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Drug Use and Profile of Individuals Arrested on Drug-related Charges in Taiwan

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ABSTRACT

A total of 931 urine specimens and associated donor profile data resulting from drug-related arrests made between January and July 2002 were collected from 12 cities/counties throughout Taiwan. Urine specimens were screened on a REMEDi HS drug profiling system. Drug use findings and profile data were subjected to pattern analysis. Results indicated a drug positive rate of 74%, with 39 drugs identified. Opiates and amphetamines were the major drugs of abuse, with detection rate of 40% and 38%, respectively. Drug users were found in all age categories (from 12 to 57 years old), and were predominantly male (M/F ratio > 5). Most arrests were made in residences or along roadways (92%-95% of total arrests). A large number of those arrested had quit school before completing junior high school and many had records of multiple arrests. By contrast, club drugs (MDMA/ketamine) were found in our sample group at lower rates (10% and 5%, respectively). Club drug users tended to be younger (mostly under 27 years old), better educated, and with a smaller gender gap (M/F ratio < 3.5). Club drug users were identified only in four relatively urbanized cities/counties and many arrests were for first offenses. Benzodiazepines (BZ) were found throughout the sample, with a detection rate of 18%. The profile identified for BZ users is similar to that of opiate and amphetamine users, although a higher ratio of BZ users (14%) were arrested in recreational places.

Key words: urine test, opiates, amphetamines, benzodiazepines, MDMA, ketamine, user profile

INTRODUCTION

Urine drug testing, considered an objective tool for detecting levels of various narcotics in the system, is commonly used to detect recent drug use[1,2]. Urine drug testing has also been used in drug abuse monitoring. For example, Richardson and Morein[3] studied jail urine screening programs and found their results useful indicators of local drug use patterns. The US Arrestee Drug Abuse Monitoring (ADAM) program, in place since 1987, provides data that is used regularly in policymaking, prevention strategy development, and crime-related research[4]. Similar programs in Australia (Drug Use Monitoring in Australia (DUMA))[5], Britain[6] and other countries[7] have also been established, although methods employed have limited the range of drugs screened. In general, monitoring for commonly used narcotics is done using specific immunoassays that are not able to detect structurally-unrelated drugs.

Government urine test records dating back to the early 1990s, the result of drug use monitoring programs begun in response to a drastic increase in methamphetamine abuse at that time, provide reliable trend data for heroin and methamphetamine abuse in Taiwan. However, the abuse of other club drugs, which are taking increasing prominence in Taiwan addiction treatment programs, are not detected using immunoassays targeting morphine and methamphetamine. Analyzing 2,944 urine specimens from drug-related arrests in western Taiwan (the most densely populated section of the country) taken over a six-month period, we found a 1.15% positive detection of MDMA and 0.37% positive detection of marijuana metabolites[8]. The geographic distribution of positive specimens indicated both drugs were used primarily in urban areas. Lua *et al*. have reported positive MDMA and ketamine detection rates as high as 76% and 47% among rave party participants[9]. As routine urine tests on arrestees check for methamphetamine and morphine only, studies are confined to detecting only major drugs and, at most, a few others. Furthermore, in contrast to the broad-based research done on heroin and methamphetamine use, the limited geographic scope of these studies prevents a full understanding of the extent of usage of emerging club drugs (MDMA, marijuana, ketamine, etc.). Our study was designed specifically to address the full spectrum of abused drugs as well as the background profiles of those arrested for drug use in Taiwan.

METHODS

I. *Sampling*

Twelve of Taiwan's 25 cities and counties were selected for inclusion in this study. These included Taipei City and Taipei and Taoyuan Counties (in northern Taiwan); Taichung City and Miaoli, Taichung and Changhua Counties (in central Taiwan); Kaohsiung City and Tainan

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and Kaoshiung Counties (in southern Taiwan); and Hualien and Yilan Counties (in eastern Taiwan). We set our collection target at 1,000 urine specimens of the approximately 40,000 test samples taken annually from arrested drug user suspects and assigned a sample quota to each city and county that reflected its population and drug-related offense record. Specimens and drug offender information used in this study spanned a period from January to July 2002. Random samples were sent by local laboratories to the National Bureau of Controlled Drugs for further analysis.

II. *Survey Form*

A questionnaire, designed by our laboratory and filled out by the police, collected objective, fact-based data about the source of each sample. Data included specimen collection date; the age, gender and education level of the individual arrested; the reason for the urine test; the individual's arrest record; and the location of and reason(s) for this arrest incident. For reasons of privacy, no personal identification information was collected.

III. *Urine Drug Analysis*

The broad-spectrum drug-screening instrument REMEDi HS system (BIO RAD Co.), a high performance liquid chromatography device with an UV detector, was used for urine drug analysis. This highly automated system includes a built-in library to screen for over 900 drugs and metabolites, including stimulants, local anesthetics, antidepressants, antibiotics and pesticides. In this study, specimens were screened for more than 100 of the over 200 drugs on Taiwan's list of controlled substances. Drugs targeted included methamphetamine, amphetamine, morphine, codeine, other synthetic opioids, MDMA, MDA, ketamine, cocaine, other stimulants and benzodiazepines. Detection limits were set to 100-300 ng/mL for 57 chemically basic drugs and to 80-600 ng/mL for the more chemically neutral benzodiazepines.

As REMEDi cannot be used to screen for acidic drugs such as marijuana, a narcotic detected in a previous survey[8], we screened for marijuana metabolites using an Emit d.a.u. enzyme immunoassay on a Hitachi 705, with a cutoff detection of 50 ng/mL. Specimens that tested positive were then derivatized with BSTFA and further analyzed for confirmation with an Agilent 6890 GC/MS using single ion monitoring. The detection limit was set to 3 ng/mL for tetrahydrocannabinol carboxilic acid, a metabolite of one of the active marijuana components.

IV. *Statistical Analysis*

For statistical analysis, either an x^2 or Fisher's exact test was used for comparison, as appropriate, and a p value of 0.05 was used as the criterion of significance. The significance of the most often found drugs or metabolites was analyzed with respect to the data profile of sample donors.

RESULTS

I. *Samples*

Between 70 and 390 samples were received from each of the four geographic regions in response to our request for 1,000 sets of filled-out questionnaires and urine specimens. A total of 931 were valid, with rates of recovery varying from 88% to 100% among different regions.

Sample donor profiles are summarized in Table 1. Males outnumber females by a factor greater than four. Most (82%) were between 18 and 37 years of age, with a peak (25%) in the 23 to 27 year-old bracket. Two-thirds (68%) had left school before finishing junior high school. More than half were repeat offenders. In contrast to the general population, where one third (34%) finish high school and 26% earn a college degree[10], those arrested on drug abuse charges are disproportionately less educated, young, and predominantly male. Thirty-seven percent of

Table 1. Profile of individuals arrested on drug-related charges (n = 931)

Variable		Number	%
Age (year)	12-17	75	8.1
	18-22	195	20.9
	23-27	228	24.5
	28-32	193	20.7
	33-37	140	15.0
	38-47	77	8.3
	48-57	16	1.7
	>57	2	0.2
	Not known	5	0.5
Gender	Male	745	80.0
	Female	165	17.7
	Not known	21	2.3
	M/F ratio	4.5	
Education level (grade)	0-6	63	6.8
	7-9	566	60.8
	10-12	238	25.6
	College	28	3.0
	Post Graduate	2	0.2
	Not known	34	3.7
Offense	Drug use	886	95.2
	Drug sale	9	1.0
	Both	25	2.7
	Not known	11	1.2
Arrest history	First Arrest	358	38.5
	Second Arrest	307	33.0
	More	232	24.9
	Not known	34	3.7
Place of arrest	Residence	345	37.1
	Roadside	312	33.5
	Recreational	229	24.6
	Other	18	1.9
	Not known	27	2.9
Context of arrest	Police check	911	97.9
	Criminal charge	12	1.3
	Other	4	0.4
	Not known	4	0.4
Total		931	100

the individuals in our sample group were arrested in the home or other residence, 34% at roadside, and 25% in an entertainment venue such as a dance club, pub, karaoke parlor, video game-arcade or Internet café. Almost all (97.9%) were caught as a result of random police checks and only 1.3% were taken into custody on criminal charges. Most (95.2%) were arrested on suspicion of drug use rather than drug sale.

II. *Drugs Detected*

Of the 931 valid sample urine specimens, 691 (74%) contained at least one of 39 distinct drugs/metabolites (Table 2). Forty and 38% of specimens registered positive for opiates and amphetamines, respectively. Eighteen percent registered positive for a test covering 17 benzodiazepines/metabolites substances (in Taiwan, triazolam, brotizolam and flunitrazepam are listed as schedule III drugs, while others are listed as schedule IV), while over 5% registered positive for each of the three benzodiazepines/metabolites (diazepam, oxazepam and temazepam). In Taiwan, diazepam is used widely as an anti-anxiety agent, muscle relaxant and anticonvulsant. Oxazepam and temazepam are both diazepam metabolites[11]. Benzodiazepines may result from intake of prescription medication. MDMA is a schedule II drug. Ketamine has been a schedule III drug since 2002. Detection rates of between 4~10% for MDMA and ketamine in our specimen group indicate that club drug use in Taiwan is significant – reaching usage rates of about one quarter that of opiates and amphetamines.

III. *User Profile*

Samples testing positive were analyzed for the following five drug types: (1) opiates (morphine, codeine and their metabolites), (2) amphetamines (methamphetamine and amphetamine), (3) benzodiazepines (17 drugs and their metabolites), (4) MDMA (MDMA and MDA), and (5) ketamine.

Drug use varied by age, with about half the users of opiates, amphetamines and benzodiazepines falling between 28 and 37 years of age. Those under 27 years old show a relative preference for MDMA and ketamine. This may be due to peer pressure and the novelty of these drugs coupled with the recreational settings in which these club drugs are typically used. Over 70% of those in the group using opiates, amphetamines and benzodiazepines had less than 9 years of schooling (the national minimum in Taiwan). MDMA and ketamine users tended to have higher levels of education. The statistical significance of the education profile for amphetamines users was verified by x^2 analysis ($p < 0.01$).

Male preponderance was found for every category of drug, with opiates users showing the largest gender gap and ketamine users showing the smallest. Opiates users demonstrated statistical significance ($p < 0.01$) in gender proportion (Table 3).

Table 2. Drugs and metabolites detected in urine samples from drug-related arrests (n = 931)

Drugs	Detection number	Detection rate %
Opiates	**371**	**40**
Morphine & metabolites	367	39
Codeine & metabolites	282	30
Amphetamines	**350**	**38**
Methamphetamine	312	34
Amphetamine	224	24
Benzodiazepines	**170**	**18**
Oxazepam	107	11
Temazepam	90	9.7
Diazepam	77	8.3
Lorazepam	30	3.2
Demoxepam	11	1.2
Flunitrazepam & metabolites	10	1.1
Brotizolam	8	0.86
Triazolam	7	0.75
Flurazepam & metabolites	7	0.75
Alprazolam	6	0.64
Norclobazam	6	0.64
Nitrazepam	3	0.32
Carbazepine-10,11-epoxide	3	0.32
Lormetazepam	3	0.32
Bromazepam	2	0.21
Midazolam	2	0.21
Clonazepam	1	0.10
MDMA	**92**	**9.9**
MDMA & metabolites	69	7.4
MDA & metabolites	44	4.7
Ketamine	**44**	**4.7**
Others	**91**	**9.8**
Methyl ephedrine	21	2.3
Ephedrine	19	2.0
Tramadol	17	1.8
Methadone	9	1.0
Marijuana metabolite	7	0.75
Pethidine & metabolites	7	0.75
Oxymorphone	5	0.54
Phenylpropanolamine	4	0.43
Phenobarbital	3	0.32
Fentanyl	2	0.21
Pentazocine	2	0.21
Secobarbital	2	0.21
Clobenzorex	1	0.10
Hydrocodone	1	0.10
Mazindol	1	0.10

Marijuana was detected with Agilent 6890 GC/MS, the rest were detected with REMEDi HS system.

Eighty-four percent of opiates and amphetamines users in our samples were repeat offenders -- underscoring the addictive nature of these drugs. By contrast, 85% of MDMA and ketamine users were first-time offenders. Arrest histories demonstrated statistical significance for opiates, amphetamines and benzodiazepines (Table 3).

When types of drugs used are broken down by geographic region, central Taiwan leads all other regions in opiate use by a wide margin and, interestingly, MDMA and ketamine users in our sample are found exclusively in met-

Table 3. Arrestee analysis by drug type (n = 931)

Variable \Drug type		Opiates			Amphetamines			Benzodiazepines			MDMA			Ketamine		
		Case	%	*p* value	Case	%	*p* value	Case	%	*p* value	Case	%	*p* value	Case	%	*p* value
Age	<=17	5	1.4	0**	4	1.1	0**	7	4.1	—[a]	23	25.0	—	7	15.9	—
df=6	18-22	27	7.3		35	10.3		16	9.4		47	51.1		17	38.6	
	23-27	112	30.4		91	25.6		44	25.9		15	16.3		13	29.5	
	28-32	102	27.4		99	28.9		47	27.6		6	6.5		5	11.4	
	33-37	81	22.0		71	19.9		40	23.5		1	1.1		1	2.3	
	38-47	34	9.2		40	11.7		14	8.2		0	0		1	2.3	
	>=48	9	2.4		9	2.5		2	1.2		0	0		0	0	
Gender	Male	313	86.0	0.008**	289	83.8	0.251	140	84.3	0.435	68	84.4	1.0	29	67.4	1.0
df=1	Female	51	14.0		56	16.2		26	15.7		22	24.4		14	32.6	
Education	<=6	29	7.9	—	28	8.1	0**	14	8.3	0.899	0	0	—	1	2.9	—
df=3	7-9	249	68.0		244	70.9		106	62.7		42	51.9		21	61.8	
	10-12	84	23.0		66	19.2		44	26.0		36	44.4		11	32.4	
	>=13	4	1.1		6	1.7		5	3.0		3	3.7		1	2.9	
Offense	Use	346	94.0	—	321	92.8	—	165	97.6	—	91	98.9	—	44	100	—
df=2	Sale	4	1.1		8	2.3		0	0		0	0		0	0	
	Both	16	4.4		17	4.9		4	2.4		1	1.1		0	0	
Arrest	1st	60	16.4	0**	56	16.2	0**	47	28.1	0.003**	69	85.2	—	29	85.3	—
history	2nd	151	41.4		167	48.4		67	40.1		11	13.6		4	11.8	
df=2	>=3	154	42.2		122	35.4		53	31.7		1	1.2		1	2.9	
Place of	Roadside	174	46.9	0**	153	43.7	0**	62	36.5	0.002**	14	15.7	—	8	20.0	—
arrest	Recreation	7	1.9		10	2.9		23	13.5		61	68.5		23	57.5	
df=3	Residential	167	45.0		177	50.6		78	45.9		13	14.6		9	22.5	
	Other	23	6.2		10	2.9		7	4.1		1	1.1		0	0	
Context	Police check	361	97.7	0.075	346	99.1	0.551	163	96.4	0.012*	91	100	0.62	42	100	1.0
of arrest	Criminal	8	2.2		3	0.9		6	3.6		0	0		0	0	
df=1	charge															
Locality	Northern	102	27.5	0**	138	39.3	0**	49	28.8	0.027*	36	39.1	—	21	47.7	—
df=3	Central	166	44.7		132	37.6		51	30.0		0	0		0	0	
	Southern	68	18.3		42	12.0		55	32.4		56	60.9		23	52.3	
	Eastern	35	9.4		39	11.1		15	8.8		0	0		0	0	

1. x^2 test used for statistical analysis; [a] — ": not suitable for x^2 test's analysis.

2. Fisher's exact test is used for 2 × 2 Table.

3. **: $p < 0.01$, *: $p < 0.05$. Significant difference assumed when p value is less than 0.05.

ropolitan Taipei (northern Taiwan) and Kaohsiung City (southern Taiwan). Both are significantly more urbanized than the rest of the country. Locality data demonstrate statistical significance ($p < 0.05$) for opiates, amphetamines and benzodiazepines (Table 3)

Very few opiates (2%) and amphetamines (3%) users were identified among those arrested in recreational settings, where 14% of benzodiazepines users were found. The majority of club drugs (MDMA and ketamine) users (>57%) were caught in a recreational setting. Place of arrest data demonstrate statistical significance ($p < 0.05$) for opiates, amphetamines and benzodiazepines. Further analyses of places of arrest for MDMA and ketamine users are also significant, as, after combining numbers in the "Other" and "Roadside" categories, the x^2 test p value is less than 0.01.

Among our 931 sample specimens, 18% tested positive for benzodiazepines (17 drugs/metabolites) and around 10% tested positive for each of diazepam, oxazepam and temazepam. This latter figure is not a surprise because of the widespread prescription use of diazepam. Clonazepam was the only benzodiazepine found in this study that has not been registered for medicinal use in Taiwan. We believe that a majority of benzodiazepines detections represent non-medically prescribed consumption. While flunitrazepam has been noted as a club drug of concern, it had a low detection rate (1.1%), ranking sixth on the list of benzodiazepine detections.

User profiles in Table 3 also show that MDMA and ketamine users differ significantly from users of opiates and amphetamines, particularly in terms of geographic distribution, age, history of arrest, and place of arrest variables.

In addition to the five drug types mentioned above, we also detected 15 other drugs, including stimulants, other synthetic opioids, THC and barbiturates (Table 2). Many of these can be obtained through licit channels (e.g., doctor's prescription or over-the-counter purchase).

DISCUSSION

REMEDi HS system has been used in the testing of urine amphetamines[12] and benzodiazepines[13] with good efficiency. It is also considered an effective screening tech-

nology in forensic cases[14]. In this study, the 39 drugs/metabolites detected and their rankings tally with other indicators of drug abuse in Taiwan published in monthly Department of Health drug abuse statistics[15] (covering Department of Justice drug seizure data; DOH treatment unit reports; and nation-wide statistical data on the results of urine tests conducted as a routine part of drug related arrests) and reported in other studies[8,16]. The representative nature of our sample was checked by comparing the ratio of morphine positives to methamphetamine positives in this study to that in reports submitted by local health bureaus over the same period. The comparative ratio of 1.18/1.00 indicates compatibility.

This study provides a relatively comprehensive overview of drug use prevalence in Taiwan during the period surveyed. Conclusions similar to ours were reported by Makkai and Feather[5] in the Drug Use Monitoring in Australian Report.

In this study, 74% of urine specimens read positive for at least one controlled drug. This drug positive rate is slightly higher, but still comparable, to that reported in other countries' studies such as ADAM in the US (64% drug positive)[17], a report on marijuana usage in Australia (61% drug positive)[5], and a similar UK report (61% drug positive)[6].

Amphetamines and opiates have been the major illicit drugs seen in Taiwan since the early 1990s and are relatively equal in usage. Most amphetamine positive urine samples in this study also tested positive for methamphetamine, indicating that amphetamine detected may be primarily a methamphetamine metabolite. Similarly, the fact that most codeine positive urine samples also tested positive for morphine suggests the two may enter the system through the ingestion of one opiate drug.

These results are similar to those found in other countries in East and South Asia[18] but very different from those recorded in Europe[6,19] and North America[20,21]. However, similar methamphetamine usage levels can be found in a study by Gibson *et al*., which examined drug use patterns and trends in California's Central Valley[22] (primarily the Sacramento area) – an area that has led the US in methamphetamine abuse since the late 1980s. As many as 28% of individuals in arrest cases surveyed in 1998-99 tested positive, which was still lower than the 38% positive rate for amphetamines in sample group.

Positive rates for MDMA and ketamine identified by this study, while lower relative to amphetamines and opiates, are still high enough to indicate their significance as illicit drug categories. Other club drugs, such as flunitrazepam and marijuana were also found, but at very low rates. The absence of cocaine findings in this study contrasts greatly with the experience of western countries.

Since the 1990s, more amphetamine positives have been found relative to opiate positives by the routine urine drug tests performed on those arrested on drug-related charges in Taiwan. This trend is echoed by Lua *et al*.[16] who performed urine drug tests on arrested individuals in four Taiwan counties from 1997 to 1998. Our study showed a high, but similar, prevalence of opiate and amphetamine use. A significant portion of our samples comprised MDMA users, although it remains unknown at this point whether MDMA and other club drugs have the potential to attract a substantial number of new users and cause further public health and social problems.

In the current study, we demonstrate that MDMA and ketamine abuse in Taiwan is lower than abuse of amphetamines and opiates. Cross-referencing with user data further indicates that the profile of the typical MDMA/ketamine user differs significantly from that of the typical amphetamine/opiate user. MDMA and ketamine users in Taiwan are younger but of a similar gender ratio to Baltimore-Washington area rave club drug users studied by Arria *et al*. in 2000[23]. MDMA use grew with rave culture among youth in the West and then spread globally. As such, MDMA usage patterns tend to be similar across national boundaries. Arria's finding that users of ecstasy in his study were likely to also use marijuana and cocaine, and thus be classified as poly-drug users, is in stark contrast to the low marijuana and nearly absent cocaine findings among users in Taiwan.

In this study, benzodiazepine was prevalent in samples taken from all four regions, with results similar to those of studies on benzodiazepines previously conducted in Taiwan as well as in other countries[5,6,20,24,25]. Newmeyer[21] reported high (40%) positive rates for benzodiazepines in urine samples from drug-related arrests in the San Francisco Bay area. Yacoubian, in his 1997 study of Philadelphia drug arrests, identified benzodiazepines as commonly used with other major illicit drugs[21]. Makkai suggested the prevalence of benzodiazepines may also reflect their use in opiate dependence management programs, self-treatment of anxiety disorders, and the treatment of other mental problems[5]. There seems to be a common cause, suggesting that further study is needed to clarify the use of these drugs in society.

In our study, a significantly larger number of benzodiazepine users than opiate and amphetamine users were arrested in recreational places – indicating benzodiazepine's popular use as a recreational drug. This is consistent with Lua's rave party participants findings[9], among whom he registered an 11% positive rate for benzodiazepines. Considering the limited sensitivity of the REMEDi profiling system to benzodiazepines, especially flunitrazepam (which may be more problematic at low dosages), the actual abuse rate for benzodiazepines may be higher than that indicated and deserves further exploration.

Other drugs, although detected at lower rates, are also worth noting. These include ephedrine, methyl ephedrine (cough control), phenylpropanolamine (mainly a weight loss drug), pethidine (a pain reliever), methadone, phenobarbital, tramadol, oxymorphone, fentanyl, pentazocine and secobarbital. These drugs were also reported in an emergency screening study done in the Taipei area in 1992~1993[26]. These drugs may be involved in abuse,

albeit to a lesser extent, and deserve to be examined more closely in the future.

Prevalence estimates have been a fundamental component of policy and decision-making for drug-control authorities. The findings in this study provide data on conventional drug (opiates and amphetamines) use in relation to club drug (MDMA and ketamine) use that may be applicable to evidence-based prevention and/or treatment programs. The difference in user profiles for different drug types highlight the need for more sophisticated approaches in dealing with users of different drugs.

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