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The Color of Meth: Is it Related to Adverse Health Outcomes? An Exploratory Study in Tijuana, Mexico

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Abstract

In a study of injection drug users (IDUs) in Tijuana, Mexico, logistic regression identified factors associated with injection of colored vs. clear methamphetamine in the prior six months (N=613). Colors injected most often were clear (50%), white (47%), yellow (2%) and pink (1%). IDUs injecting colored meth were more likely to experience recent abscesses (34%) compared to those injecting clear meth (24%) (p=0.008), an association that persisted after adjusting for confounders. Market characteristics, possibly relating to purity or adulterants, may be associated with abscesses among methamphetamine injectors. Further study is needed to confirm and determine the mechanism of this association to better inform prevention messages.

Keywords

abscess; skin infections; methamphetamine; injection drug use; Mexico

Introduction

Up until the mid-1990's, most methamphetamine production and trafficking in the United States was carried out by motorcycle gangs and a variety of other small-scale, local producers.[1] However, in the 1990's, an intense crackdown on methamphetamine labs in the U.S. prompted Mexican drug organizations to start producing high quality, low priced methamphetamine and they began to out-compete U.S.-based groups.[2] Clandestine labs are believed to have initially obtained precursor chemicals, such as ephedrine and pseudoephedrine, from pharmaceutical or chemical companies producing or importing chemicals into Mexico, before restrictions were placed on precursor sales.[3] Seizures of methamphetamine precursors have increased steadily in Mexico since the late 1990's.[3]

Currently, ~90% of methamphetamine entering the U.S. is produced in Mexico, which has created local consumption markets.[4] Although methamphetamine is recognized as a major drug of abuse in many U.S. cities, its importance has been recognized in Mexico only in recent years. In the border city of Tijuana in northwestern Mexico, 44% of drug users cited

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methamphetamine as the most common reason for seeking treatment at drug abuse treatment centers, an increase from 30% in 2000.[5] In a qualitative study of injecting drug users (IDUs) in 2004, we found evidence of an emerging methamphetamine problem in Ciudad Juarez (adjacent to El Paso, Texas), and an established methamphetamine scene in Tijuana, where the drug was often injected alone or in combination with heroin.[6] Drug users in Tijuana reported using methamphetamine of various colors, including clear ("ice"), white, yellow and pink.[6] We hypothesized that different methamphetamine colors may reflect the nature of various adulterants and could serve as proxy indicators of adulteration and/or purity. As such, different colors of methamphetamine could be associated with negative health outcomes, such as abscesses and overdoses. We studied whether methamphetamine color was associated with abscess and overdose in a subsequent quantitative study of IDUs in Tijuana. Since Mexico is the primary source for methamphetamine entering the U.S., associations observed in Tijuana may have a bearing on trends seen elsewhere.

Methods

Participants

Between April 2006 and April 2007, IDUs were recruited in Tijuana into a prospective study of behavioral and contextual factors associated with HIV, syphilis and TB infections. Eligibility criteria for the study included: age ≥18 years; having injected illicit drugs within the past month, confirmed by inspection of injection stigmata ("track marks"); ability to speak Spanish or English; not planning to permanently move over the next 18 months; being able to provide informed consent. Subjects gave their written informed consent to participate. Study methods were approved by the Institutional Review Board of the University of California, San Diego and the Ethics Board of the Tijuana General Hospital.

Respondent-driven sampling (RDS) methods were used to recruit participants[7] whereby a diverse group of "seeds" (heterogeneous by age, gender, drug of choice, and neighborhood) were selected and given uniquely coded coupons to refer their peers. Waves of recruitment continued as subjects returning with coupons were each given three coupons to recruit others. Recruitment and interviews were conducted by indigenous outreach workers who were employed by a local non-governmental organization (Pro-COMUSIDA), facilitated through the use of a modified recreational vehicle that operated as a mobile clinic (the "Prevemovihl") and a storefront office.

Study Instrument—IDUs completed an interviewer-administered quantitative survey that elicited information on sociodemographic, behavioral and contextual factors. Participants were asked about their lifetime drug use histories and current (past 6 months) drug use including the types of drugs used, routes of administration, age of first injection, and locations where they injected drugs (e.g., at their home, in a shooting gallery). Use of specific methamphetamine colors was assessed by asking participants: "In the past 6 months, what was the color of the methamphetamine you usually injected?" Response categories included clear, white, pink, yellow, green, black and other (specify).

Laboratory Testing—Specimen testing was conducted at the San Diego County Health Department for syphilis and HIV confirmatory tests. The "Determine"® rapid HIV antibody test was administered to determine the presence of HIV antibodies (Abbott Pharmaceuticals, Boston, MA). All reactive samples confirmed with a Western blot and HIV enzyme immunoassay (EIA),. Syphilis serology used the rapid plasma reagin (RPR) test (Macro-Vue, Becton Dickenson, Cockeysville, MD, USA). All RPR-positive samples were subjected to confirmatory testing using the *Treponema pallidum* hemagglutinin assay (TPHA) (Fujirebio, Wilmington, DE, USA). HIV/STI test results were provided to

participants after confirmation; those testing positive were referred to municipal health clinics for free medical care.

Statistical Analysis—Statistical analyses were restricted to IDUs who reported injecting methamphetamine in the prior six months, and focused on comparisons between IDUs who reported using clear methamphetamine to those who reported using methamphetamine of any color (e.g. white, pink, yellow). Univariate and multivariate logistic regressions were performed to identify factors associated with using colored methamphetamine. In multivariate regressions, a backward manual procedure was used to develop models in which all the variables that had attained a significance level <10% in univariate analyses were considered in order from most to least significant. The likelihood ratio test was used to compare nested models, using a significance level of 5% to select variables for inclusion in the final model. Deviance and Pearson goodness-of-fit tests were performed to check for overdispersion; Hosmer and Lemeshow goodness-of-fit tests were also conducted. To identify bias that might arise from the RDS sampling process, we generated overall sampling weights based on recruitment and degree weights using the RDS Analysis Tool (version 5.6.0, October 2006, Cornell University) and applied these to logistic regression models. However, since there were no differences between the RDS-adjusted models and unadjusted models, the latter are presented.

Results

Of 1059 IDUs in the overall cohort, over half (58%) injected methamphetamine in the prior 6 months (N=613), either alone (34%) or in combination with heroin (53%) or cocaine (4%). Among the 613 methamphetamine injectors included in subsequent analyses, median age and median age at first injection were 36 and 20 years, respectively, and most (87%) were male. Prevalence of HIV and syphilis was 5% and 15%, respectively. Methamphetamine colors injected most often were clear (50%), white (47%), yellow (2%) and pink (1%).

Table 1 compares IDUs using clear versus colored methamphetamine, restricting to the sub-sample of 613 IDUs who injected methamphetamine. Compared to IDUs injecting clear methamphetamine, IDUs injecting colored methamphetamine were more likely to report lower monthly incomes and were more likely to have been recruited in the Zona Norte neighborhood, which is where the red light district is located, adjacent to the U.S.-Mexico border. IDUs injecting colored methamphetamine were also more likely to have family members who injected drugs.

In terms of drug using behaviors, IDUs injecting colored methamphetamine were more likely to inject methamphetamine alone and to inject on the street, but were less likely to inject daily or more. However, they did not differ from other IDUs in terms of other drug using characteristics including receptive needle sharing and re-use of their own needle.

Considering adverse health outcomes, IDUs injecting colored methamphetamine were more likely to experience an abscess in the last six months (34%) compared to those injecting clear (34% vs. 24%, respectively; p=0.008), but were no more likely to have experienced an overdose, or to be infected with HIV (p>0.05).

Factors independently associated with injecting colored methamphetamine included experiencing an abscess in the prior six months (adjOR= 1.64; 95% CI: 1.09 −2.48), being recruited in the Zona Norte neighborhood, and having a family member who injects drugs; whereas having a higher monthly income, and injecting daily were inversely associated with injecting colored methamphetamine. Results were similar when restricting to those who

injected clear versus white methamphetamine, or when restricting to IDUs who reported methamphetamine as their most frequently injected drug.

Discussion

In our study of IDUs in Tijuana, Mexico, we found that the odds of having a recent abscess were 60% greater among IDUs who injected colored methamphetamine compared to those who injected clear methamphetamine. Although it is possible that other factors may have accounted for these findings since our study was cross-sectional in nature, the association between methamphetamine color and the odds of experiencing an abscess persisted and was virtually identical after controlling for potential confounders (i.e., frequency of injection and income). These data suggest that market characteristics, possibly relating to adulterants, may be associated with abscesses among methamphetamine injectors in Tijuana.

Although publicly available data are lacking on the purity, nature and percentage of adulterants of street-based methamphetamine in Mexico, since methamphetamine seized in Southwestern California is almost entirely of Mexican origin[8], drug intelligence data from this region can provide some indirect clues. In 2005, the U.S. Drug Enforcement Agency estimated the price of methamphetamine at $20 per one-quarter gram and $40–$50 per gram in Southern California; gram purity levels averaged 50–95%, and ounce purity levels averaged 54–97%.[9] However, a recent National Drug Intelligence Report indicated that street prices of ‘ice’ methamphetamine in Southern California increased from $9,000 to $12,000 per pound in 2006, possibly as a result of increased interdiction and/or reduced availability of precursor chemicals.[10] The increased price of ice methamphetamine is anticipated to impact upon purity, since traffickers may be more likely to dilute their product with adulterants to stretch their supply.[10] If lower purity methamphetamine is associated with a higher incidence of soft tissue infections as our data suggest, cities in Mexico and the U.S. can expect to observe increases in abscesses and possibly related infections such as cellulitis and endocarditis. Since we observed that IDUs with lower monthly incomes were more likely to inject colored methamphetamine, these IDUs may be at appreciably higher risk.

The association between injecting colored methamphetamine and the odds of having an abscess was primarily driven by injection of white methamphetamine, since other colors were reported far less frequently. We can only speculate on potential reasons for increased frequency of abscesses, and there are several areas that would benefit from additional research. While clear “ice” methamphetamine is widely considered to be of higher purity, colored methamphetamine may contain more unintentional contaminants related to the manufacturing process. Adulterants can cause significant additional health problems related to methamphetamine use and serve as another source of bacterial contamination that can cause abscesses. Contaminants include residual caustic substances, byproducts of manufacturing, granular material from crushed tablets that may facilitate inadvertent contamination or skin irritation that can lead to bacterial skin infections.[11–13] Adulterants or cutting agents are substances that are deliberately added to methamphetamine in order to “extend” the drug to increase profits, resulting in a lower purity and often lower-cost drug. Adulterants include substances such as caffeine, methyl-sulfonylmethane, or niacinamide.[14] Sidewalk chalk has been reported as an adulterant, added as a deliberate coloring agent. Pink methamphetamine may also indicate an incomplete manufacturing process using cold medications as precursors with red coatings.[15] It is difficult to hide the presence of adulterants in clear ice methamphetamine as few potential adulterants are transparent, but white or colored substances can be easily added to methamphetamine sold as a white powder.

IDUs who injected colored methamphetamine also reported lower income and less frequent injecting, and were more likely to have family members who injected drugs. It is possible that poorer IDUs may seek out less expensive and lower quality white or colored methamphetamine, and may tend to rely on family members who inject to obtain drugs. Less frequent injection may be associated with poor injection practices related to inexperience, poor hygiene and haste that may lead to bacterial skin infections. It is possible that IDUs injecting colored methamphetamine were more likely to engage in other behaviors that could account for the higher frequency of abscesses. For example, more frequent injection of black tar heroin could potentially have accounted for this finding, since it is associated with a high abscess rate. However, adjustment for injection of heroin or heroin co-administration did not alter our results, despite the fact that the type of heroin circulating in this region is almost entirely black tar (8).

Our study was limited by the fact that we could not test methamphetamine samples and needed to rely on self-reports of abscesses. Although our previous study had reported a wider range of methamphetamine colors, data on pink, black or green methamphetamine were too sparse to conduct statistical analyses. Further study is needed to confirm the correlation between methamphetamine color and purity, and whether its association with adulterants and soft tissue infections is causal in an effort to inform prevention messages. One way to test this hypothesis would be to assess methamphetamine samples and compare their purity and types and frequencies of adulterants against their color. If specific colors or types of adulterants are associated with more frequent skin infections, at the very least, drug users could be warned about these hazards. If methamphetamine color is a valid proxy for purity, this would aid drug intelligence officials and researchers who monitor drug market characteristics, thereby facilitating real-time access to drug market trends. Such information is important not only for Tijuana, but for any city where methamphetamine is an important drug of abuse.

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References

1. Finckenauer, JO.; Fuentes, JR.; Ward, GL. Mexico and the United States: neighbors confront drug trafficking. National Institute of Justice Publications; 2001. from http://www.ojp.gov/nij/international/trafficking_text.html
2. Smith, PH.; Toro, MC. Drug Trafficking in Mexico. In: Bosworth, B.; Collins, SM.; Lustig, N.; Institution, B., editors. Coming together?: Mexico-United States relations. Washington, D.C.: Brookings Institution Press; 1997. p. 125-154.
3. Drug Enforcement Agency. [Accessed Jan 19, 2005] Drug trafficking in the United States, Report DEA-01020. from http://www.usdoj.gov/dea/pubs/intel/01020/
4. Brouwer KC, Case P, Ramos R, et al. Trends in production, trafficking, and consumption of methamphetamine and cocaine in Mexico. Subst Use Misuse. 2006; 41(5):707–727. [PubMed: 16603456]
5. Instituto de Servicios de Salud Publica del Estado de Baja California (ISESALUD). Sistema de Vigilancia Epidemiologica de las Adicciones (SISVEA) [Addiction Epidemiologic Surveillance System] -Tijuana 2000–2002. Tijuana; Mexico: 2002.

6. Case P, Ramos R, Brouwer K, et al. At the borders, on the edge: Use of injected methamphetamine in Tijuana and Ciudad Juarez, Mexico. Journal of Imigrant and Minority Health. ePub May 22, 2007.
7. Heckathorn DD. Respondent-driven sampling: A new approach to the study of hidden populations. Social Problems. 1997; 44(2):174–199.
8. San Diego/Imperial County Regional Narcotic Information N. Street Drug Price List. 2006.
9. Pollini RA, Strathdee SA. Indicators of methamphetamine use and abuse in San Diego County. J Psych Drugs. in press.
10. National Drug Intelligence Center. Intelligence Bulletin: Changes in Drug Production, Trafficking, and Abuse. Fourth Quarter. p. CY2006
11. Poulsen EJ, Mannis MJ, Chang SD. Keratitis in Methamphetamine abusers. Cornea. 1996; 15:477–482. [PubMed: 8862924]
12. Puthaviriyakorn V, Siriviriyasomboon N, Phorachata J, Pan-ox W, Sasaki T, Tanaka K. Identification of impurities and statistical classification of methamphetamine tablets (Ya-Ba) seized in Thailand. Forensic Sci Int. 2002; 126:105–113. [PubMed: 12084485]
13. Remberg, B.; Stead, AH. [Accessed electronically May 30, 2007] Drug characterization/impurity profiling, with special focus on methamphetamine: recent work of the United Nations International Drug Control Programme. UNODC Bulletin of Narcotics 1999. at: http://www.unodc.org/unodc/bulletin/bulletin_1999-01-01_1_page008.html
14. National Drug Intelligence Center. [Acessed electronically May 30, 2007] Information Bulletin: MSM--Methamphetamine Cutting Agent of Choice. 2001-L0424-005. 2001. at: http://www.indianadea.com/public_docs/pubs0/673/index.htm
15. Drug Enforcement Administration, Office of Forensic Sciences. [Accessed electronically May 30, 2007] Methamphetamine colored with sidewalk chalk in Madera County, California. 2004. p. 2at: http://www.indianadea.com/public_docs/pubs0/673/index.htm

Table 1

Characteristics of methamphetamine injectors in Tijuana, Mexico who inject colored versus clear methamphetamine (N=613).

	Colored (N=305, %)	Clear (N=308; %)	Odds Ratio [95% CI]	Adjusted Odds Ratio [95% CI]
Background Characteristics				
Male	265 (87)	272 (88)	0.88 [0.54–1.42]	
Age (median; IQR*)	34 (30,39)	35 (30,39)	1.00 [0.98, 1.02]	
Monthly Income ≥ 2500 pesos	213 (72)	282 (92)	0.22 [0.14–0.36]	0.27 [0.16, 0.46]
Have family members who inject drugs	67 (22)	48 (16)	1.54 [1.02–2.32]	1.71 [1.06, 2.77]
Neighborhood				
Zona Norte mobile	133 (44)	80 (26)	2.20 [1.57–3.10]	2.40** [1.62, 3.57]
Zona Norte-office	138 (45)	165 (54)	0.72 [0.52–0.98]	
El Florido	29 (10)	37 (12)	0.77 [0.46–1.29]	
Tres de Octubre	1 (0)	18 (6)	0.05 [0.01–0.40]	
Van de la Postal	4 (1)	8 (3)	0.50 [0.15–1.67]	
† Homeless	53 (17)	48 (16)	1.14 [0.74–1.75]	
† Sex Work	33 (11)	31 (10)	1.08 [0.64–1.81]	
Drug Use Behaviors (last 6 months)				
Inject ≥1 daily	196 (68)	299 (97)	0.06 [0.03–0.13]	0.06 [0.03, 0.12]
Inject Meth Alone	207 (68)	151 (49)	2.20 [1.58–3.05]	
Inject Meth and Heroin	273 (90)	291 (95)	0.50 [0.27–0.92]	
Inject Meth and Cocaine	17 (6)	12 (5)	1.22 [0.57–2.60]	
Inject Heroin Alone	295 (98)	296 (98)	0.85 [0.28–2.57]	
Inject Cocaine Alone	35 (14)	32 (13)	1.07 [0.64–1.79]	
Inject Speedball	54 (18)	42 (14)	1.36 [0.88–2.11]	
Inject in Shooting Gallery	79 (26)	95 (31)	0.78 [0.55–1.11]	
Inject on the Street	26 (9)	8 (3)	3.49 [1.56–7.85]	
Inject w/Others	249 (82)	280 (91)	0.44 [0.27–0.72]	
Receptive Syringe Sharing	219 (72)	210 (68)	1.19 [0.84–1.68]	
# times re-used own syringe (median; IQR*)	5 (3, 10)	6 (3, 12)	0.99 (0.97, 1.01)	
Adverse Health Outcomes (last 6 months)				
Experienced an overdose	29 (10)	26 (8)	1.15 [0.66–2.00]	
Experienced an abscess	104 (34)	74 (24)	1.64 [1.15–2.33]	1.64 [1.09–2.48]
Tested HIV-positive	18 (6)	13 (4)	0.72 [0.35–1.50]	

* Inter-quartile range

** Refers to participants recruited in the Zona Norte neighborhood by mobile van vs. other neighborhoods

† last six months