The trend of drug abuse in Taiwan during the years 1999 to 2011

Shu-Fen Lee, Jui Hsu, Wen-Ing Tsay*

Food and Drug Administration, Ministry of Health and Welfare, Executive Yuan 161-2, Kuen Yang Street, Nangang, 115 Taipei, Taiwan, ROC

Abstract

Drug abuse has become one of the major public health issues in the world. In this study, we surveyed the laboratory analytical data of urine and non-urine cases collected through the Analytic Laboratory Drug Abuse Report System (ALDARS) and estimated the illicit drug use trends in Taiwan from 1999 to 2011. These samples were collected from suspects who were arrested for possessing and/or taking illicit drugs. Descriptive statistics were used to report the distribution rate and patterns of drug abuse. In addition, linear regression was applied to determine the trends of drug abuse. The results showed that methamphetamine was the most widely used illicit drug. The heroin abuse situation might have been under control, but that of ketamine may have become worse. Furthermore, an increasing trend was observed for the abuse of "designer drugs" since 2004. Phenylalkylamines was the main "designer drug". Chloroamphetamine (CA) was first notified in 2009. Subsequently, the drug has been experiencing an abuse situation, although it was considered to show no abuse potential. In summary, this study could further predict that ketamine and "designer drugs", such as phenylalkylamines and synthetic cannabinoids, might remain popular among drug users in Taiwan. The prevalent status of the emerging drugs in Taiwan and that in Western countries may be synchronized.

1. Introduction

Since the middle of the 20th century, drug abuse has become a major public health problem, with a great deal of consequences throughout society. The problems derived from drug abuse involve injuring one’s physical health, rising crime rates and numbers of victims of domestic violence, increasing prevalence of infectious illnesses (including HIV/AIDS, hepatitis B virus, and hepatitis C virus), joblessness, homelessness, and failure in school. According to the World Drug Report 2012 of the United Nations Office on Drugs and Crime (UNODC), the global drug abuse population accounts for 230 million in the world [1]. In Taiwan, approximately 1.43% of persons aged 12–64 years (252,000 people) used drugs at least once in 2009 [2].

Between 1990 and 2002, studies were performed using drug urine tests on arrested individuals in Taiwan. The results showed that amphetamines and opiates were the major illicit
drugs. More amphetamine positives were found relative to opiate ones [3,4]. In 2002, the cases of 3,4-methylenedioxy-N-methamphetamine (MDMA) and ketamine abuse were less than those of amphetamines and opiates. MDMA and ketamine users were younger than amphetamine and opiate ones [4].

The data gathered from laboratory analytical results can provide opportune information on the current status of drug abuse. It can support drug scheduling efforts [5] and can also help in policy decisions on drug abuse prevention. In Taiwan, the Analytic Laboratory Drug Abuse Report System (ALDARS) can systematically and fully gather nationwide identification of cases, including urine and non-urine samples, which were collected from suspects arrested for possessing and/or taking illicit drugs. The system can associate information from these cases, which were analyzed by national forensic laboratories including the Taiwan Food and Drug Administration (TFDA), municipal governments, county and city health bureaus, the Ministry of Justice Investigation Bureau, the National Police Administration Criminal Investigation Bureau, the Armed Forces Police Command, as well as certified urine drug testing laboratories. The ALDARS was developed and previously managed by the National Bureau of Controlled Drug (NBCD). After 2010, the NBCD, the Bureau of Food Safety, the Bureau of Pharmaceutical Affairs, and the Bureau of Food and Drug Analysis were consolidated into TFDA. All missions of the NBCD were transferred to the TFDA.

In Taiwan, the Statute for Narcotics Hazard Control is an ordinance to regulate the manufacture, purchase, possession, or distribution (sale, trade, or gift) of illicit drugs. Illicit drugs are classified into four schedules according to their potential for addiction, abuse, and harm to society. A person will be arrested and punished if he/she takes illicit drugs that are listed in Schedules 1 or 2 of the Statute. There was no punishment for a person who takes Schedules 3 or 4 illicit drugs until May 2009.

On the basis of making an effective policy on drug enforcement and drug abuse prevention, this study aimed to estimate the situation of drug abuse using the data from the ALDARS from 1999 to 2011. It not only provides detailed information on the prevalence and types of controlled drugs and emerging drugs, but also can be used to support drug scheduling decisions.

2. Methods

2.1. Data sources

This study estimated the illicit drug use trends from 1999 to 2011, using analytical data from the ALDARS. The data from ALDARS consisted of information on the urine tests of drug abusers and drug seizures. These samples were collected from suspects who were arrested for possessing and/or taking illicit drugs. In total, 738,540 urine samples and 370,106 non-urine cases were surveyed. Fig. 1 presents the total cases of urine and non-urine samples annually from 1999 to 2011.

2.2. Statistical analysis

Data analysis was performed with the Statistical Package for the Social Sciences (SPSS) Statistics 17.0 for Windows (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to report the distribution rate and patterns of drug abuse. In addition, linear regression was applied to determine the trends of drug abuse. The beta coefficient was only reported as significant if the p value was less than 0.05.

2.3. Restrictions of study

The laboratories would submit the results of the seizures that contained drugs and substances to ALDARS. Because the
positive rate of seizures cases could not be showed, this study presents the distribution rate of special drugs in the total specimen instead of its positive rate.

Urine samples are considered biological specimens. After drug consumption, the parent drugs or their metabolites can be detected in urine samples. However, the concentrations of drugs and their metabolites in urine are affected by several factors, including the time of collection of urine, the amount of drug, the frequency of abuse, fluid intake, body shape, metabolic factors [6], and the analytical methods used. In Taiwan, the regulations governing urine testing operations for drug abuse are applicable to test and judge illicit drugs in urine samples, which need to be analyzed with an initial test and/or a confirmatory test. However, the initial and confirmatory tests for emerging drugs have not been developed. Therefore, the status of abuse of emerging drugs in urine samples was not be surveyed in this study.

3. Results and discussion

3.1. Multiple drug abuse

The objective of this study was first to survey the situation of multiple drug abuse. Fig. 2 shows the estimated distribution percentage of a single drug that was identified in a urine or non-urine sample. From 1999 to 2011, the distribution percentage of a single drug identified in non-urine samples was considerably varied, while that identified in urine samples decreased during the period of 1999 to 2006, but increased from 2007.

From 2003 to 2011, there is a big difference in the trends of multiple drugs between urine and non-urine samples. Codeine can be detected in the urine samples of heroin users because street heroin contains codeine [7]. As shown from the distribution percentage of urine samples containing morphine (a metabolite of heroin) versus codeine (Fig. 2), it could be inferred that heroin seizures might always involve codeine and heroin abusers who use heroin with other drugs, such as codeine [6].

3.2. The most common drugs of abuse

Fig. 3 shows the distribution rate of the top four most commonly identified drugs including methamphetamine, heroin, ketamine, and MDMA in urine and non-urine samples from 1999 to 2011.

3.2.1. Methamphetamine

As shown in Fig. 3, from 1999 to 2011, the distribution percentages of methamphetamine identified in urine and non-urine samples were over 47% and 25%, respectively. From 1999 to 2001, these distribution rates were higher than those of heroin, but lower from 2002 to 2008. However, an increasing trend was observed since 2009. In addition, decreasing trends were observed from 1999 to 2001, but trends fluctuated considerably in the period from 2002 to 2011. Linear regression was applied, and the estimated beta coefficient of the trend of urine samples was −0.018 with a p value less than 0.05 (data not shown).

In the early 1990s, methamphetamine was the predominant drug of abuse, and it remained steady into the late 1990s [6]. Moreover, from the data collected by the law enforcement agency, the seized quantities of methamphetamine and its precursors have remained in first or second place since 1999. In short, it could indicate that the population who used methamphetamine has diminished and maintained a stable status. However, methamphetamine remained the primary illicit drug of concern.
3.2.2. Heroin
The percentage of heroin identified in urine samples was over 50% from 2002 to 2008 (Fig. 3). It showed a fluctuating trend, which has decreased since 2009. In the period from 2003 to 2008, the distribution rate of heroin seizures remained a considerably fluctuating trend, but it decreased since 2009.

The abuse of heroin, the most problematic drug type, has been under control recently. Regarding the statistics from the Taiwan Centers for Disease Control, the injection of illicit drugs has been the primary risk factor for HIV infection since 2004. To reduce the prevalence of HIV infection among injection drug users, the drug abuse prevention strategies on harm reduction were implemented and the drug reuse prevention centers were established under the county or city government in 2006. Linear regression was applied to determine the trends of drug abuse from 2006 to 2011. The estimated beta coefficients of urine and non-urine samples were $\beta_1 = 7.91$ and $\beta_2 = 8.55$, respectively, and their $p$ values were less than 0.05 (data not shown). These results indicated a significantly descending trend of heroin abuse.

3.2.3. Ketamine
The study found that the distribution rates of ketamine in urine and non-urine samples have been increasing since 2000 (Fig. 3). Linear regression was applied to assess the status of drug abuse from 1999 to 2011. The estimated beta coefficients of urine and non-urine samples were $\beta_1 = 0.17$ and $\beta_2 = 0.023$, respectively, and both $p$ values were less than 0.01 (data not shown), indicating a worsening situation of ketamine abuse over years.

In Taiwan, the number of ketamine seizures has been rising at an alarming pace. The abuse of ketamine has risen since the early 2000s [8]. Club drugs, such as MDMA and ketamine, are the most widely used at night clubs, Karaoke Television (KTVs), and dance parties to enhance social intimacy and sensory stimulation. Ketamine, a structural analog of phencyclidine, is always taken with MDMA. It can produce hallucinations and out-of-body subjective experiences similar to near-death experiences. Due to its anesthetic effect, ketamine has abuse potential [9]. One illicit drug peddler alleged that the use of ketamine is not a crime because it has no addiction potential and it does not display the hazards of heroin. Moreover, owing to its low cost, the main age group of ketamine users consists of persons aged below 29 years [10]. Due to curiosity, young people usually use it for amusement and share it with friends. Consequently, ketamine abuse has become a serious problem among young people in Taiwan.

3.2.4. MDMA
The study found that MDMA experienced an epidemic in 2002, but the level of abuse decreased and remained stable from 2005 to 2010. However, it increased slightly in 2011 (Fig. 3). MDMA was used as the most popular club drug. The World Drug Report noted that MDMA has sprung up again in some countries since 2011 [1], implying that MDMA might regain its popularity after 2011.

3.3. Abuse of emerging drugs
"Designer drugs" can be defined as unregulated new psychoactive substances whose chemical structures have been slightly altered from that of a controlled drug. The effects of these substances were shown to be similar to their parent compounds [11]. These drugs are evolving rapidly and characterized by a large variety. As shown in Fig. 4, an estimated 32 types of “designer drugs” were discovered in Taiwan from 2004 to 2011. About two-thirds of these drugs were notified after 2009. It showed that the types of “designer drugs” abused might have become varied since 2009, with a trend similar to that of other countries [11].

"Designer drugs" have been an ongoing challenge to law enforcers and public health. This study showed that the estimated number of seizure cases involving emerging drugs increased from two in 2004 to 977 in 2011. About the linear regression result, the estimated beta coefficient was 129 and its $p$ value was less than 0.001 (data not shown). This indicated that the use of emerging drugs has been increasing.
3.3.1. Phenylalkylamines

According to the categorization by Wohlfarth and Weinmann [14], most notable “designer drugs” are categorized as phenylalkylamines in Taiwan. As shown in Fig. 5, phenylalkylamines were the primary emerging drugs of abuse. The estimated number of cases involving phenylalkylamines increased from two in 2004 to 872 in 2011. The estimated beta coefficient was 74 and its p value was 0.01 (data not shown). As shown in Fig. 6, the four classes of phenylalkylamines found mainly included monomethoxy derivatives, dimethoxy derivatives, beta-keto compounds, and halogen-containing compounds.

From 2004 to 2007, monomethoxy derivatives such as para-methoxyamphetamine (PMA), para-methoxymethamphetamine (PMMA), and para-methoxymethamphetamine (PMEA) were distributed among drug users in Taiwan. These drugs appeared on the designer market since 1973 in foreign countries [15–17] and have been slowly notified since 2004 (Fig. 4). They exhibit hallucinogenic and stimulant properties [14] and are sold in tablet form labeled as “ecstasy” [18]. Their usage peaked in 2007 but experienced a decline from 2008 to 2011 (Fig. 6). PMMA was the main designer drug (Fig. 7). From April to July 2006, eight fatal intoxications involving PMMA ingestion were reported [18]. PMMA was not added to the list of illicit drugs under Schedule 3 of the Statute for Narcotics Hazard Control until August 2006. Its usage began to decrease after 2007.

From 2008 to 2010, dimethoxy derivatives were used among drug users in Taiwan. Subsequently, the use of dimethoxyamphetamine (DMA) became widespread. As shown in Fig. 4, dimethoxy derivatives such as 2C series, which were first notified in 1980 in other countries [19], were first reported in Taiwan in 2004. Their usage peaked in 2008 and declined from 2009 to 2010. Subsequently, the use of DMA has increased since 2009 (Fig. 7). In Taiwan, 2C–B was first noted in 2004 as a main designer drug (data not shown). It was classified under Schedule 3 of the Statute for Narcotics Hazard
Control list in December 2005. An epidemic trend was observed from 2006 to 2009, which may be attributed to the fact that a person who took Schedule 3 or 4 illicit drugs was not punished before 2009. On the other hand, DMA is regulated in Schedule 2 of the Statute for Narcotics Hazard Control list. However, due to its amphetamine-like stimulating effect [14], the use of DMA has begun to rise sharply since 2009.

Beta-keto compounds, which are analogs of MDMA, MDEA, and MBDB, exhibit amphetamine- and MDMA-like effects. Recently, these compounds have become a global phenomenon [14]. As shown in Figs. 4 and 6, seven new beta-keto compounds have been notified and displayed a sharply increasing trend since 2009. Both methylene and mephedrone experienced a significant increase from 2010 to 2011 (data not shown). Mephedrone was added as a controlled drug in July 2010. The status of mephedrone abuse decreased sharply in 2011. By contrast, methylene was not scheduled in the Statute for Narcotics Hazard Control list until September 2011. It is predicted that the usage of methylene might decrease in the future.

Halogen-containing compounds might be the next popular “designer drugs”. Drugs like chloroamphetamine (CA), fluoroamphetamine (FA), and fluoromethamphetamine (FMA) can produce central nervous system-stimulating effects like amphetamines [20,21]. CA was recognized to have no abuse potential [22]. The study showed that CA was first reported in April 2009 (Fig. 4) with a total of 775 cases identified from 2009 to 2011 (Fig. 6). It was illegally manufactured or synthesized in some clandestine laboratories. The detection and identification of CA in urine samples was also reported [23]. CA has been regulated in Taiwan since June 2011. As far back as 2005, FA abuse was first reported [21]. Subsequently, a large number of drug preparations containing FA were seized [24,25]. The study showed that FA abuse in Taiwan was first reported in August 2010, after which the number of cases increased to 11 in 2011 (data not shown). FMA abuse was first reported in Austria [26] in August 2011 (Fig. 4) and eight cases were reported (data not shown). According to a prior study, FA and FMA had been analyzed in human biological samples [27] and seizures [26], which indicated that these drugs might have abuse potential.

3.3.2. Synthetic cannabinoids

At present, synthetic cannabinoids have become more popular among drug users since their detection in legal herbal blends that were substituted for cannabis [14]. As shown in Fig. 4, there were six types of synthetic cannabinoids, including CP47,497, JWH-018, JWH-073, JWH-250, JWH-081, and JWH-203, found between 2010 and 2011 (data not shown). Mephedrone was added as a controlled drug in July 2010. The status of mephedrone abuse decreased sharply in 2011. By contrast, methylene was not scheduled in the Statute for Narcotics Hazard Control list until September 2011. It is predicted that the usage of methylene might decrease in the future.

3.3.3. Piperazines

Piperazines act as stimulants and/or hallucinogens [11]. As shown in Fig. 4, both benzyl-piperazine and 3-trifluoromethylphenylpiperazine were circulated among drug users from the beginning of the 21st century [28] and were first found in 2009. Subsequently, 1-(3-chlorophenyl) piperazine appeared in 2010. The estimated number of cases increased from 25 in 2010 to 95 in 2011 (Fig. 5). The effects of these drugs are similar to that of cannabis. In Taiwan, marijuana is never the main drug of abuse. In fact, with the increasing number of tourists, foreign laborers, and foreign spouses in Taiwan, the behavior of drug abuse might gradually be assimilated abroad.

3.3.4. Tryptamines

The abuse of tryptamines, which have hallucinogenic effects [14], was also found in Taiwan. 5-methoxy-N,N-dimethyltryptamine (5-MeO-DiPT), also known as “Foxy” or “FoxyMethoxy”, is the most commonly used “designer drug” among homosexual drug users in Taiwan. The abuse of this drug exhibited a fluctuating trend (data not shown). The drug was added to the list of illicit drugs in Schedule 3 of the Statute for Narcotics Hazard Control in 2011.
4. Conclusion

This study first reviewed the situation of drug abuse according to the data collected through ALDARS from analytical laboratories in Taiwan. ALDARS can systematically and fully gather nationwide identification results of cases including urine and non-urine samples. These samples were collected from suspects arrested for possessing and/or taking illicit drugs.

The study showed that methamphetamine remains the primary drug of abuse. The status of heroin abuse is recently under control, while that of ketamine has worsened. In addition, the abuse of CA is experiencing an epidemic in Taiwan. Phenylalkylamines are the main emerging drugs of concern and their abuse is increasing sharply. Synthetic cannabinoids might be one of the ongoing popular “designer drugs”. Above all, it is predicted that ketamine might remain popular, and the trend of abuse of emerging drugs in Taiwan has been synchronized with those of Western countries. In addition, “designer drugs” with stimulant and hallucinogenic effects would experience an epidemic in the future if the authority is short of policy to regulate them.

REFERENCES


