shaped by the social and structural context of substance use (Green, et al., 2009). The combinations and quantities of drugs people use and their impact on overdose risk are influenced by physiological tolerance, by drug cost and availability in legal and illegal markets, as well as by individual preferences (Darke, Duflou, & Torok, 2010; Degenhardt, Conroy, Gilmour, & Hall, 2005). Opioid use in periods of decreased individual tolerance increases the risk of overdose. This risk is pronounced when individuals undergo periods of forced abstinence during incarceration and are released without medication-assisted therapy (Binswanger, et al., 2007; Bird & Hutchinson, 2003). Receiving evidence-based treatment for opioid dependence greatly reduces overdose risk (Davoli, et al., 2007; Schwartz, et al., 2013), but treatment engagement and retention can be limited by the

availability, accessibility and cost of services. Additionally, law enforcement practices can influence individual injection behaviors, potentially facilitating drug use in situations that decrease the risk of police detection but increase the risk of overdose (Bohnert, et al., 2011; Dovey, Fitzgerald, & Choi, 2001; Kinner, et al., 2012; Milloy, et al., 2008). Overdose risk is thus produced at the intersection of biological, behavioral, social and structural vulnerabilities.

Research on opioid overdose among people who inject drugs (PWID) in Southeast Asia has been limited (Bergenstrom, et al., 2008; Milloy, et al., 2010; Quan, et al., 2011). Convenience samples of PWID from Vietnam (2003) and Thailand (2008) found a 36% one-year period prevalence and 30% lifetime prevalence of non-fatal overdose, respectively (Bergenstrom, et al., 2008; Milloy, et al., 2010). A longitudinal study in Thailand (2005–2007) found that 27% of all deaths in the cohort were due to overdose (Quan, et al., 2011). Opioid overdose has not previously been examined in Malaysia, despite Malaysia being home to an estimated 200,000 PWID (Mathers, et al., 2008), the majority of which use opioids (Bachireddy, et al., 2011; Vicknasingam, Narayanan, & Navaratnam, 2009). In 2005, Malaysia introduced harm reduction to reduce HIV transmission among PWID with needle and syringe exchange programs (NSEPs) and methadone maintenance therapy (Kamarulzaman, 2009); however, overdose prevention education and naloxone distribution programs are not available, and no national system for recording overdose fatalities exists. Given the absence of data on overdose fatalities and the strong association between non-fatal overdose and future fatal overdose (Stoové, et al., 2009), we present the first estimates of the prevalence and correlates of recent non-fatal overdose among PWID in Malaysia.

2. Methods

2.1 Study Design and Recruitment

From July to October in 2010, 460 individuals were recruited for a cross-sectional study of drug use behaviors, health outcomes associated with drug use, and risk factors for these outcomes. Eligibility criteria included: 1) being ≥18 years; 2) living in Klang Valley (greater Kuala Lumpur area); 3) drug injection in the previous 30 days, as evidenced by physical examination of injection sites and knowledge of drug preparation methods; and 4) willingness to undergo rapid HIV testing and counseling and urine toxicology testing. Participants were recruited using respondent-driven sampling (RDS), a form of chain-referral sampling designed to efficiently recruit hidden populations (Heckathorn, 1997), and were interviewed at three different research sites located at opioid maintenance therapy clinics. Two initial participants (“seeds”) were recruited by outreach workers from each of three interview sites. Participants were encouraged to recruit up to three PWID from their social network and received RM50 ($16 US) for their participation and RM25 ($8 US) for each eligible peer recruited. Trained interviewers administered the questionnaires in Bahasa Malaysia and conducted rapid HIV testing, counseling and referral. No personal identifiers were collected. This study was approved by Institutional Review Boards at the University of Malaya Medical Centre and Yale University School of Medicine.

2.2 Study Definitions

The primary outcome was self-reported recent (previous 6 months) non-fatal overdose. The Bahasa Malaysia term *"dos berlebihan"* and the English term *"overdose"* (used by some urban PWID) were used to describe the primary outcome; interviewers were trained to probe responses to distinguish from a "heavy nod." Whether participants received medical attention for a recent overdose and whether they had ever experienced an overdose in their lifetime were also measured.

In the primary analysis (Table 1), alcohol, methadone, buprenorphine, benzodiazepine, methamphetamine and heroin use in the previous 6 months (yes/no) were selected as key explanatory variables to match the 6-month timeline over which the outcome was assessed. In a secondary analysis (Supplementary Table S1), we examine associations between overdose and drug use frequency, which was only assessed for the previous 30 days. For this secondary analysis, participants' frequency of use for each drug in the prior 30 days was coded as no use (0 days), intermittent use (1 to 27 days), or daily use (≥28 days). Substance use through injection or other routes of administration were combined in the analysis. Our results were not sensitive to this decision: for substances that some participants reported administering via injection, we ran separate models replacing substance use variables with injection variables, and the direction and significance of associations in logistic regression were nearly identical (data not shown).

After consultation with local colleagues and former and active drug users, *"morfin"* use was combined with heroin use, since "*morfin*" is a term used locally to refer to higher purity heroin. Buprenorphine and buprenorphine/naloxone use were also combined in the analysis, given the similar pharmacological risk of overdose associated with each and the larger standard errors that resulted from separating them. Alternative models that separated buprenorphine from buprenorphine/naloxone and heroin from "*morfin*" showed that combining these variables does not substantially alter the results of the analysis and reduces the standard errors of the coefficients (data not shown).

Opioid dependence was defined using the Mini International Neuropsychiatric Interview (Sheehan, et al., 1998). Addiction severity was assessed using the 10-item Drug Abuse Screening Test (DAST-10) (Bohn, Babor, & Kranzler, 1991; Yudko, Lozhkina, & Fouts, 2007).

2.3 Statistical Analysis

Logistic regression was used to assess correlates of reporting a non-fatal overdose in the previous 6 months. Explanatory variables were selected for inclusion in a preliminary model if they had a biologically plausible or documented association with overdose, if they were associated ($p<0.10$) in bivariate logistic regression, or if they were identified as variables of interest regardless of bivariate association (e.g. all substance use variables and NSEP use). The Akaike information criterion (AIC) was used to select a final model with a parsimonious set of explanatory variables. All interactions between variables that were significantly associated with overdose ($p<0.05$) in the final main effects model were assessed; none were significant. The bootstrap was used to estimate confidence intervals

because it often outperforms asymptotic approximations in smaller samples (Efron & Tibshirani, 1993; Horowitz, 2003). A secondary model replacing all binary 6-month drug use variables with ordinal 30-day drug use frequency variables is presented in Supplementary Table S1, and select results where the findings from this model diverge from the primary model are presented in the text.

Marginal effects for select variables are presented to ease interpretation of the model. These marginal effects are the difference in predicted probability of recent overdose associated with a given change in the variable of interest. We present the mean and bootstrapped 95% confidence interval of this difference in probability.

To estimate the prevalence of recent overdose, we use the sample mean and the RDS-I and RDS-II estimators of the population mean that have been proposed to account for the presumed oversampling of individuals with more social ties (Heckathorn, 1997; Volz & Heckathorn, 2008b). We focus our discussion on the commonly-used RDS-II estimator (Volz & Heckathorn, 2008b). The assumptions required for using these estimators have been challenged (Heimer, 2005), and simulation and empirical studies have shown that even under ideal conditions these estimators can be biased with high sampling variance (Goel & Salganik, 2010; McCreesh, et al., 2012; Wejnert, 2009). Nevertheless, we present these estimators as the best available strategies for estimating the prevalence of overdose from these data. The *R* package *RDS* was used to implement the RDS estimators, with the bootstrap used to estimate standard errors (Handcock, Fellows, & Gile, 2014; R Core Team, 2013).

3. Results

Over forty percent (43.3%) of the 460 participants reported ever experiencing an overdose, and 20.0% (n=92) had experienced one in the previous 6 months. The estimated 6-month period prevalence of recent non-fatal overdose from the sample mean was 20.2% (95% confidence interval [CI] 16.5% – 23.9%; See Table 2) after excluding RDS seeds. The RDS-I and RDS-II estimators yielded prevalence estimates of 12.1% (CI 7.7% – 16.5%) and 12.3% (CI 7.9% – 16.6%), respectively. Only 3 of the 92 individuals (3.3%) who reported a recent overdose had received medical attention at the time of their overdose.

Participants were predominantly unmarried (73.3%), Malay (90.4%) and male (96.3%). Nearly all (99.1%) met criteria for opioid dependence; the remainder (0.9%) met criteria for opioid abuse. Ninety percent also met criteria for substantial or severe drug abuse severity. All participants had injected drugs in the previous month, with 91.3% injecting daily. In the prior 6 months, all participants had used opioids and all but 1 had injected opioids. Overall, 99.1% screened positive for opioids on urine testing.

Drug use behaviors and other participant characteristics are presented in Table 1 together with logistic regression estimates. Participants used a variety of drugs, often in combination. The most commonly-used drugs were heroin (95.9% 6mo; 95.0% 30d), methamphetamine (42.9% 6mo; 33.8% 30d), methadone (43.5% 6mo, 33.0% 30d), benzodiazepines (40.0% 6mo, 32.6% 30d) and buprenorphine (22.8% 6mo, 17.1% 30d). Participants reported high levels of poly-substance use: most reported use of at least 2 drugs (77.3% 6mo, 71.1% 30d)

and many reported use of at least three (49.7% 6mo, 38.5% 30d) or four drugs (30.5% 6mo, 19.3% 30d), excluding cannabis. Fifteen percent used at least two drugs every day in the previous month. Most participants reported using at least 2 classes of drugs (71.5% 6mo, 62.0% 30d) and many reported using at least 3 classes of drugs (30.2% 6mo, 18.9% 3mo). Data on the frequency of drug use in the past 30 days are shown in Supplementary Table S1.

Participants had injected drugs for a mean of 15.1 years (SD 9.2). Those who had injected for a greater number of years were less likely to report a recent non-fatal overdose, with the odds of non-fatal overdose decreasing by more than one third for every additional 5-years of injection drug use (AOR 0.6, CI: 0.5–0.7). An increase in years of injection drug use from the average of 15.1 years to one standard deviation above average (24.3 years) was associated with a 9% (CI 7% to 11%) decrease in the probability of recent overdose.

Participants interviewed in Shah Alam, a suburban area, were at higher risk of overdose than participants recruited at Kampung Baru, an urban area known for its high concentration of PWID (AOR 3.5, CI 1.2–13.9). Half of the participants (49%, n=225) reported rushing an injection from fear of the police in the previous 6 months, and those who rushed an injection for this reason had twice the odds of reporting a non-fatal overdose as those who did not (AOR 1.9, CI 1.1–3.6). Reporting rushing an injection from fear of the police was associated with an 8% (CI 1% to 16%) increase in the probability of recent overdose.

Methamphetamine and alcohol use also were associated with overdose. In the prior 6 months, 42.9% had used methamphetamine, which was associated with increased odds of overdose compared to no methamphetamine use (AOR 2.3, CI 1.3–4.6). Methamphetamine was primarily administered by smoking, with only 4.5% (n=21) injecting methamphetamine in the prior 6 months. In the prior 6 months, 24.1% drank alcohol, which was associated with twice the odds of overdose compared to not drinking alcohol (AOR 2.1, CI 1.1–4.2).

Methadone in Malaysia can be purchased intermittently from some private practitioners. In the prior 30 days, nearly one third (30.2%, n=139) of participants reported using methadone intermittently, though few (1.3%, n=6) used methadone as daily treatment. In the prior 6 months, 43.5% reported using any methadone, which was not associated with overdose (AOR 1.7, CI 1.0–3.4).

Buprenorphine and benzodiazepine use were not associated with increased odds of recent overdose, and neither was HIV infection. There was also no difference in overdose risk between those who received most of their injection equipment from needle and syringe exchange programs and those who did not. Addiction severity also was not associated with overdose (data not shown).

A separate model including 30-day ordinal drug use frequency variables in place of 6-month binary drug use variables yielded more nuanced findings (Supplementary Table S1). While methadone use in past 6 months was not associated with overdose, in the 30-day drug use frequency model, intermittent (AOR 2.8, CI 1.5–5.9) but not daily (1.0, CI 0.0–10.1) methadone use was associated with overdose. Both alcohol and methamphetamine use in the past 6 months were associated with overdose, but in the 30-day drug use frequency model,

intermittent but not daily alcohol and methamphetamine use was associated with overdose (See Supplementary Table S1).

4. Discussion

This study presents the first analysis of non-fatal overdose in Malaysia and reveals a high prevalence of recent overdose as well as structural and behavioral correlates of overdose among PWID. The 6-month period prevalence of overdose in the sample was 20%, which is higher than estimates from studies of PWID in other regions (McGregor, Darke, Ali, & Christie, 1998; Milloy, et al., 2008) and within the wide range of estimates from studies examining the 12-month period prevalence of non-fatal overdose (Bergenstrom, et al., 2008; Darke & Hall, 2003; Darke, et al., 2007; Jenkins, et al., 2011; Kinner, et al., 2012). The estimated overdose prevalence of 12.3% (95% CI 7.9 – 16.6%) from the commonly-used RDS-II estimator is within the range of estimates from other regions (McGregor, et al., 1998; Milloy, et al., 2008; Volz & Heckathorn, 2008a). Prevalence estimates from RDS estimators were lower than the sample mean due to a greater number of social ties reported by those who had recently experienced an overdose (mean 29.4 vs. 18.1; $p<0.01$). All estimates from this study suggest a high prevalence of non-fatal overdose in Malaysia. Non-fatal overdose strongly predicts future fatal overdoses (Stoové, et al., 2009) and an estimated 3 to 4 deaths result from every 100 overdoses (Darke, et al., 2003; Neale, 2003), which suggests that the participants in this sample may face high risk of death from overdose.

This study is among the first to examine overdose among PWID in Southeast Asia. A Vietnam study assessing all-cause mortality among PWID attributed 27% of deaths to overdose, but non-fatal overdose was not reported (Quan, et al., 2011). In a convenience sample of 252 PWID in Thailand, the 29.8% lifetime prevalence of non-fatal overdose was lower than that found in our sample, and they did not assess recent overdose (Milloy, et al., 2010). In the only other study assessing recent non-fatal overdose among PWID in Southeast Asia, people who inject opioids in Vietnam were found to have a 36.1% one-year period prevalence of non-fatal overdose (Bergenstrom, et al., 2008). Similar to our study, lifetime prevalence of overdose was found to be 43%, and younger PWID were more likely to report a recent overdose (Bergenstrom, et al., 2008).

In our study, participants who had rushed an injection from fear of the police were significantly more likely to report non-fatal overdose, highlighting how structural factors such as policing may shape the environment in which people experience overdose risk (Dovey, et al., 2001; Green, et al., 2009; Moore, 2004). Previous research has documented an association between abusive policing practices and non-fatal overdose risk and explored how fear of police detection can lead to hasty injection (Fairbairn, et al., 2009; Rhodes, et al., 2007), but to our knowledge no previous studies have specifically documented the association between hasty injection from fear of police and overdose risk. Rushing drug preparation and administration may lead individuals to accidentally use larger doses than intended. Shifting away from a primarily law enforcement-based approach toward a harm reduction and treatment approach to HIV and substance use has the potential to improve the health of PWID. Recent reports on policing and harm reduction in Southeast Asia highlight the critical role of engaging police, particularly at the local level, in promoting an

environment conducive to harm reduction (Chheng, Leang, Thomson, Moore, & Crofts, 2012; Jardine, Crofts, Monaghan, & Morrow, 2012; Thomson, et al., 2012). In Malaysia, the National Anti-Drug Agency (NADA/AADK) has begun a paradigm shift toward evidence-based treatment for drug users by expanding community-based substance abuse treatment and reducing compulsory drug detention centers (Al-Darraji, et al., 2014; Degenhardt, et al., 2013a; Ghani, et al., 2014). Unfortunately, widespread intervention with local police has not been implemented. Moving away from policies and policing practices that criminalize drug users and toward diversion of drug users into evidence-based treatment is an important next step for Malaysia that may reduce the risk of overdose and other negative health outcomes among PWID.

Both alcohol and methamphetamine use were associated with increased likelihood of recent non-fatal overdose, which has been reported elsewhere (Brugal, et al., 2002; Darke, et al., 1996; Fairbairn, et al., 2008; Kerr, et al., 2007; Kinner, et al., 2012). Since all participants also used opioids, and nearly all used them daily, this association may represent pharmacological or behavioral interactions between these substances and opioids. Alcohol acts synergistically with opioids to depress respiratory drive, increasing the risk of overdose. Methamphetamine users might consume larger quantities of opioids to counterbalance the stimulatory effects of methamphetamine, thus increasing their risk of opioid overdose. Alternatively, those who use alcohol or methamphetamine in addition to opioids may represent a higher-risk population in ways that were not assessed. Overdose prevention efforts should target those who use opioids in combination with other substances, such as methamphetamine and alcohol.

Although intermittent methadone use in the previous 30 days was significantly associated with recent overdose, daily methadone use was not. Data on the frequency of methadone use in the previous 6 months were unavailable. Methadone can be bought intermittently from private clinics that dispense methadone without engaging patients in daily maintenance therapy. Intermittent methadone users who continue to inject drugs should be offered affordable, accessible, appropriately dosed and structured opioid substitution therapy to reduce their risk of overdose (Davoli, et al., 2007; Schwartz, et al., 2013). Additionally, since many intermittent methadone users may be in contact with service providers, they could be reached through overdose prevention interventions such as naloxone distribution programs, which have been effectively implemented among methadone clients in a variety of settings (Walley, et al., 2013a).

Our finding that newer initiates to drug injection had a higher likelihood of recent overdose may indicate that overdose risk decreases with increased injecting experience. A more troubling potential explanation is that people at lower risk for overdose are more likely to survive longer, and people at higher risk for overdose are more likely to die after fewer years of drug injection and thus not be sampled. Previous research is inconclusive on the association between overdose and years of drug injection, which is difficult to evaluate independently from age (Darke & Hall, 2003; Darke, et al., 1996; Kinner, et al., 2012; Ødegård, Amundsen, & Kielland, 2007; Stoové, et al., 2009). Nonetheless, overdose prevention strategies should consider targeting this group with opioid substitution therapy and overdose education and prevention.

Although anecdotal evidence suggests that Kampung Baru and surrounding central urban areas have a higher concentration of more severely opioid-dependent drug users with higher drug-related risk behaviors, our findings highlight the need to consider PWID in the suburbs of Klang Valley, who are less visible but need to be included in overdose prevention efforts.

Importantly, the use of evidence-based harm reduction strategies was not associated with overdose. First, regularly accessing a NSEP was not associated with overdose, reaffirming the strong body of evidence that NSEPs do not increase risky drug use and its consequences. Second, there was no elevated risk of non-fatal overdose among those who used buprenorphine or buprenorphine/naloxone or those who received daily methadone maintenance therapy, despite the fact that most participants used these substances in combination with other drugs.

Our findings highlight an urgent need for intervention to reduce preventable deaths from opioid overdose. Naloxone distribution is at the core of effective opioid overdose prevention strategies, which is clearly articulated in the United Nations Office of Drug Control's and World Health Organization's report on opioid overdose prevention (United Nations Office on Drugs and Crime & World Health Organization, 2013). Naloxone distribution programs for people who use opioids and educational interventions that accompany them have been shown to be effective in diverse settings (Bazazi, Zaller, Fu, & Rich, 2010; Walley, et al., 2013b), but these services remain unavailable for people who use opioids in Malaysia and most low- and middle-income countries. Overdose prevention and response education should implemented alongside increasing availability of naloxone in settings frequented by PWID and distribution of take-home naloxone to PWID and their family and friends. Some overdose prevention interventions are met with resistance due to judgments about PWID and their ability to respond to overdose, but evidence shows that these objections are unfounded (Bazazi, et al., 2010).

Though these findings have several important implications, some limitations should be recognized. First, self-report of non-fatal overdose could result in overestimation or underestimation of the period prevalence of overdose, but given that most participants do not have contact with medical services at the time of their overdose, self-report is the best and one of the only ways to elicit information on non-fatal overdose. Given that overdose is both a severe and infrequent event, recall bias may be minimal, particularly since this study limited the timeframe to the previous 6 months. There are also limitations in using cross-sectional data on non-fatal overdose as a proxy for incident overdose fatalities, but in the absence of longitudinal data and administrative records of overdose deaths, non-fatal overdose and its correlates are the closest proxies available. Although we cannot be sure that all overdoses were attributable to opioid use, that all participants reported using opioids (corroborated by 99.1% prevalence of recent opioid use on urine toxicology) and nearly all (>95%) used opioids daily makes it likely that opioids were involved in all self-reported overdoses. Additionally, there are known problems with the precision and accuracy of RDS estimators (Gile & Handcock, 2010; Goel & Salganik, 2010), but these estimators and the sample mean are the best available methods to estimate population characteristics from RDS data. Notwithstanding these limitations, this study documents for the first time the problem

of overdose among PWID in Malaysia and highlights important demographic, behavioral and structural correlates of non-fatal overdose.

Future research on overdose in Malaysia should attempt to quantify the burden of mortality due to opioid overdose. The national system for recording deaths does not allow direct assessment of overdose fatalities, but administrative changes in reporting could allow monitoring of these fatalities. Longitudinal studies of PWID could directly assess the risk of death from opioid overdose, or cross-sectional studies could indirectly assess this risk by enquiring about witnessed fatal overdoses. Research should also assess the availability of naloxone in healthcare settings and the feasibility of, and potential social and legal barriers to, providing naloxone to non-medical personnel at harm reduction facilities, including active drug users and their friends and family.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- We assess prevalence and correlates of non-fatal overdose among people who inject drugs in Malaysia
- The estimated 6-month period prevalence of non-fatal overdose was high (12.3%, 95% CI 7.9–16.6%).
- Rushing an injection from fear of the police nearly doubled the odds of overdose.
- Alcohol use, methamphetamine use and fewer years of drug injection were associated with overdose.
- Intermittent, but not daily, methadone use was associated with overdose.

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Table 1

Participant characteristics and independent correlates of non-fatal overdose in the previous 6 months.

		Overdose					
	Entire Sample (N=460)	**No (N=368)**	**Yes (N=92)**	**Univariable Logistic Regression**		**Multivariable Logistic Regression**	
Explanatory Variable	**N (%)**	**N (%)**	**N (%)**	**uOR[a]**	**95% CI**	**aOR[b]**	**95% CI**
Current Income							
At or below poverty	104 (22.6%)	79 (21.5%)	25 (27.2%)	1.4	0.8–2.3	1.6	0.8–3.2
Recruitment Site							
Kampung Baru	127 (27.6%)	117 (31.8%)	10 (10.9%)	Ref.	-	Ref.	-
Shah Alam	208 (45.2%)	149 (40.5%)	59 (64.1%)	**2.6**	**1.7–4.4**	**3.5**	**1.2–13.9**
Kajang	125 (27.2%)	102 (27.7%)	23 (25.0%)	0.9	0.5–1.4	2.0	0.7–6.9
Years of drug injection							
Mean (SD)	15.0 (9.2)	16.3 (9.3)	10.2 (7.0)				
Each additional 5 years	-	-	-	**0.7**	**0.6–0.7**	**0.6**	**0.5–0.7**
HIV Infection							
Seronegative	387 (84.1%)	301 (81.8%)	86 (93.5%)	Ref.	-	Ref.	-
Seropositive	73 (15.9%)	67 (18.2%)	6 (6.5%)	**0.3**	**0.1–0.7**	0.7	0.2–1.9
Major source of injection equipment[+]							
Not Needle Exchange	297 (64.6%)	223 (60.6%)	74 (80.4%)	Ref.	-	Ref.	-
Needle Exchange	163 (35.4%)	145 (39.4%)	18 (19.6%)	**0.4**	**0.2–0.6**	0.9	0.3–2.1
Rushed injection from fear of police[+]							
No	234 (51.0%)	200 (54.5%)	34 (37.0%)	Ref.	-	Ref.	-
Yes	225 (49.0%)	167 (45.5%)	58 (63.0%)	**2.0**	**1.3–3.3**	**1.9**	**1.1–3.6**
Heroin use[+]							

		Overdose					
	Entire Sample (N=460)	No (N=368)	Yes (N=92)	Univariable Logistic Regression		Multivariable Logistic Regression	
Explanatory Variable	**N (%)**	**N (%)**	**N (%)**	**uOR[a]**	**95% CI**	**aOR[b]**	**95% CI**
No	19 (4.1%)	15 (4.1%)	4 (4.3%)	Ref.	-	Ref.	-
Yes	441 (95.9%)	353 (95.9%)	88 (95.7%)	0.9	0.3–5.1	0.3	0.1–3.5
Alcohol use[+]							
No	349 (75.9%)	290 (78.8%)	59 (64.1%)	Ref.	-	Ref.	-
Yes	111 (24.1%)	78 (21.2%)	33 (35.9%)	**2.1**	**1.3–3.4**	**2.1**	**1.1–4.2**
Methadone use[+]							
No	260 (56.5%)	219 (59.5%)	41 (44.6%)	Ref.	-	Ref.	-
Yes	200 (43.5%)	149 (40.5%)	51 (55.4%)	1.8	1.2–2.9	1.7	1.0–3.4
Buprenorphine use[+]							
No	355 (77.2%)	284 (77.2%)	71 (77.2%)	Ref.	-	Ref.	-
Yes	105 (22.8%)	84 (22.8%)	21 (22.8%)	1.0	0.5–1.7	0.7	0.3–1.5
Benzodiazepine use[+]							
No	276 (60.0%)	221 (60.1%)	55 (59.8%)	Ref.	-	Ref.	-
Yes	184 (40.0%)	147 (39.9%)	37 (40.2%)	1.0	0.6–1.6	1.0	0.5–2.0
Methamphetamine use[+]							
No	262 (57.1%)	226 (61.6%)	36 (39.1%)	Ref.	-	Ref.	-
Yes	197 (42.9%)	141 (38.4%)	56 (60.9%)	**2.5**	**1.6–4.1**	**2.3**	**1.3–4.6**
Used >1 substance per day[+]							
No	121 (26.4%)	103 (28.1%)	18 (19.6%)	Ref.	-	Ref.	-
Yes	338 (73.6%)	264 (71.9%)	74 (80.4%)	1.6	0.9–3.0	0.7	0.3–1.6

[a] uOR = Unadjusted Odds Ratio,

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[b] aOR = Adjusted Odds Ratio,

[+] Assessed in the prior 6 months.

Table 2

Estimates of the Prevalence of Non-Fatal Overdose in the Previous Six Months

Estimators	Estimated 6-month Period Prevalence of Non-Fatal Overdose	95% Confidence Interval
Sample mean, bootstrap CI	20.2%	16.5% – 23.9%
RDS-I, bootstrap CI	12.1%	7.7% – 16.5%
RDS-II, bootstrap CI	12.3%	7.9% – 16.6%

Seeds excluded in all above calculations.