Drug and Alcohol Dependence 149 (2015) 93–99

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Prevalence and associated factors of inhaled nitrites use among men who have sex with men in Beijing, China

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ARTICLE INFO

Article history:
Received 12 May 2014
Received in revised form 21 January 2015
Accepted 21 January 2015
Available online 28 January 2015

Keywords:
Inhaled nitrites
Usage
Health Belief Model
Men who have sex with men
China

ABSTRACT

Background: Inhaled nitrites are commonly used by men who have sex with men (MSM) in western countries. As such compounds are not illicit, they are widely available in China. Recent studies have documented a high prevalence of inhaled nitrites use in this population.
Methods: Snowball sampling was used to recruit 576 MSM in Beijing, China, who completed an anonymous face-to-face interview.
Results: Of the participants, 49.8% had heard of "Rush" or "inhaled nitrites". The prevalence of use in the last three months was 28.3% among all participants and 56.8% among those with awareness about the compounds. A stepwise model found that age group (26–35 years old, ORm = 3.91; ≤25 years old, ORm = 3.05; reference group: >35 years old, $P < 0.01$) and multiple male sex partnerships (ORm = 2.29, $P < 0.01$) were associated with inhaled nitrites use. Adjusted for these two variables, constructs based on the Health Belief Model (HBM) were significantly associated with inhaled nitrites use in the last three months: Perceived Severity Scale [Adjusted Odds Ratios (AOR) = 0.72, $P < 0.001$], the Perceived Benefit Scale (AOR = 1.20, $P < 0.001$), the Perceived Barrier Scale (AOR = 0.81, $P < 0.01$), the Cue to Action Scale (AOR = 1.45, $P < 0.001$), and the Perceived Self-efficacy Scale (AOR = 0.71, $P < 0.001$).
Conclusions: The prevalence of inhaled nitrites use was high. It may further increase sharply among MSM in China when awareness becomes more common. Cognitive variables derived from the HBM provided a useful framework for designing interventions at structural, inter-personal and individual levels. Policy changes should also be considered.

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1. Introduction

Inhaled nitrites are volatile liquids composed of alcohol, sodium nitrite and sulfuric acid (Mullens et al., 2011). The Omnibus Crime Bill in the U.S. outlawed the sale of all alkyl nitrites in 1990. However, these compounds are commonly sold via the Internet and other venues as incense, video-head cleaners, boot cleaners or leather cleaners (Romanelli et al., 2004). In China, inhaled nitrites are commonly known as "Rush". These are not listed as illicit drugs and are available at online stores or adult stores nationwide, often sold as men's fragrances in bottles of 10–100 ml at 10 to 30 RMB (US$1.6 to 8.3) per 10 ml. Over 10,000 links had been located at the Taobao Marketplace (www.taobao.com) in January, 2014, using the keywords "Rush" and "gay people". This online shopping site is the most popular one in China, which is comparable to e-bay and Amazon, and has 500 million registered users. Therefore, it can be inferred that inhaled nitrites are highly accessible in China.

Inhaled nitrites can result in both short-term adverse effects, such as tachycardia, lightheadedness and syncopal feelings (Berlin, 1987; Newell et al., 1985), and long-term adverse effects, such as crusty skin lesions, dermatologic eruptions, allergic reactions, elevating intraocular pressure, mothemglobinemia and hemolytic anemia (Berlin, 1987; Newell et al., 1985). These drugs are carcinogenic (Chin-Hong et al., 2005) and are associated with criminal behaviors, concomitant abuse of multiple drugs, and mental health problems among adolescents (Howard et al., 2008; Wu et al., 2005).

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http://dx.doi.org/10.1016/j.drugalcdep.2015.01.021
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The use of inhaled nitrates greatly impacts STD/HIV among MSM, as it is associated with the human herpes virus infection, a higher prevalence of unprotected anal intercourse (UAI), and higher number of sex partners, and is predictive of HIV sero-conversion (Buchbinder et al., 2005; Colfax et al., 2005; Lampinen et al., 2007; Ostrow et al., 2009; Plankey et al., 2007; Prestage et al., 2009). The HIV epidemic among men who have sex with men (MSM) in China is worsening, with HIV incidence exceeding 5.0 per 100 person-years in a number of cities (Xu et al., 2010; Yang et al., 2010).

Many MSM find inhaled nitrites use very appealing, as it results in an instantaneous warming sensation and facial flushing due to vasodilatation of cerebral blood vessels (Berlin, 1987; Newell et al., 1985). It also dilates the anal sphincter, facilitates anal intercourse among MSM (Berlin, 1987; Newell et al., 1985) and increases euphoria and sexual orgasms (Mathew et al., 1989). As nitrites metabolize rapidly, such effects only last for a few minutes (Berlin, 1987; Newell et al., 1985). Inhaled nitrites are hence often used by MSM right before or during anal intercourse (Romanelli et al., 2004).

In many countries, the prevalence of inhaled nitrites use among MSM is high. For instance, the lifetime prevalence of use was 63.2% in Japan (Hidaka et al., 2006) and the prevalence in the last six months was 31.6–40.6% in the U.S. and in Australia (Fernandez et al., 2005; Prestage et al., 2009). In China, the prevalence of psychoactive drug use among MSM used to be low and was only 2.5% in 2007 (Ruan et al., 2007). Prevention of substance use is hence usually not on the agenda of HIV prevention programs targeting MSM in China. It is uncertain whether the situation has changed over time and it is warranted to understand situations of inhaled nitrites use among MSM in China.

To our knowledge, there is one qualitative and four quantitative studies investigating inhaled nitrites use among MSM in China. The qualitative study, which was conducted in 2005, showed that inhaled nitrites were very expensive and rare in China (He et al., 2007). One quantitative survey conducted among MSM in Shenyang in 2012 found a lifetime prevalence of 19.2% (Xu et al., 2014), while another one conducted in Beijing in 2012 reported a lifetime prevalence of 47.3% and 42.3% in the last 12 months. (Li et al., 2014). The other two quantitative studies were based on the same survey conducted in Shanghai in 2010 and only targeted HIV positive MSM (He et al., 2013, 2012).

Studies conducted in countries such as the U.S. and Australia identified risk factors that took into account age, number of sex partners (Harte and Meston, 2011), UAI (Harte and Meston, 2011), number of types of drug used (Harte and Meston, 2011), and the perceived benefit of inhaled nitrites use related to sexual pleasure and social interaction (Mullens et al., 2011). Only two of the quantitative studies targeting MSM in China had identified significant factors of inhaled nitrites use, including younger age, higher education level, recruitment of male partners via the Internet, multiple male sex partnerships and UAI (Li et al., 2014; Xu et al., 2014).

Therefore, there is a dearth of studies investigating associations between cognitive factors and the use of inhaled nitrites. In particular, no study has involved behavioral health theories, such as the Health Belief Model (HBM). The HBM has commonly been applied to explain various risk behaviors, including substance use (Bonar and Rosenberg, 2011; Hingson et al., 1990; Walter et al., 1993) and to design various health-related interventions (Mehta et al., 2013). It consists of six constructs, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cue to action and perceived self-efficacy (Janz and Becker, 1984). Given that health promotion programs based on health behavioral theories are more effective than non-theory-based ones (Michie et al., 2008), we tested the applicability of HBM in understanding factors of inhaled nitrites use. We investigated the prevalence of inhaled nitrites use in the last three months among MSM in Beijing, China and examined factors, related to use, that were based on cognitions derived from the constructs of the HBM.

2. Materials and methods

2.1. Study population and data collection

A cross-sectional study was conducted in Beijing from December, 2012 to July, 2013. The inclusion criteria were: (1) Chinese men age 18–60 years old living in Beijing and (2) anal intercourse with at least one man in the last three months. As there was no sampling frame, it was not feasible to use probability sampling methods. We instead used a sampling strategy that had been used in a number of studies (Abara et al., 2014; Deuba et al., 2013; Li et al., 2014; Mason et al., 2013; Xu et al., 2014). In this study, we recruited MSM from multiple sources. First, participants were recruited via outreaching in gay venues (e.g., gay bars, clubs and saunas) by staff of a non-governmental organization (NGO), the Beijing Rainbow Volunteer Workstation, which provided HIV-related services for MSM. Second, a recruitment advertisement was placed on a website which disseminated HIV prevention information (http://www.hivolunt.net) to gay men throughout the study period. Third, referrals were made by participants. Gay-friendly venues and websites are important channels through which MSM could be accessed, as such sites are commonly used by MSM for social purposes and recruitment of male sex partners, and are also important sources of HIV-related information and potential channels for delivering HIV-related interventions. The usage of such multiple sources allowed us to include MSM of different characteristics. Prospective participants then visited the NGO, which was located in the Beijing Jingcheng Dermatology Hospital. Experienced fieldworkers, who were also staff of the NGO, confirmed participants' eligibility to join the study, briefed them about the study, and conducted the anonymous face-to-face interviews in a room in which privacy was ensured. Participants were told clearly that refusals would not affect their right to use any service and that they could quit the interview at any time without being questioned. A total of 756 eligible MSM were invited to join the study; 180 (23.8%) declined to participate in the study; 576 (76.2%) provided written informed consent and completed the survey. No incentive was given to the participants. The study was approved by the Institutional Review Boards of the National Center for AIDS/STD Control and Prevention and the China Center for Disease Control and Prevention (CDC).

2.2. Development of the questionnaire

A panel, consisting of two MSM volunteers, two epidemiologists, one psychologist and two experienced fieldworkers, was formed to develop the questionnaire. No study has used the HBM to explain inhaled nitrites use among MSM, although several studies have looked at perceived benefits (He et al., 2007; Mullens et al., 2011) as a factor of inhaled nitrites use. We included these items in our questionnaire. After panel discussions and informal interviews (involving four MSM who had previously used inhaled nitrates), new items for the other constructs of the HBM (perceived severity, perceived barriers, cue to action and perceived self-efficacy) were generated. Items were created under the framework of the HBM, and consensus was reached by the panel. The questionnaire was then filled out by six other MSM and was finalized after taking their comments into account. Data obtained from these ten MSM were not included in the statistical analysis.

2.3. Measures

Participants were asked about their socio-demographic information (e.g. age, marital status, city of registered residence (Hukou), highest education level attained, monthly personal income), sexual orientation and the number of male sex partners they had anal intercourse with in the last three months. Participants who had heard of Rush or inhaled nitrites were asked whether they had used such drugs in the last three months.

Five scales of the HBM were constructed by summing up individual item scores. The scales were: (1) the Perceived Severity Scale (four items, e.g., "Using Rush would be harmful for physical health in long-term"), (2) the Perceived Benefit Scale (five items, e.g., "Using Rush during anal intercourse would increase sexual pleasure"), (3) the Perceived Barrier Scale (three items, e.g., "Using Rush is illegal"), (4) the Cue to Action Scale (two items, e.g., "Your male sex partners had suggested you to use Rush"), and (5) the Perceived Self-efficacy Scale (two items, e.g., "If my peers asked me to use Rush, I am confident that I can refuse them") (response categories: 1 = strongly disagree, 5 = strongly agree). Using exploratory factor analysis, single factors were identified for the scales of perceived severity and perceived benefits that explained 63.1% and 59.5% of the total variances respectively. The internal reliability (Cronbach's alpha) of the scales formed ranged from 0.638 to 0.878 (see Table 2 for individual items).

2.4. Statistical analysis

The prevalence of awareness and the use of inhaled nitrites, as well as their respective 95% confidence intervals (CI) were presented. Using awareness of Rush or inhaled nitrites and use of inhaled nitrites in the last three months as dependent variables, univariate odds ratios (ORu) of background variables were

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