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REVIEW ARTICLE

A Systematic Review of Materials Used in Sexual Violence against Women

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KEYWORDS

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ABSTRACT: Drug-facilitated sexual assaults (DFSA) are crimes that remain largely underrecognized by the public and may not receive sufficient attention from health and legal policymakers. The primary objective of this systematic review was to investigate individuals affected by drug-facilitated sexual assault (DFSA) in order to inform the development of effective health and policy strategies. To conduct this study, a comprehensive search was performed for relevant studies published between 2018 and 2021. The search followed PRISMA guidelines and was conducted in internationally recognized databases, including Web of Science, Science Direct, Scopus, PubMed, and Google Scholar. A total of 39 studies that met the inclusion criteria were selected for analysis. The findings of the review revealed that the most commonly identified substances involved in DFSA were alcohol, benzodiazepines, cannabinoids, methamphetamine, and amphetamines. In contrast, traditional drugs were found to be used less frequently by perpetrators. Most hospitals used liquid chromatography-mass spectrometry (LC-MS) and gas chromatography-mass spectrometry (GC-MS) for substance identification. Additionally, blood and urine were the most commonly analyzed biological matrices for detecting these substances. Based on the findings, it can be concluded that alcohol and various drugs, including benzodiazepines, cannabinoids, methamphetamine, and amphetamines, were the most frequently associated with drug-facilitated sexual assaults. These results highlight the need for targeted health and policy interventions to raise awareness and mitigate the occurrence of DFSA.

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INTRODUCTION

Accurately quantifying the true incidence of sexual violence continues to pose significant methodological and reporting challenges. Several factors contribute to this difficulty [1]. Victims often hesitate to report due to embarrassment, lack of support, or fear of discouragement [1]. Additionally, the time elapsed between the incident and the report can affect the accuracy of data [2]. The delay in collecting biological evidence for analysis further complicates the process [2]. Furthermore, many substances used in such cases have a short half-life. These drugs are quickly metabolized and removed from the victim's body, leaving no trace. This makes detection and diagnosis more difficult [1, 2].

Violence against women is a multifaceted social phenomenon, marked by profound moral, cultural, political, and religious complexities, and often interpreted through a wide range of theoretical frameworks and perspectives [3]. Violence against women is widely recognized as a significant public health concern and has been acknowledged as such by the World Health Organization (WHO) [4].

Sexual violence is one of the most pervasive and severe manifestations of gender-based violence, underscoring the deep-rooted power asymmetries within gender relations [3,5]. It encompasses a range of acts, including rape, attempted rape, sexual assault, indecent exposure, and harassment. These forms of violence frequently occur alongside other physical abuses, such as bodily harm, attempted femicide, domestic abuse, and threats [6].

Sexual violence is a widespread global issue that transcends boundaries of gender, age, ethnicity, and socioeconomic status, and has persisted across various historical and cultural contexts [7]. While it can affect individuals of all genders, women remain disproportionately impacted throughout the course of their lives [8]. Notably, girls and adolescent females are particularly vulnerable to experiencing sexual violence during their early developmental stages [7–9].

Sexual violence has profound and lasting consequences for both physical and psychological health, with effects that can emerge in both the short and long term [10]. Immediate physical outcomes may include unintended pregnancy, genital tract trauma, and the transmission of sexually transmitted infections (STIs) [10]. In the longer term, survivors often experience gynecological complications and sexual dysfunction [11]. Moreover, a history of sexual violence is strongly associated with an increased risk of mental health disorders, including depression, panic attacks, suicidal ideation, substance abuse, and addiction [10,11].

Due to the seriousness of this issue, sexual violence has been defined as a global public health problem by the Pan American Health Organization (PAHO) and WHO due to the violation of human rights and the psychological and social effects it causes on victims [6].

Sexual violence against women can manifest in various forms, one of which involves the administration of behavior-altering substances to facilitate assault [12]. Commonly referred to as "date rape drugs," the use of such substances has increased in recent years, largely due to their subtle sensory characteristics that allow them to be surreptitiously mixed into beverages or ingested unknowingly by victims [13]. Consequently, drug-facilitated sexual assault (DFSA) has emerged as a growing public health concern [14]. However, accurately estimating the prevalence of DFSA remains difficult, as many victims delay reporting, do not seek immediate medical care, or miss the critical window for toxicological testing [15].

Furthermore, substances implicated in DFSA are frequently co-administered with ethanol, producing overlapping toxicodynamic effects that can obscure clinical evaluation and lead to misdiagnosis as simple alcohol intoxication [16,17]. In such instances, the assault typically occurs when the victim—rendered incapacitated or unconscious due to alcohol, drugs, or other psychoactive agents—is unable to resist or provide informed consent [16,17].

Given the clinical, forensic, and public health relevance of this issue, the present study aims to review the literature on substances involved in drug-facilitated sexual violence

against women. It further seeks to examine the pharmacological properties of these agents, including their pharmacokinetics, mechanisms of action, duration of detectability in the human body, and the forensic methodologies employed for their identification.

MATERIALS AND METHODS

This study was conducted as a systematic review of relevant literature published between 2018 and 2021. The search strategy adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and was carried out across internationally recognized databases, including Web of Science, ScienceDirect, Scopus, PubMed, and Google Scholar. A total of 39 studies that fulfilled the predefined inclusion criteria were selected for data extraction and subsequent analysis. Studies were excluded if they lacked appropriate statistical analysis or were review articles. The inclusion criteria for study selection encompassed the following:

- Published articles whose title is the evaluation of sexual assault on women under the influence of various drugs and narcotics.
- Articles and reports published between 2018 and 2022.
- The selected past studies should be based on cohort, case-control, cross-sectional, case series and case report methods.

Accurately quantifying the prevalence of sexual violence remains a complex challenge. Keywords such as "DFSA," "Chemical Submission," "drug-facilitated crimes," "Drug-Facilitated Sexual Assault," "Date Rape," "Rape Drugs," "Drink-Spiking violence," "Drug-Facilitated," "Sexual Assault Chemical Submission," "Sexual Violence," "Violence against women," "Effects of sexual violence," "Drug abuse," and "Alcohol Use," among others, were employed in the search strategy. Similar MeSH terms were applied across various databases. To enhance the comprehensiveness of the search, reference lists of the retrieved articles were examined (reference checking) to identify additional relevant studies, and citation tracking was also performed. As illustrated in Figure 1, the literature search, particularly for articles, was conducted following the PRISMA guidelines [18]. Informal reports, letters to the editor, unpublished works, and content from websites were excluded from the analysis. Ultimately, 39 peer-reviewed articles were selected and analyzed for this systematic review.

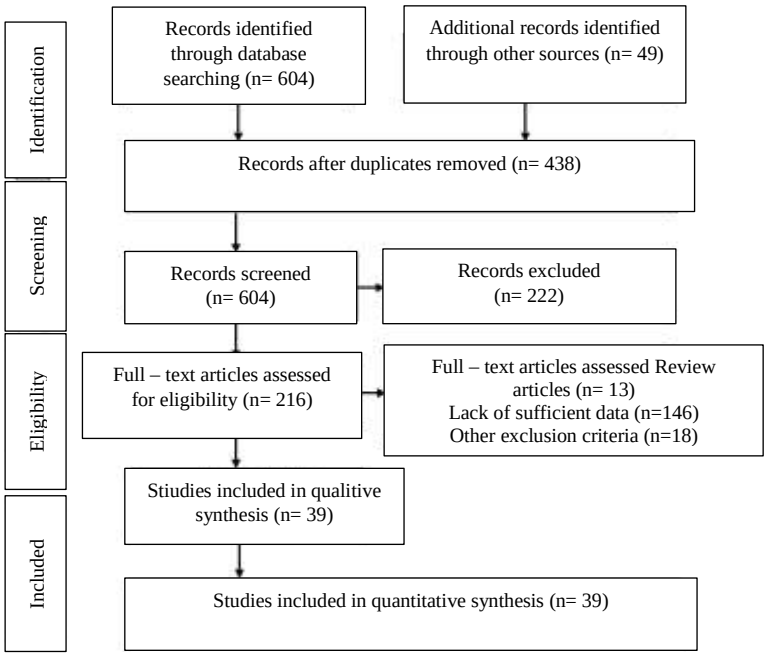

Figure 1. Flow diagram of study identification according to PRISMA.

RESULTS

Finally, 216 studies were selected, and the abstract and title of the selected studies were evaluated (uregFi 1). Considering the inclusion and exclusion criteria, only 39 studies met the inclusion criteria of the present study, and their results are presented in Tables 1 to 3.

Based on the results of the evaluated articles, the most common samples under analysis to evaluate the drugs used included urine, blood, and simultaneous evaluation of hair and nails, respectively (Table 2). In addition, the results of the present study showed that Liquid Chromatography-Mass Spectrometry (LC-MS), Gas Chromatography-Mass Spectrometry (GC-MS) and High-Performance Liquid Chromatography with Diode Array Detection (LC-DAD) were the best recommended techniques for forensic tests (Table 3). The results showed that in sexual violence, alcohol, benzodiazepines, cannabinoids, methamphetamine and amphetamine were the most consumed substances, while traditional drugs were the least consumed (Table 3).

Table 1. The descriptive information about considered previous studies

Sample size	Abundance of women (%)	Average age (Year)	Reference
1000	91.6	26.8	[19]
256	100	22	[20]
161	98.1	22	[21]
107	100	25.9	[22]
107	97	27	[23]
1240	72	27	[24]
1	100	56	[25]
NR	NR	Adults	[26]
136	100	Adults	[27]
*	NR	NR	[28]
**	NR	NR	[29]
NR	NR	NR	[30]
NR	NR	NR	[31]
218	100	42	[32]
***	NR	NR	[33]
NR	NR	NR	[34]
264	100	31	[35]
308	93	26	[36]
68	100	31	[37]
****	NR	NR	[38]
377	100	25	[39]
NR	NR	NR	[40]
NR	NR	NR	[41]
422	100	24	[42]
NR	NR	NR	[43]
120	100	NR	[44]
NR	NR	NR	[45]
702	94.7	24.7	[46]
445	100	24.17	[47]
157	100	27.9	[48]
342	100	18–62	[49]
118	100	20	[50]
632	100	Adults	[51]
41174	50	Adults	[52]
344	100	Adults	[53]
56	100	NR	[54]
203	22.7	Adults	[55]
161	100	Adults	[56]

*Cohort study; Four studies; *** Domestic violence cases; **** Criminal cases; NR: Not reported

Table 2. The Analysis method, sampling and duration between poisoning and testing based on the results of past studies

Biological sample type	The time interval until the experient	Analysis method	Reference
Blood and urine	NR	LC/QTOF-MS	[19]
Blood, urine and hair	<24 hours	GC-MS; GC-MS-MS; HPLC-DAD	[20]
Blood and urine	2–93 hours	(HS)GC-FID; LC-TOF-MS; GC-MS; LC-MS-MS	[21]
Blood and urine	NR	LC-MS-MS; GC-MS	[22]
Blood, urine and hair	<48 hours	LC-MS-MS	[23]
Blood and urine	NR	(HS)GC; GC-FID	[24]
Urine and hair	NR	LC–MS-MS	[25]
Blood and urine	NR	LC–MS-MS; GC-MS; GC-MS-MS; HPLC-DAD	[26]
Urine	NR	LC-MS	[27]
Blood and urine	NR	LC–MS and GC-MS	[28]
Urine	NR	LC–MS-MS	[29]
Urine	NR	Green nanostructured liquids	[30]
Urine and nail plaque	NR	GC-MS	[31]
Urine and hair	NR	GC-MS; LC-MS-MS	[32]
Urine	NR	GC-MS	[33]
Blood, hair and urine	NR	GC-MS; LC-MS-MS	[34]
Blood and urine	NR	GC-MS; LC-MS	[35]
Blood and urine	NR	GC-MS and LC-MS	[36]
Nail plaque and urine	NR	NR	[37]
Urine, blood and hair	NR	GC-MS	[38]
Nail plaque and urine	NR	GC-MS	[39]
*****	NR	GC-MS	[40]
Blood and urine	NR	GC-MS	[41]
Blood and urine	NR	GC-MS	[42]
Urine	NR	NR	[43]
Blood and urine	48 hours	GC-MS	[44]
Urine, hair and blood	NR	NR	[45]
Blood and urine	NR	GC-MS	[46]
Urine and nails	NR	GC-MS	[47]
Urine	NR	NR	[48]
Urine, hair and nails	NR	GC-MS	[49]
Urine	NR	NR	[50]
Urine	NR	NR	[51]
Blood and urine	NR	NR	[52]
Blood and urine	NR	NR	[53]
Urine and hair	NR	NR	[54]
Urine and hair	NR	NR	[55]
Urine	NR	NR	[56]

LC/QTOF-MS: Liquid Chromatography–Quadrupole Time-of-Flight Mass Spectrometry; GC-MS: Gas Chromatography–Mass Spectrometry; GC-MS/MS: Gas Chromatography–Tandem Mass Spectrometry; HPLC-DAD: High-Performance Liquid Chromatography–Diode Array Detector; (HS)GC: Headspace Gas Chromatography; GC-FID: Gas Chromatography–Flame Ionization Detection; GC-FPD: Gas Chromatography–Flame Photometric Detection; LC-TOF-MS: Liquid Chromatography–Time-of-Flight Mass Spectrometry; LC-MS: Liquid Chromatography–Mass Spectrometry; LC-MS/MS: Liquid Chromatography–Tandem Mass Spectrometry

Table 3. Distribution of the most common substances used on victims of sexual violence

Type of material (Alcoholic drinks)	Benzodiazepine	Methamphetamine / amphetamine	Cannabinoid	Cocaine	Opioid	Reference
30.9	7.6	16.5	28.8	10.4	12.8	[19]
22.3	5.1	0.7	7.4	5.6	4.7	[20]
46.9	NR	11.7	25.9	1.2	NR	[21]
NR	NR	NR	NR	NR	NR	[22]
67	3.7	28	NR	9.3	NR	[23]
17	NR	NR	9.5	NR	NR	[24]
NR	NR	NR	NR	NR	NR	[25]
NR	NR	NR	NR	NR	NR	[26]
NR	30	NR	NR	NR	NR	[27]
NR	NR	NR	NR	NR	NR	[28]
NR	NR	NR	NR	NR	NR	[29]
NR	NR	NR	NR	NR	NR	[30]
26.3	57.5	NR	NR	11.2	NR	[31]
66.6	NR	NR	NR	NR	NR	[32]
NR	NR	NR	NR	NR	NR	[33]
NR	NR	NR	NR	NR	NR	[34]
NR	31	NR	13	NR	9	[35]
24	NR	NR	NR	NR	NR	[36]
NR	NR	NR	NR	NR	NR	[37]
NR	NR	NR	NR	NR	NR	[38]
NR	NR	NR	NR	17.5	NR	[39]
NR	NR	NR	NR	NR	NR	[40]
NR	NR	NR	NR	NR	NR	[41]
39	65	NR	NR	NR	NR	

DISCUSSION

According to the reviewed studies, the most frequently analyzed biological samples for detecting drugs included urine, blood, and combined analysis of hair and nails, respectively [21]. Furthermore, the findings indicate that liquid chromatography-mass spectrometry (LC-MS), gas chromatography-mass spectrometry (GC-MS), and liquid chromatography with diode-array detection (LC-DAD) are the most recommended analytical techniques in forensic investigations [22]. These methods are preferred due to their capability to detect a broad spectrum of compounds and their metabolites, even at very low concentrations [23]. Following these, High-Performance Liquid Chromatography coupled with Diode-Array Detection (HPLC-DAD) and gas chromatography with flame ionization detection (GC-FID) were identified as commonly used techniques for sample analysis [24,25].

The evaluated studies showed that ethanol poisoning was the highest risk in DFSA. In most cases, alcohol is consumed voluntarily by the victim, and most of the victims are young women who may normally use alcoholic beverages in relationships and social gatherings. However, the results of past studies show that alcohol is not the only factor in these crimes and a quick toxicological analysis of DFSA is necessary to determine other possible substances [19,21-25].

Following alcohol, substances most frequently identified in cases of drug-facilitated sexual assault (DFSA) include benzodiazepines, cannabinoids, methamphetamine, and amphetamines, as reported by numerous international studies [22–24]. Benzodiazepines, in particular, are widely accessible in many countries, often available for purchase online at low cost. When used in combination with alcohol or other psychoactive substances, benzodiazepines can significantly increase an individual's vulnerability to criminal victimization. This underscores the urgent need for stricter regulatory controls on the prescription, sale, and distribution of these medications. Similar concerns extend to other sedative and hypnotic agents, which have also been implicated in several DFSA-related investigations [21,22].

Stimulant drugs such as cocaine and methamphetamine are sometimes employed in the commission of sexual assaults to heighten the victim's vulnerability. In addition to stimulants, perpetrators may also use volatile substances like chloroform to incapacitate victims. Given the increasing prevalence of these agents among offenders, there is a growing need to develop more sensitive and efficient toxicological detection methods capable of identifying rapidly metabolized or fugitive compounds [55–57].

When an individual suspects they have been sexually assaulted but has limited or no memory of the event, a comprehensive examination of the body and clothing for foreign substances or fluids is typically performed [58]. It is essential that the suspected victim seeks medical care promptly and refrains from bathing, cleaning, changing clothes, or consuming food before the examination. Providing detailed recollections of the incident, even if fragmented, can aid the assessment process. In conjunction with the victim's account, healthcare professionals conduct biological testing, including sexual and urine assays, to detect the presence of drugs. Multiple studies indicate that the most commonly utilized diagnostic techniques in clinical settings include immunoassays, liquid chromatography, and gas chromatography-mass spectrometry. Nevertheless, due to the often low concentrations of substances involved in drug-facilitated sexual assaults, there remains a considerable risk of false-negative results, which may compromise the accuracy of the diagnosis [59,60].

Another problem that exists in sexual crimes with the use of drugs is that the victims do not refer to the police centers due to the conscious or unconscious use of drugs and alcohol, as well as because of the fear of legal proceedings. In addition, due to poisoning with these substances, the victims do not have the ability to remember exactly what happened at the time of poisoning, and this causes a delay in referring and conducting toxicology tests. Therefore, by quickly referring to the hospital and not fearing legal action, it can create a safe space for victims to express their

situation, without fear of legal action, and also prevent potential criminals from easily accessing drugs and sedatives [61, 62].

If there is delay in reporting or going to the treatment centers, the compounds that were used for the assault or rape may have been metabolized before the visit and therefore not detectable in the blood or urine [63,64]. The results of past studies have shown that as the delay between the time of sexual assault and the time of sampling increases, especially if the delay is more than 24 hours, there is lower probability that drugs will be detected in urine samples. Therefore, it can be said that a negative test result cannot rule out the use of drugs in sexual crimes with complete certainty. Because, as mentioned above, this negative result may be due to the low concentration of the substance(s) used, and it may also be due to the passage of time [65].

Limitation

There are several limitations inherent in this study. First, the review of past literature was confined to publications from the period between 2018 and 2022, which may exclude relevant research from earlier years that could have provided a broader context or additional insights. Second, the inclusion criteria were limited to articles published in the English language, which potentially excludes valuable studies in other languages, particularly those that may offer unique regional perspectives on DFSA. Additionally, the scope of the review focused primarily on forensic toxicology techniques and substances used in DFSA, meaning that other aspects, such as psychological or sociocultural factors, were not addressed. Lastly, there is a need for further research that not only expands the temporal and linguistic boundaries of the literature but also explores emerging detection methods and their applicability to a wider range of substances.

CONCLUSIONS

According to the obtained results, it can be concluded that most of the sexual crimes were related to excessive consumption of alcohol and various drugs including benzodiazepines, cannabinoids, methamphetamine and amphetamine. Therefore, increasing the awareness of the general public about the health risks of the mentioned compounds is extremely necessary. In addition, the use of strong and valid analysis techniques, especially spectrometry (LC-MS/GC-MS) and diode array detector (LC-DAD) is recommended for use in forensic centers. In general, it can be said that due to the increase of sexual crimes related to substances at the global level, in order to reduce such crimes, it is necessary to optimize and update the existing instrumental techniques to detect types of poisons every day. The high abundance of materials used in DFSA as well as the diversity of these compounds makes it difficult to identify them in analytical tests. Therefore, creating effective diagnostic methods and using them at the global level allows forensic experts to have reliable scientific standards and provide acceptable results to judicial authorities for decision-making. In addition, according to the results of past studies, it is suggested that creating public awareness campaigns with the aim of highlighting the risk of being victim of sexual crimes, after consuming alcohol and drugs, can be useful in increasing awareness and changing people's attitudes.

CONFLICT OF INTEREST

Authors confirm that there are no relevant financial or non-financial competing interests to this study.

ETHICAL CONSIDERATION

The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences, Tehran, Iran (Ethic code: IR.IUMS.REC.1401.542).

Author's contribution

A .M.; Data curation, formal analysis, software, writing - original draft, writing review & editing; S.S.; Supervision, investigation, methodology, project administration, data curation; K.A and L.A, M.A.; formal analysis, methodology, data curation.

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Informed consent

Verbal consent obtained from the participants to participate in the present study.

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