Toxicological assessment of the role of alcohol and drugs in drug-facilitated sexual assault cases in New Zealand

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Abstract

This report details the toxicology profile of victims of drug facilitated sexual assault (DFSA) in New Zealand from 2015-2018. This study represents all of the toxicology results for DFSA cases in New Zealand during this time period, of which there were 161 cases. Blood and urine samples were screened for legal and illicit drugs in addition to testing for alcohol and correlating alcohol concentration with sampling delay. Our results indicate that increased delay in sampling time resulted in a corresponding decrease in alcohol concentration. In victims who had declared alcohol use but of which none was detected, the average sampling time was 14 hours for blood and 17 hours for urine which is in excess of the average sampling delay for even the lowest alcohol positive samples. The most frequently detected alcohol concentration was in the range of 51-80mg/100ml for blood and 121-200mg/100ml for urine with an average sampling time of 8.5 and 6.5 hours respectively. We also examined acetone concentrations in alcohol positive samples and our results indicate that 82% of blood alcohol positive samples contained acetone at concentrations between 5-10 mg/L and 68% of alcohol positive urine samples contained acetone at a concentration greater than 20 mg/L. It may be that the nature of sexual assault affects an individual's metabolism of alcohol and results in increased acetone production. Cannabis was the most commonly detected illicit drug, followed by methamphetamine. In relation to medicinal drugs there was a high usage of antidepressants and antipsychotics suggesting the victims may have been people of vulnerable personality. Based on case information it does not appear there are any cases where stupefaction by unknown administration of a drug has occurred, instead loss of consent through voluntary alcohol and drug consumption is more common and poses a greater risk than surreptitious drug administration.

Keywords: DFSA, New Zealand, Alcohol, Acetone,

Introduction

The classic portrayal of drug facilitated sexual assault (DFSA) is the administration of drugs like Rohypnol (flunitrazepam), Valium (diazepam) or gamma-hydroxybutyrate (GHB) into an unsuspecting victim's drink. In practice the spiking of drinks with specific "date rape" drugs such as Rohypnol is a rarely encountered scenario in forensic toxicology. A far more common form of sexual assault is through impaired consent. This is often the result of excess alcohol consumption or recreational drug use. Loss of consent due to voluntary intoxication is still classified as DFSA. As a result, the types of drugs detected in DFSA cases typically reflect the most prevalent drugs used in the area and population. Though recreational and medicinal drugs have a significant representation in DFSA cases, alcohol is widely accepted as the major contributor to this offense. Critically, delays in reporting sexual assault has led to under reporting of alcohol in DFSA cases, with samples collected for analysis beyond the recommended 24 hour time limit enhancing the possibility of false negatives [1, 2]. Recent research has indicated the key role of rapid sample collection [blood (<24 h), urine (72 h)] for alcohol analysis and also highlighted alcohol as the primary substance associated with DFSA [3].

The purpose of this study was to examine DFSA cases reported to authorities in New Zealand that may have involved the use of alcohol, illicit and licit drugs. The need for data relating to commonly abused substances and their trends in DFSA cases are vital given that New Zealand has recorded an increase in drug convictions over the past two years, along with 36% of 18-24-year olds reporting higher rates of harmful drinking. Furthermore, 27% of all drug related convictions were for people convicted of being in possession or of using substances in 2017 [4].

With a population of approximately 5 million, estimates for the social cost of drug-related harms and interventions, as reported by the New Zealand Ministry of Health for the year 2014/15, was 1.8 billion NZD, with government spending approximately 230 million NZD per annum in response to this issue

[5]. Research has suggested a growing usage of cannabis, with 80% of New Zealand's adolescent population using cannabis by the age of 21 and a further 10% reporting dependency. Studies focusing on the indigenous Polynesian people (Māori) show that 63% of adults report to having used cannabis between the ages of 16-64 years [6], while a road traffic toxicology study in New Zealand indicated that cannabis was the most widely detected recreational drug in suspected drugged drivers [7]. It is therefore likely that cannabis will also play a key role as an intoxicating agent in DFSA cases. While in relation to sexual assault, a systematic worldwide review found that, of the 7231 cases analysed and 412 estimates of non-partner sexual violence covering 56 countries, New Zealand ranked third highest alongside Australia [8]. Literature analysis for DFSA cases pertaining to New Zealand remains limited, however a population-based survey of 16,480 New Zealanders showed significant involvement of alcohol in over half of the sexual and physical assaults reported [9].

This study is the first detailed forensic toxicology assessment of the role of alcohol, illicit and medicinal drugs in sexual assaults in New Zealand. It was carried out on samples submitted by the New Zealand Police (NZ Police) from 2015 and to 2018. The Institute of Environmental Science and Research (ESR) New Zealand has laboratories in Auckland, Wellington and Christchurch that carry out all forensic analyses for the NZ Police including any analyses required for DFSA cases. The Toxicology Laboratory, which is based in Wellington, carries out the testing of blood and urine samples from DFSA victims for evidence of alcohol and/or other drug use. The objective of this study is to assess the most commonly encountered illegal drugs, what extent sampling time affects the detection of and the concentration of alcohol, the role of medicinal drugs in sexual assault, and to consider the significance of the presence of acetone in alcohol positive samples. Specifically we wished to identify what percentage of blood and urine samples contained acetone and if possible determine if this could be a phenomenon linked to the emotional and physiological stress endured by victims of DFSA.

Materials & Methods

Sample collection for toxicology analysis & data criteria

The following is a brief outline of how sexual assault cases are handled by ESR. The Forensic Toxicology laboratory in Wellington carries out all of the toxicology testing for the NZ Police for the whole of New Zealand. Information obtained from the NZ Police website, giving statistics for the 24 months from January 2016 to December 2017, indicate that there were 11042 sexual assault complaints. The types of complainants are not detailed, but given the number we could expect that they might cover the full range from inappropriate touching to rape. Typically, but not always, a medical examination is carried out on the complaint of sexual assault. These examinations are performed by specially trained doctors utilising a specific medical examination kit. In New Zealand, the Medical Sexual Assault Clinicians (MEDSAC) have laid out the guidelines for the treatment of victims of sexual assault. These guidelines prioritise the victim's care and ensure that all forensic sampling is only performed on a voluntary basis. A full forensic examination includes samples from the hair, surface of the skin, intimate swabs, blood and urine. Urine samples are analysed up to 72 hours after an alleged assault, when sampling time is longer than this, analysis of a head of hair sample taken at least six weeks after the alleged assault is recommended. All forensic examinations are performed on case and victim specific basis. Therefore, the judgement of what samples to take or areas to examine will be made by the forensic medical examiner on a case by case basis. Samples are then submitted, when deemed appropriate, to ESR for analysis. Not all medical examinations include taking blood or urine for toxicological testing and even when such samples are taken testing is not always required. A centralised laboratory management system was introduced at ESR in December

2015; from this 162 cases of sexual assault were identified that had blood and/or urine toxicology testing.

Case samples that are submitted for analysis are accompanied by a 15 page document filled in by the doctor during the medical examination detailing any trauma, samples taken, demeanour, and commentary on loss of memory. Of relevance to toxicology is the time and date of alleged incident, the time and date of blood and urine sampling, declared use of alcohol and drugs/medication both pre and post the time of the alleged assault. Details of the analysis techniques performed on these samples is described below. Briefly alcohol and volatile analysis is carried out using head space gas chromatography with flame ionisation detection (HSGC-FID). Analysis for evidence of drug use involves initial parallel screening of blood by immunoassay screening for cannabis use and of blood and/or urine extracts by liquid chromatography with time of flight mass spectrometric detection (LC-TOFMS) for a wide range of medicinal drugs and drugs of abuse. Analyses for some specific analytes are carried out by gas chromatography with mass spectrometric detection (GC-MS) or liquid chromatography with tandem mass spectrometric detection (LC-MSMS).

In this study we have separated our findings into blood samples and urine samples that were positive for the listed drugs and alcohol concentration. This study does not delineate between polydrug use or distinguish on a case by case basis, but rather gives an overview of the presence of the drugs in urine and blood and in the case of alcohol, the concentration and collection time.

Headspace gas chromatography with flame ionisation detection (HSGC-FID)

This method can detect ethanol at levels down to 1 milligram per 100 millilitres, although anything less than 5 milligrams per 100 millilitres is reported as a trace. This technique is used for all suspected drunk driver cases, coronial cases and other criminal cases. This technique can also detect acetone to levels below one milligram per litre (mg/L) although levels below 10 mg/L are rarely reported. A calibration curve for acetone is not routinely run in analytical batches, so all acetone concentrations

are considered approximate. For this report all acetone levels have been rounded to the nearest 5 mg/L.

Immunoassay

This technique is used to screen for evidence of cannabis use in blood. Any samples giving 'not negative' results are analysed by LC-MSMS to confirm the presence of THC. All the other drugs traditionally screened for by immunoassay, such as opiates and benzodiazepines, are detected by the LC-TOFMS screen. A urine immunoassay may be used to screen for amphetamines, benzodiazepines, barbituates, cannabis, cocaine, methadone and opiates. The urine immunoassays screens for a standard range of drugs and their sensitivity is determined by the manufacturer's instructions (Immunalysis ™), these kits screen for opiates including codeine, morphine and 6-MAM. For benzodiazepines the following drugs aminoclonazepam, aminonitrazepam. aminoflunitrazepam, hydroxy-alprazolam, oxazepam, nordiazepam, temazepam are typically detected in this screen. Immunoassay results that are not confirmed by LC-TOFMS, are confirmed by other specific LC-MSMS methods.

Liquid chromatography with time of flight mass spectrometric detection (LC-TOFMS).

Both blood and urine samples undergo a liquid-liquid extraction which isolates basic and neutral drugs as well as some acidic ones. The spectral data collected for each sample is compared to a number of separate in-house databases which contain information about a wide range of illicit and medicinal drugs. The LCMSMS detection limits in blood for most drugs is 0.01 mg/L, for THC the limit is 0.2 ng/mL. The LC-TOFMS limits of detection are variable depending on the drug type but for the vast majority of analytes the LOD is less than 0.02 mg/L. Urine samples are not typically hydrolysed when LC-TOF analysis is carried out, but may be for LCMSMS analysis. Glucuronides are not screened for. The number of drugs in these databases has increased to over 2000 with the inclusion of many of the new psychoactive substances. While these databases may give an indication

of the use of some new drugs, the presence of a drug is only reported if an authentic reference standard is run as part of the same analytical batch as the sample.

Gas chromatography with mass spectrometric detection (GC-MS)

This technique is used to look for evidence of stupefaction by gamma-hydroxybutyrate (GHB), gamma-butyrolactone (GBL) or 1, 4 butanediol (1,4B). As GBL and 1,4B form GHB in the body, blood and/or urine may be analysed for the presence of GHB using a liquid-liquid extraction followed by derivatisation step. This analysis would only be carried out if there had been a short time delay, less than 6 hours for blood, less than 12 hours for urine, and there were claims of memory loss or unusual stupefaction, not explained by excessive alcohol use. This GC-MS technique was recently supplanted by a validated LC-MSMS method that detects GHB. It should be noted that in these sexual assault cases GHB has only been detected when the drug was willingly taken.

Liquid chromatography with tandem mass spectrometric detection (LC-MSMS)

LC-MSMS is used for the confirmation of cannabis use, as the LC-TOFMS method is not able to detect THC at levels associated with normal use. An LC-MSMS method is also used to confirm the presence of methamphetamine as the LC-TOFMS method does not provide sufficient unique fragments. Since 2018 blood and urine samples have also been extracted and routinely screened by LC-MSMS and LC-TOFMS for evidence of the use of a range of synthetic cannabinoids, those known to be currently available in New Zealand or available in the past. This method can also detect carboxy-THC.

Results

This study details the toxicological findings of 162 cases of DFSA in New Zealand submitted by the NZ Police from December 2015 to 2018 and is the first complete nationwide study of its kind. Of the 162 cases, 159 were female, 3 were male, and the age range of the victims was 12-55 years old with a median age of 22 and an average age of 25 years. The time delay is measured from the reported cessation of the assault to the time of sample collection. It should be noted that these times are an

estimation based on the victim's statement and recollection of events. Therefore these times should be considered an approximation. In addition to this, some sexual assaults are carried out over a long period of time. For 160 cases (2 cases did not have sampling time information), this delay ranged from 2-93 hours, with an average time delay of 16 hours and a median time to sampling of 10 hours. For 130 of the 162 cases the time delay was less than 24 hours.

Quantitation of alcohol in samples of suspected victims of sexual assault.

Of the 162 cases submitted for alcohol analysis 76 were positive for alcohol in blood and/or urine. In total 51 blood samples and 76 urine samples were alcohol positive (Table 1 & 2). The most frequently detected concentration range in blood was 51-80 mg/100mL. At blood alcohol levels greater than 20 mg/100mL, alcohol is eliminated at a fairly consistent rate. It is often possible in these cases to determine the approximate BAC at the time of the alleged assault. For example, using an average delay to sampling time of 7.4 hours, by back calculating using an average elimination rate of 19 mg/100mL, the alcohol concentrations at the time of incident could have been approximately 140 mg/100mL greater then what was detected in blood.

There appears to be a clear correlation between sampling time and alcohol concentration. In blood samples the highest concentration range relates to the shortest sampling time while the longest sampling time correlates with the lowest blood alcohol concentration (BAC). In urine the two longest sampling times correlate with the two lowest concentrations of urine alcohol while the two shortest sampling times correspond to the highest alcohol concentration. In nearly all cases the victims declared their alcohol use. By contrast in cases where alcohol was declared and not detected (data not shown), the average sampling time was significantly higher. The average sampling time of 17 hours for urine and 14 hours for blood, are both higher than the average sampling time of the lowest alcohol ranges detected in this study. These results highlight the significance of timely sample collection as alcohol, the most commonly encountered drug in DFSA cases, is frequently undetected and reported

in the literature as alcohol negative, which in turn underestimates the scale of alcohol's true involvement in these case types.

Quantitation of acetone in samples of suspected victims of sexual assault.

This is the first study to assess acetone levels in victims of sexual assault. We investigated what percentage of alcohol positive samples contain acetone. The analytical technique used by ESR clearly distinguishes between ethanol and acetone but some analytical techniques may not be able to separate the two compounds. Acetone is naturally produced via the Acetyl-Co-A pathway (a typical energy metabolic pathway), particularly during ketogenesis. Ketone bodies are formed by the breakdown of fatty acids and ketogenic amino acids, brought on by low blood glucose levels, they occur commonly by fasting, in type 1 diabetics and in alcoholics after prolonged binge-drinking without intake of sufficient carbohydrates. Our results indicate that 34 of the 51 alcohol positive blood samples contained acetone, with the most common acetone concentrations (82%) being detected between 5-10 mg/L in blood (Table 3). In urine, 52 out of the 76 alcohol positive samples contained acetone, with the most frequently detected acetone concentrations (62%) ranged between 5-60 mg/L in urine (Table 4). These results suggest that in both blood and urine samples there is a high percentage of acetone positives in victims of sexual assault, although the exact reasoning and mechanism for this remains to be elucidated. Our results are noticeably higher than other studies which have measured basal levels of acetone in both alcohol positive samples and in subjects exposed to acetone rich environments [10, 11].

Analysis of illicit drugs detected in potential cases of drug facilitated sexual assault.

This study examined what the most common drugs of abuse were in suspected cases of sexual assault (Table 5). Our results indicate that cannabis is the most frequently detected drug, having been detected in 31 blood samples and 15 urine samples. In this study 42 suspected victims of sexual assault admitted cannabis use (including 3 cases of synthetic cannabinoids), but in 11 cases no

cannabis was detected. The average sampling time for these cases was 15 hours. Due to its geographical location, New Zealand has traditionally not been an area of pronounced cocaine abuse; typically the abuse of this drug is on a much smaller scale than in relation to other English speaking and culturally similar countries such as Australia, United Kingdom, Ireland, United States and Canada. In this study there were no samples positive for cocaine. There were two cases of admitted cocaine use but the sampling time in both cases was greater than 20 hours. By contrast methamphetamine is the second most commonly encountered drug in DFSA cases in New Zealand. Methamphetamine was detected in 12 blood and 18 urine samples. Unlike cannabis there were fewer admissions of methamphetamine use, with only 9 cases of admitted use and the 10 cases where methamphetamine was detected but not declared. There were also a small number of cases of MDMA (3 in total) and 2 cases of other illicit drugs; these were both related to glue sniffing. As with several other recent studies [12, 16, 17, 18], the most common drugs of abuse are the most frequently detected, regardless of their pharmacology or their perceived suitability as date rape drugs.

Analysis of medicinal drugs detected in potential cases of drug facilitated sexual assault.

We examined the role of antidepressants, antipsychotics, analgesics/painkiller and benzodiazepines in the samples of suspected victims of DFSA. The most commonly detected medicinal drug were drugs of the antidepressant, anticonvulsant and antipsychotic class. These drugs were detected in 28 blood and 41 urine samples (Table 6). The three most frequently encountered drugs in this category were citalopram, which was detected in 8 blood and 10 urine samples, all but one case declared their use. Fluoxetine was the second most commonly detected drug which was found in 6 blood and 8 urine samples, all but two cases declared their usage of this drug. Quetiapine was the third most frequently detected drug in this category, being present in 4 blood and in 5 urine samples and all but one case declared their usage. Other detected drugs in this category included venlafaxine and risperidone. Opiates and analgesics were also commonly encountered with codeine being detected in 5 blood and

10 urine samples. Tramadol was found in 2 blood and 6 urine samples, while morphine was found in 1 blood and 2 urine samples.

Benzodiazepines were detected in 14 blood and 21 urine samples. The most frequently detected benzodiazepine was diazepam, which was found in 6 blood and 9 urine samples. For 2 of the blood samples and 4 of the urine samples usages were not declared by the complaint. Lorazepam was detected in 4 blood and 5 urine samples and was only declared in one case. Clonazepam was detected in 3 blood and urine samples and not declared in only one case. Other benzodiazepines/sedatives that were present in this study include zopiclone and alprazolam. The high detection of benzodiazepines, antidepressant and antipsychotics in this study suggests the complaints were suffering from anxiety, depression and of a vulnerable personality.

Discussion

This study is the first to identify the toxicology profiles of complaints of DFSA in New Zealand. We determined what the most common concentration ranges of alcohol were in potential victims of sexual assault. The effect of time delay between incident and sampling on alcohol concentration was also examined. Additionally, we have investigated the prevalence and concentration of acetone in alcohol positive blood and urine samples, while also analysing the drug profile of the most frequently encountered illicit and medicinal drugs.

This research suggests that alcohol is one the major facilitators of sexual assault, a phenomenon that has been well described in numerous other studies [2,12, 13, 14, 15,16]. The major challenge of determining the role of alcohol in DFSA cases is for blood and urine samples to be collected as soon as possible. It should be recommended that these samples be taken in the first stages of the medical examination, if not earlier. In this study we have focused on detailing the correlation between decreasing alcohol concentration and increased delay to sampling time. The results show that the samples with the highest alcohol concentration are associated with the shortest time delay in sample

collection. Several studies have linked increased BAC to increased risk of sexual assault [12, 17-21]. Our results indicate the majority of the complainants BAC were in the ranges of 51-80 mg/100mL & 81-120 mg/100mL (Table 1). Although these are not unduly excessive BAC, the average delay to sampling time was 8 and 7 hours respectively. Therefore it is reasonable to assume that the BAC at the time of the incident would be significantly higher and closer to what would be typically considered a BAC consistent with intoxication. In urine, where alcohol clearance is reduced compared to blood, nearly half of the alcohol positive samples (47%) were contained within the two highest concentration ranges of 121-200 mg/100mL and >200 mg/100mL (Table 2).

This is one of two toxicology studies to examine the rate of acetone positives in the blood and urine of suspected rape victims. A previous study by Wigmore *et al* [25], introduced the concept that acetone may be increased in victims of sexual assault. This study proposed that the incidence of acetone is upregulated tenfold in sexual assault victim's samples. Wigmore *et al* suggested that this phenomena was linked to the increased release of stress hormones and catecholamines and that the presence of acetone was more common in sexual assault victims with visible trauma compared to those without. Furthermore, it was postulated that sampling time had a significant impact on the incidence of acetone in samples, typically samples that were collected after 10 hours showed higher concentrations of acetone than samples that were collected rapidly [25]. Those results correlate with the findings of our study that indicates that the average sampling time for acetone positive samples, for both blood and urine regardless of concentration, was always ≥10 hours. It should also be noted that Wigmore *et al* also suggested that acetone was decreased in alcohol positive samples compared to alcohol free samples, by contrast this study has focused on the incidence of acetone in alcohol positive samples as a potential interpretative issue for forensic toxicologists.

Acetone can occur as a by-product of alcohol metabolism or through endogenous metabolic pathways. During alcohol metabolism alcohol dehydrogenase acts as the primary metabolic enzyme and is responsible for the oxidation and conversion of alcohol into acetaldehyde. It is well established that

liver alcohol dehydrogenase (ADH) is a relatively nonspecific enzyme capable of using nicotinamide adenine dinucleotide (NAD) to reversibly convert primary, secondary, aromatic alcohols to their corresponding aldehydes and ketones. It may be that individuals who are under extreme physiological and emotional stress, such as victims of sexual assault, show deviations in their metabolism of alcohol that favourably increases the production of acetone. In general, the presence of acetone is not unusual in coronial samples or in individuals with metabolic disorders such as diabetes. This study however, indicates that 82% of blood alcohol positive samples contained acetone at concentrations between 5-10 mg/L and 68% of urine alcohol samples contained acetone at a concentration greater than 20 mg/L (Table 3 & 4). A previous study by Wang *et al* relating to acetone exposure in an acetone rich environment indicated that 95% of people have an endogenous blood acetone level of less than 2 mg/L [10]. A road traffic toxicology study by Jones *et al* examined acetone concentrations in suspected drunk drivers, their results indicated that the median concentration of acetone in alcohol positive subjects was 2.34 mg/L and 1.26 mg/L in control, both of which are noticeably lower than the results of this study [11]. This suggests that the acetone concentrations detected in this study are elevated. These findings may be of significance for casework practitioners. If the presence of acetone is more common in the samples of DFSA victims this could play a significant role in both the analysis and interpretation of toxicology results. It should be noted that these acetone positives cases are unusual and not commonly seen in other case settings in New Zealand. Our laboratory analyses over 4000 samples each year, taken from drivers either hospitalised following a crash or drivers who elect to have a blood sample taken following a failed road side breath test. It is extremely rare to see acetone in these samples or to see acetone expressed at the concentrations found in this study, suggesting that this phenomena is unique to cases of suspected sexual assault. At this point it is too early to determine how prevalent this trend is in suspected sexual assault samples, but future studies may help elucidate and define this phenomenon.

One of the major challenges of assessing the role of drugs in DFSA is placing the presence of the drugs in a sexual assault victim's sample into context. Drugs which are found in DFSA samples may

not be “specific” to this offence but rather a reflection of the general availability and drug use in that geographical location at the time. The other major factor is identifying covert drug administration versus voluntary recreational drug consumption. As in the case of alcohol, ingestion of certain drugs may impair the victim’s ability to give informed consent and although this is still correctly classed as DFSA, it is a different context from drink spiking and covert drug administration. For this reason we have tried to define the context in which drugs are consumed so that covert spiking and recreational drug use can be identified separately and the most common drug in each setting be correctly assessed. This categorisation is critical to rectify many of the misconceptions that surround DFSA. Our results indicate that cannabis is the most commonly detected illicit drug followed by methamphetamine (Table 5). These findings are in agreement with several other studies [12, 14, 22, 16, 23, 24] in the US, Canada and Europe, with the only significant difference being the absence of cocaine from samples in this study. This reflects the relatively limited use of cocaine in New Zealand in contrast to Europe and North America. Instead methamphetamine is more frequently abused. The results of this study correlate with previous research in our laboratory that indicates cannabis and alcohol are the most commonly used recreational drugs in motorists in New Zealand [7]. In terms of recreational drug use, the trends detected in this road traffic study broadly reflect the same trends of drug use in suspected sexual assault cases, while unpublished data since 2009 of drugs in New Zealand motorist has shown no change in these findings. In addition, recent research has highlighted the increasing usage of methamphetamine and synthetic cannabinoids since 2016/17 [26].

Both cannabis and methamphetamine are unlikely to have been administered unknowingly and pharmacologically do not produce the classic symptoms of a date rape drug, such as unconsciousness and amnesia. Equally the typical route of administration used for both drugs makes it unlikely that they have been administered surreptitiously. This is seen by the fact the majority of cannabis positive cases in this study had declared their usage. By contrast significantly fewer methamphetamine cases were accompanied by an admission of use, likely due to the legal and social implications associated with methamphetamine abuse in comparison to cannabis.

One of the major findings of this study was the high volume of antipsychotics, anticonvulsants and antidepressants found in samples of suspected victims of sexual assault (Table 6). The presence of medicinal drugs in the samples of claimants of DFSA is not unusual; numerous studies have reported high usage of benzodiazepines in these cases types. In this study, both in terms of admitted use and of sample positives, the presence of antidepressants and antipsychotics was far in excess of benzodiazepine use. This is significant as individuals suffering from mental health issues are more likely to be victims of sexual assault, due to their increased vulnerability and circumstances. Equally, the pharmacology of many antidepressant and antipsychotic drugs is such that, when they are used in conjunction with other recreational drugs and alcohol, they elicit a synergistic and potentiating pharmacological effect which may make it more likely that the individual is unable to give informed consent. Despite this, the case details from the medical evaluation of these samples do not suggest there are many, if any, cases where stupefaction by unknown administration of a drug has occurred. Although information is unreliable, particularly about medication, there are several cases of excessive alcohol consumption and knowingly taking an unknown pill. This suggests, that the major cause of DFSA is victims knowingly taking alcohol, recreational drugs and/or in combination with medicinal drugs and subsequent impairment of judgement and/or consent to sexual activity.

Conclusion

The majority of drugs detected in this study reflect those of common usage rather than a specific set of “date rape drugs”. This study also suggests that alcohol and increased BAC positively correlates with DFSA and by decreasing the time to sampling enables detection of higher blood alcohol concentrations. In addition, acetone is highly prevalent in alcohol positive urine and blood samples and may be linked to differential metabolism of alcohol in victims of sexual assault due to stress and trauma. The use of illicit drugs was in line with those commonly used by the general population. There was however a high usage of antidepressants and antipsychotics which has both toxicological and social implications for the profile of victims of DFSA. Our results suggest that loss of consent

through voluntary alcohol and drug consumption is more common and poses a significantly greater risk to victims than surreptitious drug administration.

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figure captions

Figure 1: Representation of number of blood alcohol positive samples recorded for each concentration range. Samples reported to be above the legal drink drive limit of 51 in New Zealand are those within the range of 51–120 mg/100 mL.

Figure 2: Representation of number of urine alcohol positive samples recorded for each concentration range.

Figure 3: Blood and Urine alcohol concentrations. Recorded concentration levels of alcohol detected in the blood and urine and the corresponding sample collection time. Urine samples typically had a longer sampling delay than blood.