Review: The involvement of gamma-hydroxybutyrate in reported sexual assaults: a systematic review

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Abstract

Over the past few years gamma-hydroxybutyrate (GHB) has generated widespread media interest as a possible 'date rape drug'. Our goal was to examine the extent to which GHB is associated with drug-facilitated sexual assaults. Literature was searched systematically and 11 studies, published between 1961 and June 30, 2009, were identified dealing specifically with the role of GHB in sexual assaults. GHB was detected in 0.2–4.4% of reported sexual assaults. The results demonstrate that a wide range of drugs may be present in cases of sexual assault, and many of them are much more frequent than GHB. Our results do not support the widespread labelling of GHB as a date rape drug as the prevalence of GHB is much lower than of other substances used in sexual assaults. On the other hand, however, the possible risk of GHB in this regard should not be neglected. Nevertheless, over-sensitive and sensation seeking media reports focusing on the association of sex crime and GHB might be counterproductive and misleading as they turn the attention away from other substances that are often used in sexual assaults.

Keywords

Date rape, drug-facilitated sexual assault, GHB

Introduction

Gamma-hydroxybutyrate (GHB) has become a popular illicit drug in the last two decades. GHB was synthesized in 1961 by the French surgeon Henri Laborit (Laborit, 1964) with the intention of creating a new and more effective drug in the field of anaesthesiology. From this time forth, interest in GHB escalated in various fields. Based on its sedative effect and its prolonged effect on slow (delta)-wave sleep, it was prescribed in cases of sleep disturbance (Broughton and Mamelak, 1979). It was also used as a possible antidote to alcohol withdrawal symptoms (Gallimberti et al., 1989; Saitz and O'Malley, 1997). GHB is claimed to enhance sexual functioning; however, Nicholson and Balster (2001) stress that this needs to be confirmed as the sexual effect is most likely due to the disinhibition caused by GHB. Bodybuilders have also discovered GHB, because it stimulates the production of growth hormone (Rigamonti and Muller, 2000), promotes muscle growth and decreases body fat (Nicholson and Balster, 2001).

Significant risk can be associated with GHB. Among Australian GHB users for example a study found that over half of the participants (53%) had overdosed at some time (Degenhardt et al., 2002). The addictive characteristics of GHB have also been revealed. In the mentioned Australian study, 4% of respondents were classified as dependents: GHB certainly has the ability to produce tolerance and dependence, though these effects do not appear to be as easily induced as with classical sedative hypnotic drugs and they occur only in cases of high dosage for a longer period (Galloway et al., 1997). Today, as a result of the appearance of alternative drugs, the medical application of GHB is either under strict control or totally excluded from medical practice in almost all European countries (European Monitoring Centre for Drugs and Drug Addiction, 2002). While analysing the risks of GHB it should not be neglected that the licit sodium oxybate form of GHB, called Xyrem, is an approved, controlled substance available on the US market. It is also a central nervous system depressant with abuse potential, therefore a risk management programme was developed to promote its safe use, which includes compulsory educational materials for patients, special trainings for pharmacy staffs etc. (Fuller et al., 2004).

Use of GHB in the world of bodybuilding and other sports spread to the party culture during the 1990s (Gonzalez and Nutt, 2005). Its euphoric and disinhibiting effects, its potential for enhancing sociability, the relative easiness of production and its low price rapidly made it a popular drug on the recreational scene (European Monitoring Centre for Drugs and Drug Addiction, 2002; Korf et al., 2002; Van Sassenbroeck et al., 2003; Rodgers et al., 2004; Demetrovics, 2009). Other studies, though confirming that the most common use of GHB

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is recreational, also emphasize that GHB is primarily taken in private homes rather than in clubs (Sumnall et al., 2008). Based on anecdotal data, in some cases GHB is supposedly used as a substitute for drinking alcohol, but combined consumption with alcohol is also attractive (Korf et al., 2002). GHB users are at greater risk if they combine GHB with alcohol because alcoholic beverages may potentiate the effects of GHB, and, likewise, high doses of GHB may also amplify the effects of alcohol (Nicholson and Balster, 2001; Scott-Ham and Burton, 2005).

GHB has become a widely known drug following several reports in the media – based on police or medical reports – associating the substance with cases of sexual assault (Hindmarch and Brinkmann, 1999). The media labelled GHB as a 'date rape drug' to refer to its possible facilitating role in sexual assaults, although many of these cases are clearly not 'dates' (Scott-Ham and Burton, 2005). However, it lacks any scientific or legal definition of what substances can be considered date rape drugs. In scientific literature the term 'drug-facilitated sexual assault' (DFSA) is preferred, which can be defined as 'the use of a drug, noxious substance or chemical agent to facilitate sexual contact' (Scott-Ham and Burton, 2005: 175). The term 'alleged drug-facilitated sexual assault' is also common in the scientific literature though in our understanding it has a negative, offender focused connotation implying that the victims are potentially lying. Therefore we favour the term 'reported sexual assault'.

The cases described in the media generally involved the same scenario. In a bar or a club, GHB was supposedly spiked into a girl's drink, which had a sedative effect on her, and later, when she regained consciousness, she realized that she has been sexually assaulted (Schwartz et al., 2000). Based on the characteristics of GHB, this scenario is possible and it makes it less risky to perpetrate the crime. GHB is a colourless, highly soluble substance, and therefore it can easily be ingested without the victim noticing it, although its bitter or salty taste makes it possible to recognize it (Korf et al., 2002; Degenhardt et al., 2005). It is also important that GHB has a rapid effect. Its half-life is 30 minutes and it can be detected in urine samples for up to 8–12 hours and in plasma for up to 4–5 hours (Ferrara et al., 1992).

Following such media reports, many experts rapidly shared the view that GHB is an extremely dangerous substance that increases the prevalence of sexual assaults. In connection with the possible risks mentioned, several experts proposed more careful screening for GHB, suggested supplying treatment and counselling centres with GHB-sensitive test kits and proposed running training programmes for doctors, nurses, pharmacists and college counsellors (Smith, 1999; Hensley, 2002). Hindmarch and Brinkmann (1999) for example reported on an educational campaign for youth organized by the Hoffman-La Roche healthcare company to warn of the dangers of drug-assisted sexual assault. The U.S. Department of Health and Human Services Office on Women's Health (2008) has also created educational materials on 'rape drugs' such as GHB, ketamine and flunitrazepam.

Though these efforts are unquestionably important, there is still hardly any scientific data telling us to what extent this phenomenon might be present. Some studies have been published, however, that question the danger of GHB use and have suggested the possibility that this problem is a 'myth' partly created by the mass media (Hindmarch, 1999; Deveaux et al., 2002; Jansen and Theron, 2006).

Objective

The aim of our study, in connection with the above-mentioned problem, was to determine to what extent available data support the use of GHB in sexual assaults by means of a systematic review of the scientific literature.

Methods

Inclusion criteria and search strategy

All studies that provided any type of empirical data on the relationship between GHB use and sexual assault and had been published in English, French, German or Spanish in peer-reviewed journals or scientific books were considered for inclusion. We included in the analysis all studies – research papers, case studies and review articles – that contained any new clinical or empirical data on this issue.

For the review of the literature we searched the following databases: PsycINFO, MEDLINE, PubMed, Science Direct, the Web of Science and EBSCO. The search was restricted to the period between 1 January 1961 (GHB was synthesized in 1961) and 30 June 2009. The electronic search was executed using the combination of the keywords 'GHB', 'sex*' and 'rape'. This combination identified 30 articles on PsycINFO, 140 on MEDLINE, 143 on PubMed, 17 on Science Direct, 11 on the Web of Science and 124 on EBSCO. Excluding the overlap between the six databases, we identified 194 studies altogether.

Exclusions

In the case of 66 articles the keyword GHB referred to glycated haemoglobin (GHb) and not gamma-hydroxybutyrate (GHB), and therefore these articles were excluded from further analysis. Out of the remaining 128 articles, 109 proved to be appropriate in terms of the keywords, but in fact dealt with other aspects of sexuality independent of our topic (e.g. GHB use by homosexual men) or examined other fields of GHB use and only superficially mentioned the issue of sexuality. Ultimately, 19 studies fitting our search criteria were identified. At this point, however, the electronic search was supplemented by a manual search. This meant that we reviewed the reference list of each of the identified studies and thus we were able to complement our database with all of those further studies that had not shown up in the electronic search. This review of the references resulted in the identification of three further studies.

Thus in total 22 articles were identified that dealt with the relationship between GHB use and sexual abuse or unwanted sexual behaviour. However, half of these did not fit our inclusion criteria for the following reasons. Three studies did not directly examine the relationship between GHB use and sexual assault, but the perception of the phenomenon. A further seven publications dealt with the question in general and did not provide any new data concerning the issue, while one

review (Smith, 1999) was excluded partly because of methodological considerations, and partly because it did not present factual information or new results.

Analysis and interpretation

As shown in Table 1, only 11 publications fulfilled the criteria for inclusion. Of these 11 publications, two presented case studies, while the other nine publications described a total of five studies or data collection processes. The results of the different phases of a single data collection programme carried out in the USA were reported in three articles (ElSohly and Salamone, 1999; Hindmarch and Brinkmann, 1999; Hindmarch et al., 2001). Similarly, studies published by the French Health Products Safety Agency (AFSSAPS, 2005, 2007, 2008) presented the results of the toxicological analysis of samples collected during three separate data gathering intervals (2003–2005, 2005–2006, 2007). In the three remaining publications, the results of three independent investigations were described: one regarding data from the USA (Slaughter, 2000), one regarding France (Deveaux et al., 2002), and one concerning the UK (Scott-Ham and Burton, 2005).

Methodology

The studies showed great heterogeneity in many methodological characteristics as well as in their quality. The most problematic issue was that in the case of four samples data were not restricted to sexual assault. Deveaux et al. (2002) compiled the data from six laboratories, of which two regularly performed GHB tests and the other four performed tests on request. Four categories were created to identify the context and aim of GHB use: to raise achievement in sport, to enhance mood at rave parties, to commit a crime (e.g. sexual assault) and unidentified emergency cases. However, there was no information on how many of the drug-positive cases were related to each category, which makes it difficult to interpret the results. A similar problem was faced in the three studies of AFSSAPS (2005, 2007, 2008), which were launched for three years in succession to report on a national investigation about claimed drug-facilitated crime based on the data collected by various hospitals and police forces. During the three years 910 cases were collected. However, the studies lack any description of the sampling method and information about the time interval between the incident and sampling, and no information was given about the breakdown of GHB-positive cases in different types of crime (sexual assault, physical violence etc.). Because of these shortcomings data from these four studies can be considered only as indicative, and the studies do not provide exact data on the prevalence of GHB in sexual assault. For this reason, though we report the findings of these studies, they will not be included in the overall summary of the results.

All studies applied gas chromatography-mass spectroscopy (GC-MS) for the detection of GHB. Two studies (Deveaux et al., 2002; Scott-Ham and Burton, 2005) analysed both blood and urine samples, while all other studies used only urine samples for analysis (Table 1). The presence of GHB is, however, just as precisely detectable in urine samples as in blood samples. Furthermore the collection of urine samples is a more simple and non-intrusive method, and the time available for the detection of GHB is longer, and therefore this aspect has no real significance for the results (Scott-Ham and Burton, 2005). One important methodological consideration though is the time elapsed between the assaults and sampling. As shown in Table 1, the number of samples analysed within 24 hours varied greatly between studies. Given the short half-life of GHB, however, this is of great importance, because samples acquired after 24 hours may significantly contribute to the underestimation of the prevalence of GHB.

Besides testing for GHB, the incidence of other drugs in the body of the victims was tested in all studies – except for the study by Deveaux and colleagues (2002) and the latest publication from AFSSAPS (2008).

The prevalence of GHB among victims of sexual assault

Based on the literature review the prevalence of GHB detected in cases of sexual assault varied between 0.2% and 4.4%. The four studies from the USA (ElSohly and Salamone, 1999; Hindmarch and Brinkmann, 1999; Slaughter, 2000; Hindmarch et al., 2001) reported relatively consistent results. According to them, the rate of GHB-positive samples among victims of reported sexual assault was between 3% and 4.4%. At the same time in the UK, the significantly lower prevalence of 0.2% was found (Scott-Ham and Burton, 2005). The study by Deveaux et al. (2002) – having severe methodological deficits mentioned above – reported a 1% prevalence rate, while studies by AFSSAPS showed a rate of 2.3% for the period 2003–2005, 0.2% for 2005–2006 and no cases in 2007 (AFSSAPS, 2005, 2007, 2008).

Other drugs identified among victims of sexual assault

In the selected studies 35.0%–40.9% of the cases did not identify any drug in the body of the victims. The prevalence of alcohol consumption was by far the highest, at between 37.0% and 46.4%. However, the quantity of alcohol consumed was unfortunately not reported in any of the publications. Concerning other psychoactive substances the prevalence of cannabis was between 18.2% and 25.6%, while in the case of cocaine it was between 7.7% and 10.8%. The AFSSAPS study found the prevalence of alcohol use to be 36.4% in 2003–2005 and 13.6% in 2005–2006. The prevalence of cannabis use was 26.3% in 2003–2005 and 6.5% at the time of the next data collection, while cocaine was found in 2.3% of the samples in 2003–2005 and in 0.2% in 2005–2006. Deveaux et al. (2002) did not report on the prevalence of substances other than GHB.

Co-occurrence of GHB and other drugs

The use of other substances in combination with GHB varied greatly. In the case of the GHB-positive cases studies reported the presence of another drug in between 37% and 84% of cases. Hindmarch et al. (2001) found that 39 out of the 100 GHB-positive cases contained other drugs as well. Although alcohol has by far the highest prevalence among all

Table 1. Summary of the selected studies' main results

Reference	Year of data collection	Country	Article type	Sample description	Time interval	Quality of methodology	Prevalence of GHB (standard error at 95% CI)[a]	Prevalence of alcohol (standard error at 95% CI)[a]	Prevalence of cannabis (standard error at 95% CI)[a]	Prevalence of cocaine (standard error at 95% CI)[a]	No substances identified (standard error at 95% CI)[a]
ElSohly and Salamone, 1999	May 1996–June 1998	USA	Research	1179 urine samples collected from victims of alleged sexual assault from 49 states	68.3% within 24 hours, 97.8% within 72 hours	High	4.1% (3.0–5.2)	38.3% (35.5–41.1)	18.5% (16.3–20.7)	8.2% (6.6–9.8)	39.7% (36.9–42.5)
Hindmarch and Brinkmann, 1999	June 1996–May 1998	USA	Research	1033 urine samples collected from victims of alleged sexual assault from 49 states	86.1% within 48 hours[b], 97.5% within 72 hours	High	4.4% (3.1–5.7)	37.0% (34.1–39.9)	18.5% (16.1–20.9)	7.7% (6.1–9.3)	40.9% (37.9–43.9)
Hindmarch et al., 2001	June 1996–February 2000[c]	USA	Research	3303 urine samples collected from victims of alleged sexual assault	73.0% within 24 hours, 98.8% within 72 hours	High	3.0% (2.4–3.6)	41.1% (39.4–42.8)	18.6% (17.3–19.9)	8.4% (7.5–9.3)	38.7% (37.0–40.4)
Slaughter, 2000	May 1996–March 1999	USA	Research	2003 urine samples collected from victims of alleged sexual assault	71.8% within 24 hours, 98.4% within 72 hours	High	3.3% (2.5–4.1)	41.0% (38.8–43.2)	18.2% (16.5–19.9)	8.3% (7.1–9.5)	39.1% (37.0–41.2)
Scott-Ham and Burton, 2005	January 2000–December 2002	UK	Research	1014 blood and urine samples of claimed drug-facilitated sexual assault cases	73.8% within 24 hours, 88.9% within 48 hours	High	0.2% (0–0.5)	46.4% (43.3–49.5)	25.6% (22.9–28.3)	10.8% (8.9–12.7)	35.0% (32.1–37.9)
Deveaux et al., 2002	No data	France	Research	300 blood and urine samples collected from different forensic cases	Mean time of sampling 12–48 hours	Low	1.0% (0–2.1)[d]	No data available	No data available	No data available	No data available
AFSSAPS, 2005	October 2003–March 2005	France	Research	258 urine samples collected from victims suspected to have taken drugs voluntarily or involuntarily	No data available for the entire sample	Low	2.3% (0.5–4.1)[d]	36.4% (30.5–42.3)[d]	26.3% (20.9–31.7)[d]	2.3% (0.5–4.1)[d]	No exact data available
AFSSAPS, 2007	May 2005–December 2006	France	Research	432 urine samples collected from people suspected to have taken drugs voluntarily or involuntarily	No data available	Low	0.2% (0–0.6)[d]	13.6% (10.4–16.8)[d]	6.5% (4.2–8.8)[d]	0.2% (0–0.6)[d]	No exact data available
AFSSAPS, 2008	2007	France	Research	220 urine samples collected from people suspected to have taken drugs voluntarily or involuntarily	No data available	Low	0%	No data	No data	No data	No exact data available
Stillwell, 2002	–	USA	Case report	48-year-old Caucasian woman claiming to be victim of sexual assault	>12 hours	–	–	–	–	–	–
Varela et al., 2004	–	Spain	Case report	20-year-old woman claiming to be victim of sexual assault	No data	–	–	–	–		–

[a]Standard errors are calculated by the authors.
[b]No exact data about the number of samples taken within 24 hours.
[c]An extension of Hindmarch and Brinkmann, 1999.
[d]No data about the proportion of victims of alleged sexual assault among all cases.

substances detected in sexual assault, a striking finding of this study was that no cases were detected containing GHB in combination with alcohol. Drugs present in GHB-positive samples included cannabis, cocaine, amphetamines, benzodiazepines and often their various combinations. The authors emphasized that the majority of these drugs could not have been ingested without the victim's awareness. ElSohly and Salamone (1999) presented an even higher rate of co-occurrence of GHB and other drugs. A total of 84% of the 48 cases that tested positive for GHB also contained other licit or illicit drugs such as alcohol (33.3% of the GHB-positive cases), cannabis (20.1%), benzodiazepine (20.1%), and cocaine (8.3%). Slaughter (2000) reported that 62.7% of all GHB-positive samples contained no other drug; however, the types of drug present were not specified in the study.

Case reports

One important finding of our review is the low number of case reports published in scientific journals on GHB used for sexual assault. With respect to the wide media interest in GHB as a potential date rape drug it is surprising that only two case reports have been published on this issue.

Stillwell (2002) reported a case history of a 48-year-old Caucasian woman in the USA who met a man through the Internet. They met at her home and the man offered her a bottle of sports drink containing some relaxing health products. After consuming the drink she fell unconscious and recovered after four hours. 'During that time the victim's physical perception was that she was subjected to nonconsensual sexual intercourse while she was unconscious due to the effects of the mixture she had consumed.' (Stillwell, 2002: 1133). The publication, however, does not mention whether sexual intercourse was confirmed by medical examination. The laboratory results were positive for GHB.

Varela et al. (2004) described the case of a 20-year-old woman in Spain who reported at the emergency department of a hospital that she had probably been sexually assaulted the night before when she had gone out to a club. She had two non-alcoholic drinks and smoked cigarettes but she did not consume any illegal drugs. She claimed that 'she had a gap in her memory. Her next memory was that she woke up in bed in a strange flat with two unknown men who took her to the street, left her, and disappeared.' (Varela et al., 2004: 255). The GHB test was positive, but no alcohol or other drugs were detected in the urine sample.

Discussion

A systematic review of the literature shows that intensive attention from the media has not stimulated scientific attention to the same extent regarding examination of the relationship between GHB use and sexual assault. GHB was synthesized nearly half a century ago and has now been present on the recreational scene for approximately two decades and has gained a dubious reputation during this time primarily due to its supposed role in sexual assaults. In spite of this, a total of two case studies and nine empirical studies have reported data on this issue. The latter present five data collections limited to three countries: the USA, the UK and France. Apparently, this field is difficult to examine. However, this might explain the low number of empirical studies and the methodological problems and shortcomings, but cannot be a reason for the lack of case studies as well. Nevertheless, another aspect can also contribute both to the low number of studies on this issue and especially to the fact that all relevant studies were published very recently, in the past 10 years. Namely, the development of GHB monitoring in urine and plasma samples using GC-MS occurred only in the early 1990s (Ferrara et al., 1993).

The sedative and disinhibiting properties of GHB make it a desirable agent and an understandable choice for perpetrators of sex crimes (Schwartz et al., 2000; Scott-Ham and Burton, 2005; Jansen and Theron, 2006). Based on the above-mentioned data, however, such use of GHB is not frequent. Studies from the USA have identified the rate of GHB-positive cases among victims of reported sexual assault as being between 3% and 4.4%. Scott-Ham and Burton (2005) found a significantly lower prevalence (0.2%) in the UK, which might partly be explained by the fact that given the presence of endogenous GHB in the body the authors considered a case positive if the concentration of GHL was greater than the recommended cut-offs of 5 and 10 μg/ml in blood and urine, respectively. The available French data showed a similarly low prevalence, though due to methodological problems we have to treat these results carefully. Notwithstanding the low prevalence of GHB, alcohol use was reported to be between 37% and 46.4% among the victims. This rate greatly exceeds the prevalence of all other illicit substances. It is important to mention that none of the studies included in this review reported on blood alcohol level in victims. Future research needs to provide data on the level of alcohol in victims to better understand the relation between alcohol use and DFSA and to validate the concern that heavy drinking carries the highest risk for young women to become a victim of sexual assault.

Nevertheless, we have to be careful when interpreting these results because the detection and reporting of GHB positive cases face a double burden. First, the short half-life and thus fast breakdown of GHB (Nicholson and Balster, 2001) might cause underestimation of the real prevalence of the substance. It is true, however, that there is a similar risk for alcohol, with its similarly rapid breakdown rate (Scott-Ham and Burton, 2005). However, in the case of other substances with slower breakdown (e.g. cannabis) it is possible that the results include consumption greatly preceding the assault, and thus the prevalence of these drugs in relation to the unwanted sexual behaviour might have been overestimated. Second, another distorting factor is that only 10–15% of victims report sexual assault (Girard and Senn, 2008). Victims of sexual assault are usually reluctant to make an accusation or ask for help because of their fear of stigmatization and feelings of guilt and shame (Koss and Dinero, 1989; Kimerling and Calhoun, 1994). A further hindrance in reporting the perpetrator to the police is the fact that the majority of the offenders are not strangers but acquaintances (Slaughter, 2000) and that GHB impairs short-term memory (Grove-White and Kelman, 1971), making the process of prosecutions even more difficult both for the victim and the authorities.

A central statement in the news is that GHB gets into the body of the victim without her being aware of it. Though direct data are not available on this issue, it is possible to draw a few deliberate conclusions based on the identified substance use patterns. While the scenario of spiking the substance into a drink cannot be totally disproved in cases of victims consuming only GHB, based on the results of Hindmarch et al. (2001) the possibility of spiking GHB into an alcoholic beverage is very unlikely given that authors did not find a single case in which only alcohol and GHB were detected in the sample. However, data are hardly available on the voluntary–involuntary aspect of GHB use. Only Scott-Ham and Burton (2005) report an estimated prevalence about the involuntary use of GHB, stating that only 2% of the sample was attributed to involuntary ingestion. Though this estimate is only based on a low number of GHB positive cases. Nevertheless, the results reported by Korf et al. (2002) based on interviews with Dutch GHB users also support this finding; most GHB users (96.7% of women) had had sexual contact under the influence of GHB and 6.7% reported unwanted sex in this state. It is important to emphasize, however, that victims used GHB wilfully in these cases. Another important aspect, in accordance with the results of Sumnall et al. (2008), is that GHB is not only a club drug, but its use is highly linked to after-parties held in somebody's home and home parties with friends and acquaintances in general. In relation with this it is not surprising that the perpetrator of the sexual assault usually belongs to the victim's circle of acquaintanceship, and therefore the victim is not raped by a stranger (Korf et al., 2002). This fact, while also possibly contributing to the low number of recorded cases, on the other hand draws attention to the differences between the real scenario and the scenario described by the media. According to the latter scenario, GHB is spiked into the drink by a stranger who later rapes the victim, who has lost consciousness; though based on real reports it is far more likely that the sexual act happens during common use of GHB between acquaintances, friends or even former sexual partners (Korf et al., 2002).

Another important aspect to mention, also connected with the discussion above, is the attribution of responsibility. A general belief of our society states that women bear the responsibility for the regulation of a sexual interaction between a man and a woman (Burt, 1980; Hensley, 2002). Hence, paradoxically, victims of sexual assault often have to face the fact that they are the ones who are made responsible for the crime. Studies stress that female university students using substances for recreational purpose who subsequently become the victim of sexual assault are exposed to particularly deep scorn and that their social judgment is even more negative if they cannot remember what has happened (Perreault et al., 2005; Girard and Senn, 2008). Involuntary ingestion of drugs, however, basically modifies the social judgment of victims' culpability or responsibility. Girard and Senn (2008) and Angelone et al. (2007) highlight the fact that women who are assaulted while under the effect of GHB are not considered responsible; involuntary sedation of victims relieves them of the unjust social stigma. This might be a reason why victims tend to live with the suspicion that GHB had been spiked into their drinks and in this way they might raise the prevalence of GHB-related sexual assault.

In conclusion, besides the low prevalence of GHB, there are still cases in the studied samples in which GHB was identified as the only substance present in the victim's body. These results confirm that GHB should still be considered as a drug that could be used in sexual assault. On the other hand, however, it also has to be emphasized that there is a variety of drugs that can be used in this type of crime. The image of GHB as a dangerous drug suggested by reports in the media is rather misleading and harmful because this may shift public attention away from other substances, in particular from alcohol, which are more strongly associated with sexual assault (Slaughter, 2000; Nutt, 2006). In addition to alcohol the above-mentioned studies have identified approximately 20 different types of drug in the bodies of the victims, meaning potential risks for sexual assault. The problem therefore should require attention in general and should not specifically address GHB, whilst preventive interventions should deal generally with DFSA and not only the relationship between sexual assaults and GHB. Though the emergence of GHB has great significance with regard to focusing attention on the problem of DFSA, in the future it would worth treating the phenomenon from a broader perspective and considering GHB as only one of the many possible substances used in sexual assaults.

In addition, it has to be mentioned that poly-drug use involving GHB may vary in different countries and among different population groups. For instance, a large body of literature reports on the characteristics of GHB use and the co-occurrence of the use of GHB and metamphetamine or other types of drug among homosexual men (Halkitis and Palamar, 2006; Parsons et al., 2007; Grov et al., 2008), which has not been included and discussed in this review, should, however, be analysed in the future.

While new drugs appear on the market to incapacitate victims for the purpose of carrying out sexual assault, it is a great challenge to empirical research to give a precise picture of these developments. The reluctance of the victims to report a sexual assault to law enforcement agencies is only one side of the problem. On the other side, due to the rapid elimination of GHB and the deficits in the monitoring system of DFSA cases, GHB use is underreported. First, free and easy access to rape test kits containing a specimen bottle for a urine sample should be considered so that samples can be collected nearer to the time of the assault. Second, to foster empirical research a new conceptual framework is needed for a better monitoring of DFSA and for developing appropriate responses. As is stated in a recent review of the European Monitoring Centre for Drugs and Drug Addiction, 'Monitoring and reducing the incidence of drug-and alcohol-facilitated sexual assaults should be accompanied by changes in the law, better methods of forensic analysis and better training and support for criminal justice personnel and hospital emergency staff' (Olszewski, 2008: 15).

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