



2013

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Recommended Citation

Chen, W.J.; Ting, T.-T.; Chang, C.-M.; Liu, Y.-C.; and Chen, C.-Y. (2013) "Ketamine use among regular tobacco and alcohol users as revealed by respondent-driven sampling in Taipei: Prevalence, expectancy, and users' risky decision making," *Journal of Food and Drug Analysis*: Vol. 21 : Iss. 4 , Article 47. Available at: <https://doi.org/10.1016/j.jfda.2013.09.044>

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Ketamine use among regular tobacco and alcohol users as revealed by respondent-driven sampling in Taipei: Prevalence, expectancy, and users' risky decision making

Wei J. Chen^{a,b,c,*}, Te-Tien Ting^{a,d}, Chao-Ming Chang^a, Ying-Chun Liu^a, Chuan-Yu Chen^{b,d,e}

^a Institute of Epidemiology and Preventive Medicine, College of Public Health, Taipei, Taiwan, ROC

^b Department of Public Health, College of Public Health, Taipei, Taiwan, ROC

^c Department of Psychiatry, College of Medicine and National Taiwan University Hospital, Taipei, Taiwan, ROC

^d Center of Neuropsychiatric Research, National Health Research Institutes, Zhunan, Taiwan, ROC

^e Institute of Public Health, National Yang-Ming University, Taipei, Taiwan, ROC

ABSTRACT

Keywords:

Decision making

Expectancy

Ketamine

Respondent-driven sampling (RDS)

The popularity of ketamine for recreational use among young people began to increase, particularly in Asia, in 2000. To gain more knowledge about the use of ketamine among high-risk individuals, a respondent-driven sampling (RDS) was implemented among regular alcohol and tobacco users in the Taipei metropolitan area from 2007 to 2010. The sampling was initiated in three different settings (i.e., 2 in the community and 1 in a clinic) to recruit seed individuals. Each participant was asked to refer one to five friends known to be regular tobacco smokers and alcohol drinkers to participate in the present study. Incentives were offered differentially upon the completion of an interview and successful referral. Information pertaining to drug use experience was collected by an audio computer-assisted self-interview instrument. Software built for RDS analyses was used for data analyses. Of the 1,115 participants recruited, about 11.7% of the RDS respondents reported ever having used ketamine. Positive expectancy of ketamine use was positively associated with ketamine use; by contrast, negative expectancy was inversely associated with ketamine use. Decision-making characteristics as measured on the Iowa Gambling Task (IGT) using reinforcement learning models revealed that ketamine users learned less from the most recent event than both tobacco- and drug-naïve controls and regular tobacco and alcohol users. These findings about ketamine use among young people have implications for its prevention and intervention.

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* Corresponding author. Institute of Epidemiology and Preventive Medicine, College of Public Health, 17 Xu-Zhou Road, Taipei 100, Taiwan, ROC.

E-mail address: wjchen@ntu.edu.tw (W.J. Chen).

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1. Increasing popularity of ketamine use among young people

Ketamine was initially used for war injuries in the early 1970s [1], and became a club drug in the 1990s [2]. Since 2000, the popularity of ketamine for recreational use among young people began to increase [3], particularly in Asia [4]. The consumption of ketamine can lead to a variety of health problems, such as cognition impairment, kidney dysfunction, and accidental deaths [2,5], and may result in even more severe health problems if used with other drugs simultaneously or in sequence [6,7].

The culture of illegal drug or inhalant use among young people in Taiwan underwent a major change in the past two decades. In national surveys from 1991 through to 1996 among adolescent students aged 13–18 years in Taiwan, the prevalence of any illegal drug or inhalant use ranged from 1.1% to 1.5%, with the most commonly consumed illegal drugs or inhalants being methamphetamine, glue sniffing, and flunitrazepam [8]. However, later surveys in the 2000s indicated that club drugs, which mainly consisted of ecstasy, ketamine, and marijuana, had emerged as the most commonly consumed illegal drugs among young people in Taiwan [9,10].

Early epidemiological evidence of the increasing popularity of ketamine in Taiwan was from a pilot outreach study. In a survey via a street outreach program among 2,126 adolescents aged 12–18 years recruited from Taipei street sites in 2002, ketamine was found to be the second most commonly consumed illegal drug for adolescents with truancy, with 12.1–14.5% reporting ecstasy use, 4.6–7.3% reporting ketamine use, and 3.5–8.8% reporting marijuana use, whereas the corresponding estimate was 3.1–3.4% for youths without truancy [9]. Later, more extensive, nationwide outreach programs across 26 cities/towns in Taiwan were conducted in the period from 2004 to 2006 with a total of 18,420 participants aged 12–18 years. For those who were living with their families but reported to have experience of running away from home ($n = 1626$), ketamine ($n = 75$, 4.6%) was again found to be the second most common illegal drug ever used, next to ecstasy ($n = 139$, 8.5%) [11].

The popularity of ketamine as a recreational drug was further confirmed in national surveys among school-attending adolescents in Grades 7, 9, 10, and 12, aged 11–19 years, in 2004–2006 [10]. Ecstasy and ketamine, by and large, remained the most and second most commonly used illegal drugs, respectively, during the 3-year period for both middle and high school students [10]. For middle school students, the prevalence of ecstasy use was 0.28%, 0.25%, and 0.07% in 2004, 2005, and 2006, respectively, and the corresponding figure for ketamine was 0.15%, 0.18% and 0.15% in 2004, 2005, and 2006, respectively. For high school students, the prevalence of ecstasy use was 1.72%, 0.82%, and 0.52% in 2004, 2005, and 2006, respectively, and the prevalence for ketamine was 1.13%, 0.61%, and 0.44% in 2004, 2005, and 2006, respectively. Among ecstasy users, ketamine (41.4–53.5%) was the most common other drug used; meanwhile, ketamine continued to be initiated almost exclusively at the same age as ecstasy. Nevertheless, the proportion of ecstasy-naïve ketamine users increased slightly but significantly from 0% in 2004 to 5.3% in 2006.

Based on these prevalence data, ketamine seemed to be becoming more popular within adolescent drug culture, particularly among middle school students, during the study period of 2004–2006. This switching of popularity between ecstasy and ketamine might be attributed to the harsher regulations on the use of ecstasy (with offenders being incarcerated for enforced detoxification and drug education) compared with that of ketamine (no incarceration for offenders) in Taiwan.

2. Using respondent-driven sampling to reach high-risk individuals

Because illegal drug users are often clustered or connected in social networks, researchers have developed respondent-driven sampling (RDS) to explore this hidden population via probability-theoretical methods to compensate for nonrandom sampling [12–15]. Starting in 2008, a series of RDS implementations was undertaken in Taiwan, where the stigma against illegal drug use remains strong and severe punishment is stipulated by law [16,17]. The RDS was carried out among regular tobacco and alcohol users in the Taipei metropolitan area in 2008–2010. Through regular tobacco and alcohol users, who were shown to have an elevated risk of illegal drug use [10], the RDS procedures efficiently reached the subpopulation of illegal drug users. The recruitment criteria and implementation of the RDS have been described in detail elsewhere (Ting T-T, Chen C-Y, Tsai Y-S, et al, unpublished data). Briefly, every seed was asked to recruit one to five friends who were regular tobacco and alcohol users and were 18–40 years old. When their peers were introduced to this study, these newly recruited individuals were also asked to refer their peers. Incentives were offered differentially upon the completion of an interview and successful referral.

Prior to beginning an interview, the interviewers took the respondent to a private place to provide informed consent using a nickname. The participants were reassured that their information was strictly confidential and that they only needed to give their nickname, the last four digits of a 10-digit national identification number, and a cell phone number for the researchers to follow up with them annually via the Internet. Each participant underwent an audio computer-assisted self-interview regarding their experience with drug use, the expectancy of ketamine use, and other measurements. All of the information provided by the respondents was used only for data linkage and the creation of individual accounts for their questionnaires and neuropsychological tests, including the Iowa Gambling Task (IGT) [18]. This RDS sample thus provided a group of ketamine users whose network of relationships were known and can thus be subjected to estimation using social network-based methods.

3. Ketamine becoming the most commonly consumed illegal drug in the RDS sample

During the 3-year period from 2008 to 2010, 1,115 individuals were successfully recruited via RDS. Population prevalences adjusted for RDS (i.e., an estimate using both transition

probability and the network weighting system) were estimated using the RDS Analysis Tool (RDSAT) [15] and their standard errors were estimated using the bootstrapping method.

The results indicated that the weighted prevalence of lifetime use of three club drugs were 11.7% for ketamine, 11.7% for ecstasy, and 10.5% for marijuana, the three most commonly consumed illegal drugs. Meanwhile, the prevalence of past-year use was 4.3% for ketamine, 4.0 for ecstasy, and 3.8% for marijuana. Thus, in this RDS sample of regular tobacco and alcohol users, ketamine has replaced ecstasy as the most commonly used illegal drug.

4. Expectancy and prevalence of ketamine use

Previous studies have indicated that understanding people's expectations of a particular drug use is important for developing interventions and prevention regarding the drug [19,20]. It has been found that a high positive expectancy is associated with strong endorsement or desire to use a drug and a high negative expectancy with the shunning of such use [21]. It remains that little is known about young people's expectancies regarding ketamine use and whether such expectancies are related to their ketamine-using behavior.

In the RDS study, each participant was asked to fill a ketamine expectancy questionnaire that was modified from the Adolescent Cannabis Expectancy Questionnaires [22] by replacing "cannabis" with "ketamine." The results of both the internal consistencies and confirmatory factor analysis indicated good fits for this ketamine expectancy questionnaire. More details are described elsewhere (Chang C-M, Ting T-T, Chen C-Y, et al, unpublished data).

On the basis of ketamine-use experience, participants were categorized into three groups: illegal drug-naïve ($N = 845$, 83%), ketamine use only ($N = 30$, 3%), and ketamine use with other drugs ($N = 137$, 14%). The results of multinomial logistic regression analyses indicated that a continuous score on positive expectancy was positively associated with ketamine use only [odds ratio, $OR = 1.51$, $p < 0.01$] and ketamine use with other drugs ($OR = 1.68$, $p < 0.001$); by contrast, a continuous score on negative expectancy was inversely associated with ketamine use only ($OR = 0.80$, $p < 0.05$) and ketamine use with other drugs ($OR = 0.70$, $p < 0.001$).

We then used the median of positive and negative expectancy among the illegal drug-naïve group, respectively, to dichotomize expectancy into high versus low subgroups. Using the subgroup of low-positive plus high-negative as the reference, the results of multinomial logistic regression analysis revealed that the subgroup of high-positive and low-negative was positively associated with ketamine use only ($OR = 3.28$, $p < 0.05$) and ketamine use with other drugs ($OR = 41.21$, $p < 0.0001$).

5. Risky decision making among ketamine users

Because substance users tend to be involved in risky behaviors, such as violence, gambling, drunk driving, and risky

sexual behaviors [23], they may have deficient decision-making skills that can be measured using a psychological task such as the IGT, which was originally developed to examine decision-making deficits in patients with prefrontal cortex damage [18,24].

We hypothesized that people who have ever used illegal drugs would have more deficient decision-making skills than regular users of tobacco and alcohol who have never tried illegal drugs, on the basis of gateway development in substance use. More advanced substance use might be associated with worse parameters in the reinforcement learning models such as Prospect Valence Learning (PVL) models [25], which consist of parameters characterizing underlying decision features, including sensitivities to gains and losses, learning ability, and stability.

We administered a computerized version of the IGT to each member of the RDS-derived cohorts of 2008 and 2009 when they were followed-up yearly. More detail about the implementation of the IGT among the RDS cohorts is described elsewhere (Liu Y-C, Ting T-T, Wang S-H, et al, unpublished data). A total of 240 regular tobacco and alcohol users from the RDS samples and 45 tobacco- and drug-naïve controls were included for the subsequent analyses. Among the 240 RDS participants, 55 were classified as illegal ($n = 42$; 20 of them having ever used ketamine) or nonprescription ($n = 13$) drug users, and the remaining 185 were classified as regular tobacco and alcohol users. A PVL model containing Utility Shape, Loss Aversion, Recency, and Consistency was fitted to each participant's trials on the IGT using the hierarchical Bayesian method.

Among the three groups, only the controls obtained a positive net score in the last block of 20 trials. The PVL model analyses revealed a prominent combination of high sensitivity to gains (Utility Shape) and insensitivity to losses (Loss Aversion) in illegal/nonprescription drug users, followed by regular tobacco and alcohol users, and a low sensitivity to gains and sensitivity to losses in the controls, especially for males. The other two parameters reflected substance-induced cognitive change (Recency) or parameterization of the model (Consistency).

6. Conclusion and perspectives

By means of a RDS-derived sample of regular tobacco and alcohol users, we recruited a group of ketamine users who were not in treatment for such drug use. The popularity of ketamine has surpassed ecstasy as the most commonly used illegal drug among these young tobacco and alcohol users in Taiwan during the study period of 2008–2010. These individuals' expectancy about ketamine was associated with their use, with those showing a high positive expectancy and low negative expectancy of using ketamine having the highest likelihood of using the drug, whereas those with a low positive expectancy and a high positive expectancy having the lowest likelihood of ever using ketamine. These results help shed light on the relationship between different ketamine use patterns and ketamine expectancy, and have important implications for understanding the cognitive processes underpinning decision making by substance users at a relatively

early stage of substance use. The information provides useful insights for the intervention or prevention of ketamine use.

Acknowledgments

This work was supported by grants from the Department of Health, Taiwan (DOH96-NNB-104; DOH97-NNB-1018; DOH98-NNB-1010; DOH99-FDA-6120) and a doctoral scholarship from National Health Research Institutes to T.-T. T. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

REFERENCES

- [1] Domino EF. Taming the ketamine tiger. *Anesthesiology* 2010;113:678–84.
- [2] Morgan CJA, Curran HV. The Independent Scientific Committee on Drugs. Ketamine use: a review. *Addiction* 2012;107:27–38.
- [3] United Nations Office on Drug and Crime (UNODC). World drug report 2011. Vienna: UNODC; 2011.
- [4] Li J-H, Vicknasingam B, Cheung Y-W, et al. To use or not to use: an update on licit and illicit ketamine use. *Subst Abuse Rehabil* 2011;2:11–20.
- [5] Freese TE, Miotto K, Reback CJ. The effects and consequences of selected club drugs. *J Subst Abuse Treat* 2002;23:151–6.
- [6] Lankenau S, Clatts M. Patterns of polydrug use among ketamine injectors in New York City. *Subst Use Misuse* 2005;40:1381–97.
- [7] Grov C, Kelly BC, Parsons JT. Polydrug use among club-going young adults recruited through time-space sampling. *Subst Use Misuse* 2009;44:848–64.
- [8] Chou P, Liou M-Y, Lai M-Y, et al. Time trend of substance use among adolescents in Taiwan, 1991–1996. *J Formos Med Assoc* 1999;98:827–31.
- [9] Chou L-C, Ho C-Y, Chen C-Y, et al. Truancy and illicit drug use among adolescents surveyed via street outreach. *Addict Behav* 2006;31:149–54.
- [10] Chen WJ, Fu T-C, Ting T-T, et al. Use of ecstasy and other psychoactive substances among school-attending adolescents in Taiwan: national surveys 2004–2006. *BMC Public Health* 2009;9:27.
- [11] Wang S-H, Chen W-C, Lew-Ting C-Y, et al. Running away experience and psychoactive substance use among adolescents in Taiwan: multi-city street outreach survey. *BMC Public Health* 2010;10:29.
- [12] Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. *Soc Probl* 1997;44:174–99.
- [13] Heckathorn D. Extensions of respondent-driven sampling: analyzing continuous variables and controlling for differential recruitment. *Sociol Methodol* 2007;37:151–207.
- [14] Salganik MJ, Dodds PS, Watts DJ. Experimental study of inequality and unpredictability in an artificial cultural market. *Science* 2006;311:854–6.
- [15] Volz E, Heckathorn DD. Probability based estimation theory for respondent driven sampling. *J Off Stat* 2008;24:79–97.
- [16] Chiang S-C, Chen S-J, Sun H-J, et al. Heroin use among youths incarcerated for illicit drug use: psychosocial environment, substance use history, psychiatric comorbidity, and route of administration. *Am J Addict* 2006;15:233–41.
- [17] Chiang S-C, Chen C-Y, Chang Y-Y, et al. Prevalence of heroin and methamphetamine male users in the northern Taiwan, 1999–2002: capture-recapture estimates. *BMC Public Health* 2007;7:292.
- [18] Bechara A, Damasio AR, Damasio H, et al. Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition* 1994;50:7–15.
- [19] Christiansen BA, Smith GT, Roehling PV, et al. Using alcohol expectancies to predict adolescent drinking behavior after one year. *J Consult Clin Psychol* 1989;57:93–9.
- [20] Goldman MS. Risk for substance abuse: memory as a common etiological pathway. *Psychol Sci* 1999;10:196–8.
- [21] Stacy AW, Galaif ER, Sussman S, et al. Self-generated drug outcomes in high-risk adolescents. *Psychol Addict Behav* 1996;10:18–27.
- [22] Willner P. A view through the gateway: expectancies as a possible pathway from alcohol to cannabis. *Addiction* 2001;96:691–703.
- [23] Hart CL, Ksir C, Ray O. *Drugs, society, and human behavior*. New York: McGraw-Hill; 2009.
- [24] Buelow MT, Suhr JA. Construct validity of the Iowa gambling task. *Neuropsychol Rev* 2009;19:102–14.
- [25] Ahn WY, Busemeyer JR, Wagenmakers EJ, et al. Comparison of decision learning models using the generalization criterion method. *Cogn Sci* 2008;32:1376–402.