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| RESEARCH ARTICLE

Drug Consumption: Analyzing A Series of Urine Samples from Algiers Addicts by GC-MS Low Cost Derivatization Method

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| ABSTRACT
The complex and evolving landscape of drug addiction poses significant public health challenges in Algiers, Algeria. With growing concerns about drug addiction and its associated consequences, it becomes imperative to comprehensively understand drug consumption patterns among individuals grappling with addiction in this region. Drug addiction is a multifaceted issue influenced by various factors such as drug availability, sociodemographic characteristics, and personal choices. The prevalence of drug addiction continues to rise, warranting a thorough examination of the specific substances that dominate the local addiction landscape. A descriptive retrospective analytical study was conducted, analyzing 92 cases of drug consumption profiles among addicts in the Algerian province of Algiers. Urine samples collected between January 1, 2020, and October 15, 2022, from drug-addicted patients in Algiers, were examined using Gas Chromatography-Mass Spectrometry (GC-MS). The meticulous analysis of this diverse population revealed that THC and pregabalin are the two most frequently consumed substances, often used together in poly-drug combinations. Surprisingly, there is a notable prevalence of opioid consumption, especially within families, raising concerns about a potential opioid crisis in Algiers.

| KEYWORDS

Substance abuse, Drug addiction Algiers, Algeria, Drug consumption patterns, opioids crisis

| ARTICLE INFORMATION

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1. Introduction

The intricate challenge posed by drug addiction, compounded by obstacles to care and discrimination, reaches beyond individuals to impact entire communities. This pervasive problem not only presents a substantial public health hurdle but also endangers the mental and physical well-being of young people in Algeria. Addressing drug addiction in Algeria involves a complex interplay among individuals, substances, and societal influences. Despite attempts to deter drug use, addiction rates persistently escalate across diverse demographics. The Algerian National Office for Drug Control reported a 27,19 % increase in the number of drug addicts receiving treatment between 2021 and 2022. Unfortunately, comprehensive understanding remains insufficient, notably in Algiers, where there's a lack of thorough investigation(Ismail et al., 2021).

The objective of this work, focusing on establishing drug consumption patterns in Algiers, Algeria, is paramount. This goal seeks to uncover and analyze specific trends in drug use within the local community. By comprehending these patterns, policymakers and healthcare professionals can craft tailored interventions, allocate resources efficiently, and implement targeted programs.

Additionally, a deeper understanding of these consumption patterns enables a more precise assessment of associated health risks, facilitating the development of preventive measures.

2. Material and Methods

2.1 Study design and population

This is an analytical, retrospective, and descriptive study of 92 urine samples from intoxicated individuals of both genders and various age groups, referred to the toxicology department for toxicological screening. The samples were collected between January 1, 2020, and October 15, 2022, and stored at a temperature of -20º.

• **Inclusion criteria:**
- Cases with a confirmed history of drug addiction
- Cases residing in the province of Algiers

• **Exclusion criteria:**
- Molecules administered as part of patient care

2.2 Sample and Data Collection

To understand drug consumption patterns among residents of Algiers province dealing with addiction, we analyzed 92 urine samples sent to the toxicology department. These samples were submitted for reasons ranging from medical emergencies to post-mortem investigations. This study encompassed individuals from diverse demographics within Algiers province, irrespective of age or gender, all engaged in the use of psychoactive substances.

The data extracted for analysis originated from requests for toxicological screening. This comprehensive dataset includes various details: gender, age, the contextual background prompting the need for screening, medical and addiction history, clinical presentation, samples collected, the time gap between sample collection and patient admission, and medications administered for therapeutic purposes.

Urine is considered the matrix of choice for screening drugs and/or their metabolites, serving as exposure markers. It accumulates a wide range of substances and can be collected non-invasively in large volumes. Moreover, it provides a longer window of detectability compared to blood or gastric lavage, offering insights into substance consumption over the 24 to 48 hours preceding the analysis, including substances with a short blood half-life. It's for these advantages that this matrix was used to determine the profile of consumed molecules (Tenore, 2010).

The samples were collected at the admitting hospital facilities and sent to the Toxicology Department at the Mohamed Lamine Debaghine University Hospital Center by courier service.

2.3 Toxicological screening

2.3.1 Reagents

All the solvents and reagents used are of analytical grade. Ammonium chloride from Riedel-de-Haën, acetonitrile, and ethyl acetate from Sigma-Aldrich Chemie, and chloroform, isopropanol, methanol, and dichloromethane provided by Riedel-de-Haën were utilized.

The active ingredients used to prepare standard solutions were supplied by Lipomed and from the National Laboratory for the Control of Pharmaceutical Products (LNCPP) **Table 1**.

Table 1: List of standards obtained from the LNCPP and Lipomed.

LNCPP Standards	7-Aminoflunitrazepam, Amitriptyline, Atropin, Baclofen, Bisoprolol, Bromazepam, CBN, CBD, Carbamazepin, Chlorpromazin, Citalopram, Clomipramine, Clonazepam, Cocaine, Desipramine, Diazepam, Dextromethorphan, Fentanyl, Fluoxetine, Gabapentin, Haloperidol, Hydroxyzine, Imipramine, Levetiracetam, Lidocaine, Loxapine, Mianserin, Midazolam, Metronidazole, Olanzapine, Oxycodon, Paroxetin, Phenobarbital, Pregabalin, Promethazine, Propranolol, Sertralin, THC, Tetrazepam, Trihexyphenidyl, Tramadol, Trimipramine, Triazolam, Venlafaxine, Zolpidem.
Lipomed standards	Amphetamine, Codeine, Ecgonine methylester (EME), MDMA (3,4-methylenedioxymethamphetamine), MDA, Mephedrone, Methadone, Methamphetamine, Morphine, Nordazepam, Norketamine, Oxazepam, Temazepam.

2.3.2 Equipment

Identification was performed using a GC-MS system consisting of a SHIMADZU GC-2010 PLUS® gas chromatograph equipped with an AOC 6000 auto-sampler and coupled to a quadrupole mass spectrometer, the SHIMADZU GCMS-QP2020® NX®.

2.3.3 Sample preparation

2.3.3.1 Extraction

2 ml of urine obtained from non-drug users were heated in a water bath with 1 ml of 37% hydrochloric acid for 15 minutes. After hydrolysis, the sample was alkalized with 2 ml of ammoniacal buffer to achieve a pH of 8 to 9. Then, 5 ml of the extraction solvent, which is a mixture of ether, dichloromethane, isopropanol, and ethyl acetate (in a ratio of 4:2:2:2), was added. The mixture was agitated for 10 minutes and then centrifuged at 6000 rpm for 10 minutes. The extract was evaporated under nitrogen at 40°C.

2.3.3.2 Derivatization:

The residue was derivatized at 90°C for 20 minutes using 60 µL of acetic anhydride and 40 µL of pyridine(Versace et al., 2012). The samples were then cooled to room temperature and evaporated to complete dryness under a stream of nitrogen. Finally, the samples were reconstituted with 100 µL of ethyl acetate, and a 2 µL aliquot was injected into the GC.

2.3.3.3 Instrumentation GC-MS Method:

For the analysis, the method was implemented with a total analysis time of 21.92 minutes. The upper temperature limit (LT) was set at 310°C for this method. The ionization source was maintained at a temperature of 250°C, and the collision energy was set at 70 eV. The injector operated at a temperature of 270°C in splitless mode. The column used for this analysis was an Rxi-5ms (RESTEK®) column, 30 meters in length, with an internal diameter of 0.25 mm and a film thickness of 25 µm. Helium was used as the carrier gas at a flow rate of 1.16 ml/min. The temperature program included the following steps: an initial phase at 100°C for 1 minute, followed by an increase in temperature at a rate of 35°C/min until reaching 200°C. Subsequently, the temperature was increased to 250°C at a rate of 20°C/min and held at this temperature for 3 minutes. The temperature was then raised to 275°C at a rate of 15°C/min and held for 5 minutes. Finally, a final temperature increase to 300°C at a rate of 28°C/min was performed, followed by a 5-minute hold. This method was carefully optimized from the SHIMADZU method (*Application Handbook Clinical*) to ensure precise and reproducible analytical results.

2.3.3.4 Data acquisition

The chromatograms obtained in the GC-MS mode were processed using LabSolutions software. Compound identification was carried out using the "full-scan" acquisition mode. The spectral libraries utilized for this purpose included NIST 2017 and 2018, as well as WILEY 2015. Major and qualifier ions used for the identification of each molecule, along with their retention times according to the chromatographic method mentioned, are listed in **Table 2**

2.3.4 Validation:

The validation of the qualitative method was carried out in accordance with the validation protocol proposed by the French Society of Clinical Biology (SFBC) and the French Society of Analytical Toxicology (SFTA) in 2019 (Guitton et al., 2019), which encompasses extraction efficiency, limit of detection (LOD), inter-sample contamination, and selectivity evaluation. **Table 2 depicts the characteristic ions and the results of the validation of the analytical method.**

Table 2: Characteristic ions and the results of the validation of the analytical method

Molecules	Characteristic ions (m/z)	Retention time	Selectviity (a)		Detection limite LOD ng/ml	average yield (%)	RSD %	inter-sample contamination
Propofol AC	163 (43-178)	4,615	Propofol AC ; Preabaline AC	1,042	20	75 %	10 %	0 %
Pregabalin AC	124 (84-142)	4,809	Preabaline AC ; AMP AC	1,07	1243	17 %	27 %	0 %
AMP AC	44 (86-118)	5,145	AMP AC ; Levetiracetam AC	1,07	94	75 %	11 %	1 %
Levetiracetam AC	126 (69-41)	5,504	Levetiracetam AC ; MET AC	1,006	479	10 %	96 %	-1 %

MET AC	58 (100.-91)	5,535	MET AC ; Gabapentine AC	1,019	100	76 %	27 %	-1 %
Gabapentin AC	195 (153-81)	5,64	Gabapentine AC ; EME AC	1,001	851	17 %	18 %	-10 %
EME AC	82 (182-83)	5,646	Methylester-ecgonine AC; Meronidazole AC	1,064	40	76 %	5 %	0 %
Metronidazole AC	87 (43-171)	6,005	Meronidazole AC ; Mephedrone AC	1,077	10	78 %	20 %	-1 %
Mephedrone AC	58 (100-174)	6,465	Mephedrone AC ; MDA AC	1,07	96	81 %	16 %	-1 %
MDA AC	44 (44-162)	6,92	MDA AC ; Lidocaine	1,02	50	75 %	7 %	-9 %
Lidocaine	86 (87-228)	7,055	Lidocaie ; MDMA AC	1,048	21	76 %	12 %	-1 %
MDMA AC	58 (162-100)	7,395	MDMA AC ; Baclofen AC	1,032	55	80 %	15 %	-4 %
Baclofen AC	138 (237-43)	7,635	Baclofne AC ;Pheobarbital	1,006	181	15 %	20 %	-1 %
Phenobarbital	204 (117-205)	7,68	Pheobarbital ; Norketamine AC	1,01	60	69 %	34 %	-1 %
Norketamine AC	230 (202-166)	7,76	Norketamine AC ; Tramadol AC	1,021	4	73 %	25 %	-1 %
Tramadol AC	58 (188-59)	7,92	Tramadol AC ; Venlafaxine AC	1,098	25	83 %	8 %	-1 %
Venlafaxine AC	58 (202-121)	8,7	Venlafaxine AC ; Methadone	1,019	21	83 %	6 %	0 %
Methadone	72 (73-91)	8,865	Methadone ; Dextrometrophane	1,01	6	85 %	11 %	-1 %
Dextromethorphan	59 (271-150)	8,955	Dextrometrophane ; Ketamine AC	1,036	29	70 %	13 %	0 %
Ketamine AC	216 (208-180)	9,28	Ketamine AC ; Amitriptyline	1,008	3	68 %	37 %	0 %
Amitriptyline	58 (59 - 202)	9,355	Amitriptyline ; Cocaine	1,004	1	70 %	5 %	0 %
Cocaine	82 (182-303)	9,395	Cocaine ; Oxazepam AC	1,015	13	76 %	8 %	-1 %
Oxazepam AC	230 (273-77)	9,535	Oxazepam AC ; Trimipramine	1,003	100	70 %	6 %	-7 %
Trimipramine	58 (249-193)	9,56	Trimipramine ; Mianserin	1,001	30	72 %	7 %	-14 %
Mianserin	193 (249-193)	9,565	Mianserin ; Imipramine	1,007	1	76 %	13 %	-1 %
Imipramine	234 (235-85)	9,63	Imipramine ;Fluoxetine AC	1,01	10	74 %	18 %	-2 %

Fluoxetine AC	86 (44-190)	9,725	Fluoxetine AC ;Trihexyphenidyl	1,019	3	69 %	14 %	0 %
Trihexyphenidyl	98 (218-57)	9,91	Trihexyphenidyl ; Promethazine	1,03	123	77 %	12 %	-1 %
Promethazine	72 (73-213)	10,205	Promethazine ; Atropine AC	1,007	10	69 %	13 %	0 %
Atropine AC	124 (82-83)	10,275	Atropine AC ; Carbamazepine	1,036	34	90 %	4 %	-1 %
Carbamazepine	193 (192-236)	10,65	Carbamazepine ; Propranolol AC	1,043	328	48 %	4 %	-4 %
Propranolol AC	140 (181-127)	11,106	Propranolol AC ; Citalopram	1,006	34	73 %	12 %	1 %
Citalopram	58 (45-59)	11,175	Citalopram ; Clomipramine	1,011	55	58 %	5 %	0 %
Clomipramine	58 (268-85)	11,295	Clomipramine ; THC AC	1,002	16	62 %	13 %	0 %
THC AC	297 (121-313)	11,32	THC AC ; Bromazepam AC	1,002	39	65 %	7 %	0 %
Bromazepam AC	121 (249-247)	11,34	Bromazepam AC ; Cannabidiol 2AC	1,004	40	60 %	13 %	0 %
Cannabidiol 2AC	231 (210-228)	11,38	Cannabidiol 2AC ; Diazepam	1,025	108	41 %	8 %	-10 %
Diazepam	256 (283-284)	11,665	Diazepam ; Cannabinol, AC	1,023	11	61 %	5 %	0 %
Cannabinol AC	295 (337-338)	11,935	Cannabinol, AC; Chlorpromazine	1,022	28	62 %	10 %	-1 %
Chlorpromazine	58 (284-87)	12,195	Chlorpromazine ; codeine AC	1,013	16	67 %	11 %	-4 %
Codeine AC	341 (341-282)	12,35	Codeine AC ; Nordazepam	1,006	22	64 %	6 %	-1 %
Nordazepam	242 (328-242)	12,425	Nordazepam ; Levomepromazine	1,001	91	65 %	6 %	-2 %
Levomepromazine	58 (328-242)	12,44	Levomepromazine ; Oxycodone AC	1,016	14	69 %	15 %	0 %
Oxycodone AC	357 (314-263)	12,645	Oxycodone, AC; Bisoprolol AC	1,013	52	51 %	26 %	0 %
Bisoprolol AC	139 (91-160)	12,814	Bisoprolol AC ; Loxapine	1,031	205	64 %	10 %	-14 %
Loxapine	83 (70 - 257)	13,215	Loxapine ; Midazolam	1,006	11	59 %	8 %	-4 %
Midazolam	310 (312-325)	13,295	Midazolam ; Diactylmorphine	1,036	13	60 %	5 %	-2 %

Morphine 2AC	327 (268 - 369)	13,78	Diactylmorphine ; Tetrazepam AC	1,022	18	61 %	5 %	-2 %
Tetrazepam AC	288 (85-71)	14,085	Tetrazepam AC ; Desimipramine AC	1,028	140	43 %	7 %	-6 %
Desipramine AC	208 (114 - 193)	14,475	Desimipramine AC ; Tetrazepam AC	1,01	9	58 %	3 %	-1 %
Temazepam AC	271 (273-300)	14,62	Tetrazepam AC ; Fentanyl	1,014	14	53 %	8 %	-1 %
Fentanyl	146 (245-189)	14,825	Fentanyl ; Olanzapine AC	1,061	23	52 %	9 %	-1 %
Olanzapine AC	242 (272-213)	15,725	Olanzapine AC; Sertraline	1,04	100	60 %	4 %	-1 %
Sertraline AC	290 (274-276)	16,36	Sertraline AC ; Zolpidem	1,005	5	50 %	10 %	3 %
Zolpidem	235 (219-302)	16,44	Zolpidem ; Haloperidol	1,025	37	55 %	21 %	-3 %
Haloperidol	192 (206-357)	16,854	Haloperidol ; Clonazepam	1,021	90	51 %	5 %	-3 %
Clonazepam	280 (280-71)	17,205	Clonazepam ; Aminoflunitrazepam AC	1,061	286	62 %	6 %	-14 %
Amino-flunitrazepam AC	325 (297-324)	18,25	Aminoflunitrazepam AC ;Paroxetine AC	1,012	155	45 %	13 %	-59 %
Paroxetine AC	234 (44 - 86)	18,46	Paroxetine AC ; Hydroxyzine AC	1,005	4	57 %	6 %	0 %
Hydroxyzine AC	201 (203-166)	18,555	Hydroxyzine AC ; Triazolam	1,06	7	52 %	14 %	0 %
Triazolam	313 (315-238)	19,66			36	37 %	26 %	1 %

AC: Acetylated, AMP: Amphetamine, EME: methylethylecgonine, MET: methamphetamine, MDA: 3,4 methylenedioxyamphetamine, MDMA: 3,4-methylenedioxyphenethylamine or Ecstasy

2.3.5 Quality assurance

The quality of GC-MS analyses has been ensured, as recommended by the SFTA (Guitton et al., 2019), by using a blank sample and a control urine sample. This control sample contains 10 molecules encompassing various families of analysed molecules (Bisoprolol, Bromazepam, Cocaine, Codeine, Haldol, hydroxyzine, Mephedrone, propofol, Trimipramine, zolpidem) at concentrations of 100 ng/ml and 500 ng/ml. This control is conducted before each analysis."

2.4 Statistics

Analytical data were obtained through GC-MS analysis, while sociodemographic information was extracted from the service's database (EL-TYRIAK software).

Statistical analysis was conducted using Microsoft Excel and IBM SPSS version 26.

3. Results

3.1 Socio-demographic result

3.1.1 Distribution by Age Group

93.5% of the subjects were over 21 years old. The population aged between 14 and 20 years represents only 6.5% (n=6). The average age of the study population is 29.61 +/- 0.927 years, with a median of 28 years and a mode of 26 years. The minimum age was 17 years, and the maximum was 72 years**.**

3.1.2 Distribution by Gender

Male subjects represent 95.7% (n=88) of the population. It is worth mentioning that this percentage was consistent across all three age groups **Error! Reference source not found.**.

Table 3: Age group by gender of addict subjects

Effective		Gender of subjects		Total
		Male	Female	
Age range	14 to 20 years	5	1	6
	21 to 30 years	46	0	46
	31 years and over	37	3	40
Total		88	4	92

3.1.3 Distribution by Circumstances

The analysis of data based on the reason for the request indicates that 82.6% (n=76) of requests were made in a medical context (presence of clinical symptoms) following abuse, 10.9% (n=10) due to a road traffic accident, 3.3% (n=3) following a suicide attempt, and the same for postmortem cases Figure 1.

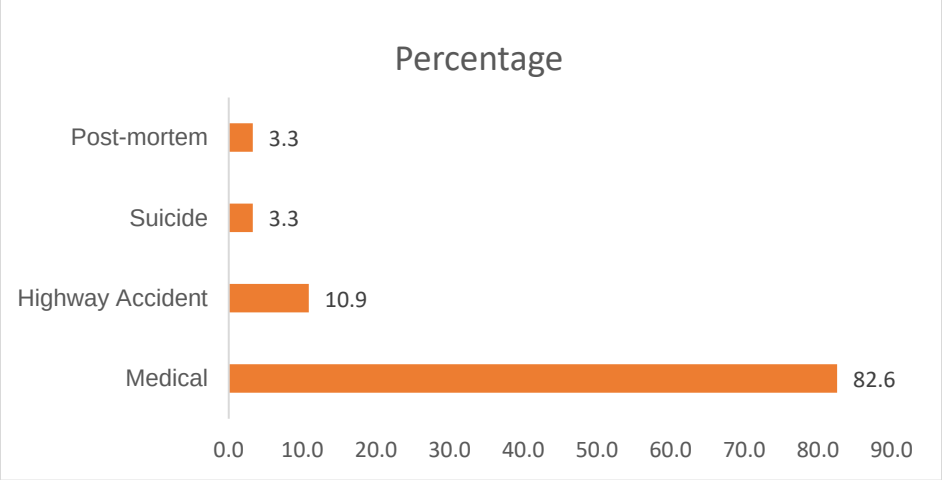

Figure 1: Circumstances of the toxicology screening request

3.2 Analytical Results.

Out of the 92 urine samples analyzed, 2 were negative. Molecules that tested positive due to therapeutic administration as part of patient care were excluded. Consequently, 5 cases positive for midazolam, 2 for atropine, 2 for phenobarbital, and 1 for propofol were not considered in the study because they were administered in a hospital setting as part of patient care. **Figure 2** represents the repartition of results by family, and **Figure 3** represents the detection frequency of each molecule. This analysis unveiled the presence of 37 different molecules distributed in the following manner.

Opioids: In terms of consumption, opioids top the list. 67 samples from the population tested positive, with 45 for morphine (diacetylmorphine), 27 for tramadol, 13 for dextromethorphan.

Remark:

One of the limitations of acetylation is the transformation, during the derivatization reaction, of morphine and 6-MAM into Diacetylmorphine, making it impossible to differentiate between the two molecules. Consequently, the identification is carried out

by considering diacetylmorphine. Therefore, it is difficult to distinguish between codeine or morphine consumption, sometimes for therapeutic purposes, and heroin consumption (Grinstead, 1991). This constitutes a limitation of this study.

Gabapentinoids: Detected in 61 samples, with 55 testing positive for pregabalin and 6 for gabapentin.
Cannabinoids: 56 patients tested positive for cannabinoids.
Benzodiazepines: Identified in 36 cases, with 18 testing positive for 1,4-benzodiazepines (diazepam, oxazepam, nordazepam, temazepam), 14 for bromazepam, 16 for oxazepam, 3 subjects combining bromazepam with a 1,4-benzodiazepine, and 1 case testing positive for clonazepam.
Amphetamine: 22 patients tested positive for MDMA and or his metabolite MDA
Cocaine and its metabolite methyl ester-ecgonine: Identified in 12 cases, accounting for 13.04%.
Tricyclic Antidepressants: Amitriptyline and trimipramine were identified in 15 and 6 subjects, respectively, from this study population.
Phenothiazines: 13 positive cases, including 69.2% (n=9) for levomepromazine, 23% (n=3) for promethazine, and 7.7% (n=1) for chlorpromazine.
SSRIs (Selective Serotonin Reuptake Inhibitors): Identified in 7 subjects, with 4 testing positive for fluoxetine, 2 for citalopram, and 1 for paroxetine.
Antiparkinsonian Drugs: Trihexyphenidyl was found in 4 patients.
Anesthetics: Lidocaine alone was found in 6 subjects.
Antiepileptics: Carbamazepine was identified in 3 cases.
Antihistamines: Represented by hydroxyzine, which tested positive in 4 cases.

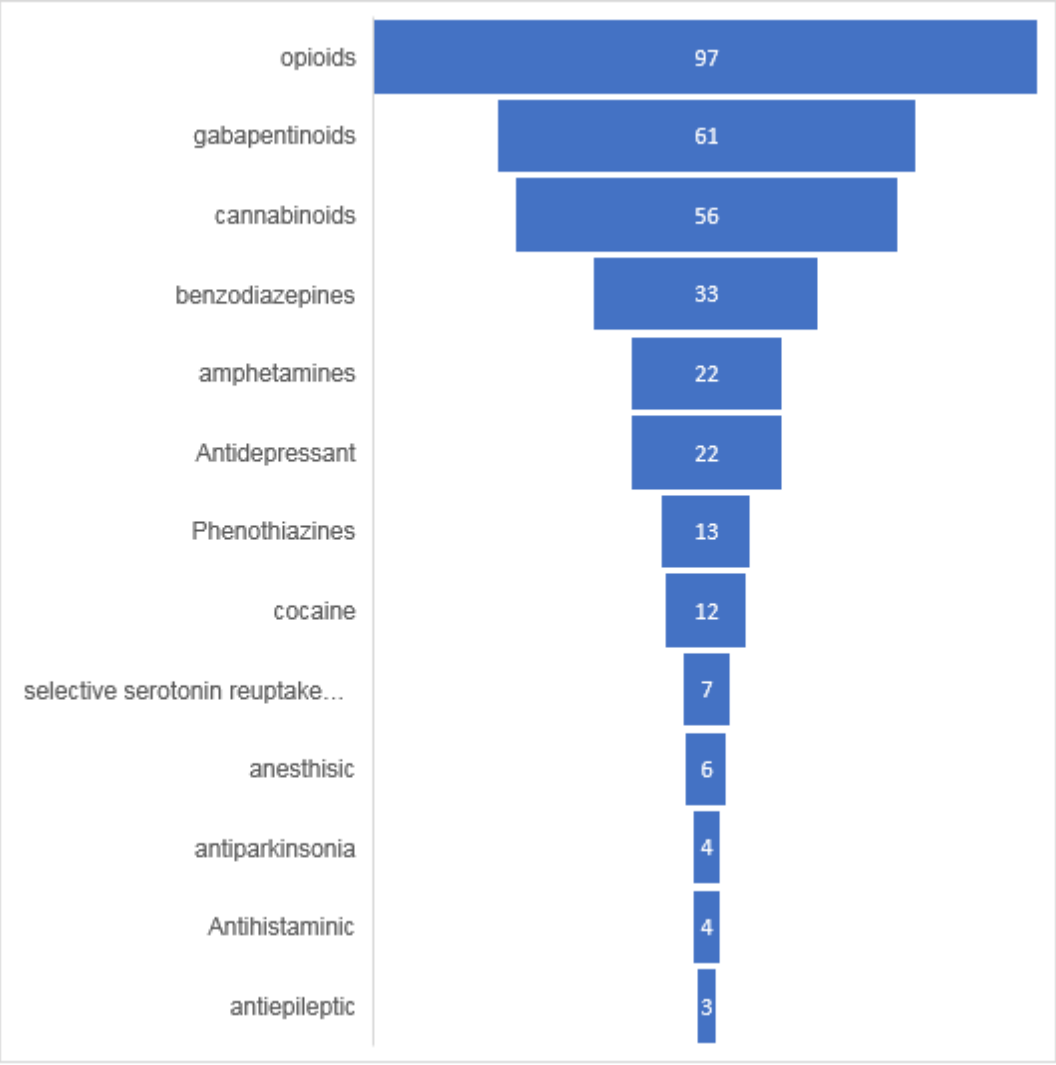

Figure 2: Reparation of detection results by family

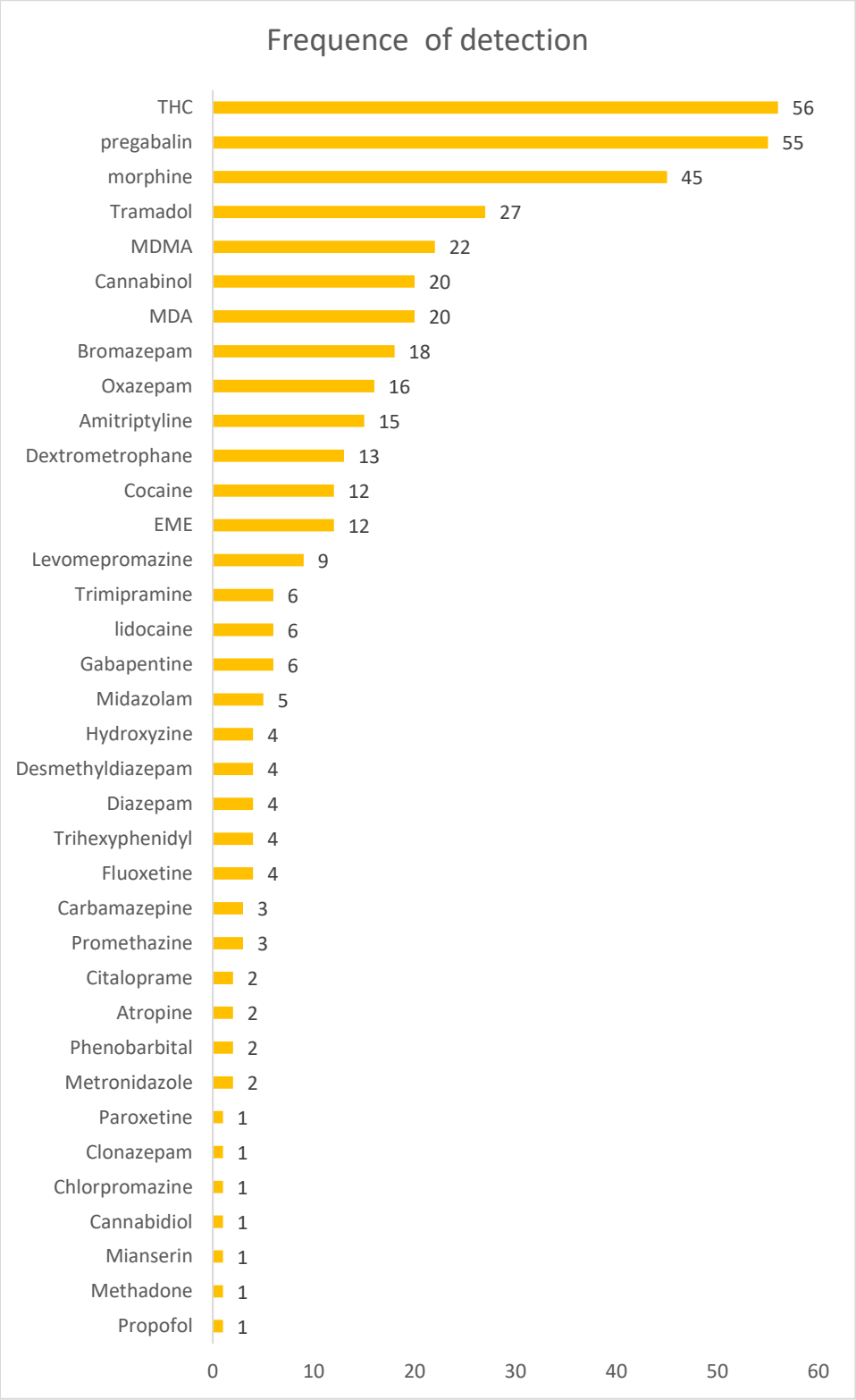

Figure 3: Frequency of substance detection by GC-MS

3.2.1 Study of the Influence of Age on the Nature of the Consumed Molecule:

We observe that individuals over 21 years of age had a consumption pattern that involved all classes of molecules, both medications and drugs of abuse, whereas those under 21 years of age had a less diverse consumption pattern, as depicted in **Figure 4**. Misuse of medications is less common in the younger age group. We note a very low proportion of consumers of Gabapentinoids, with a significant majority preferring opioids and, to a lesser extent, cannabinoids.

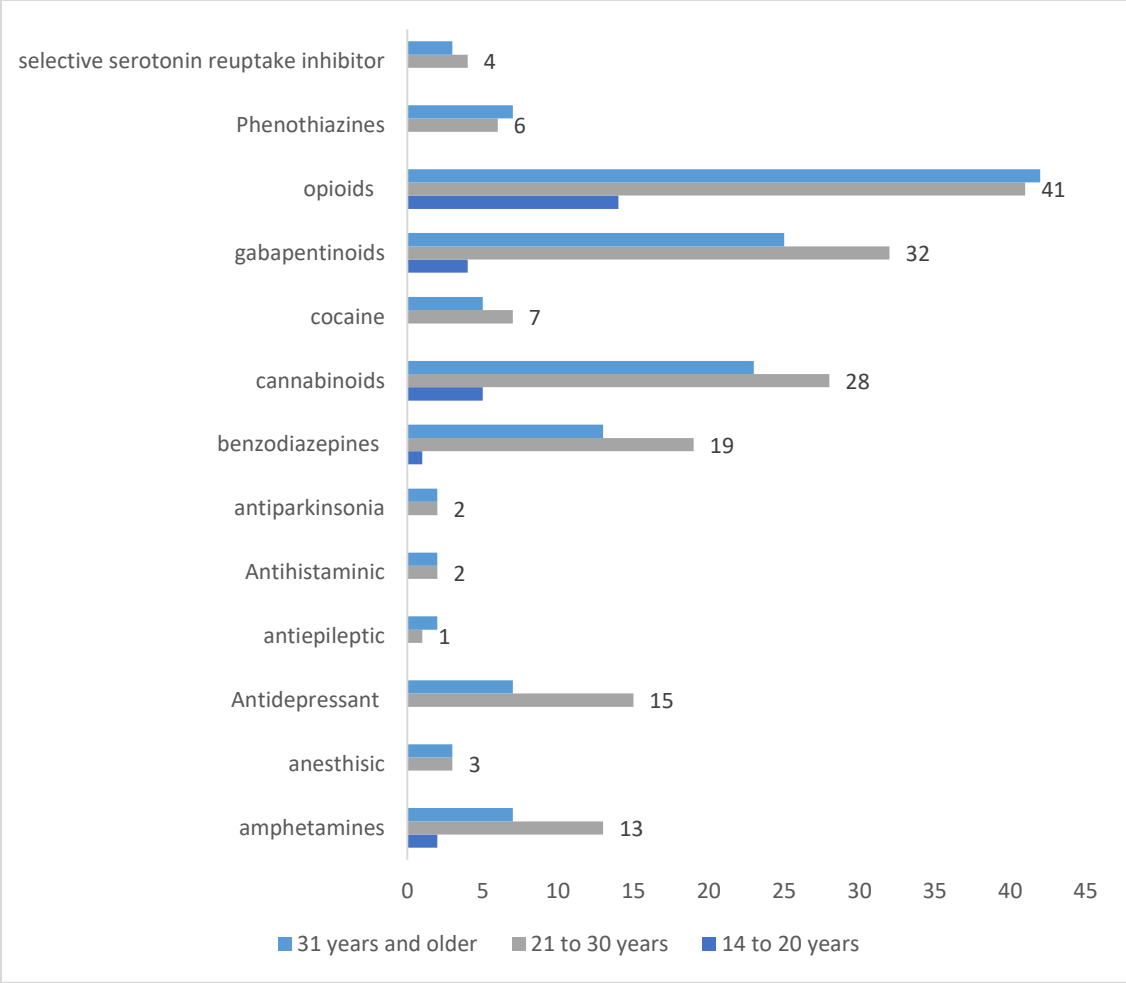

Figure 4: Influence of Age on Drug consumption behaviors

The application of the Chi-squared test, the results of which ***Table 4*** shows X^2 values ranging from 0.364 to 6.654 and p-values ranging from 0.03 to 0.83 for all classes of drugs, as shown in the table below

Table 4: Chi-square test result on the influence of age on the drug use profile

substance family	X^2	*p*
Amphetamines	2,646[a]	0,266
anesthetics	1,057[a]	0,589
Antidepressant	4,516[a]	0,105
Antiepileptic	3,614[a]	0,164
Antiparkinsonia	,440[a]	0,803
Cocaine	1,079[a]	0,583
Gabapentinoids	6,654[a]	0,036
Opioids	,655[a]	0,721
Phenothiazine	6,500[a]	0,039

4. Discussion

Opioids are involved in 54.34% of cases of drug addiction. These results are similar to the findings in reports from the European Union and the UNODC established in 2022 on drug addiction trends (*WDR22_Booklet_1.pdf*, s. d.). These reports implicate opioids in nearly 28% of cases for the EU and 69% for the UNODC in terms of demand for care, and they are involved in 74% and 40% of

drug-related deaths, respectively, in the EU and globally. Compared to other drugs, global and European consumption of opioids is lower than that of cocaine and amphetamines. This trend contradicts the results of this study, which places opioids at the top, followed by ecstasy and cocaine. Indeed, economic factors seem to be a significant element influencing consumption. Opioids rank third in terms of financial accessibility, following pregabalin and cannabis. This contrasts with the results obtained in the two reports from the UNODC and EU, which indicate that cannabis, in all its forms, remains the most consumed drug. This difference may be because cannabis is considered a "soft" drug (Bahtaoui et al., 2020) that typically does not lead to intoxications requiring hospitalization or resulting in deaths (the population targeted by this work).

The comparisons by substances reveal that THC is the most consumed molecule by drug addicts. This aligns with findings in both the UNODC and EU report on drug consumption in 2022, indicating that cannabis, in all its forms, remains the most consumed drug alongside THC. A study conducted in the Wilaya of Setif in Algeria also corroborates this (Benboudiaf et al., 2023). Following THC in second place for consumed molecules is pregabalin. This coincides with several studies conducted across various countries, noting the increased use of pregabalin in France (Dufayet et al., 2021), Australia (Cairns et al., 2019), Serbia (Antunovic et al., 2023), and even in Algeria(Zergui et al., 2023). This study's outcomes align with a separate investigation conducted in Belgium (Servais et al., 2023), highlighting that young first-generation immigrant men, primarily from North Africa, notably Algeria, have a propensity for pregabalin addiction. This correlation bolsters the conclusions drawn from this research, in contrast to the results obtained from the study conducted in the Wilaya of Setif, which indicates that benzodiazepines rank second (Benboudiaf et al., 2023).

4.1 Study of the Influence of Age on the Nature of the Consumed Molecule:

The study of the influence of age on drug consumption shows that there is no difference in the type of drugs consumed among the different age groups studied (X^2 values ranging from 0.364 to 6.654). This can be attributed to the small number of subjects under the age of 21.

4.2 Polydrug consumption

polydrug use, or mixed consumption, is defined as the simultaneous or close-in-time use of two or more psychoactive substances, leading to an overlap of effects putting a significant strain on the body and the mind (Beck et al., 2008). Indeed, polydrug consumption complicates treatment due to the challenge of managing multiple, simultaneous, or sequential withdrawals, the emergence of substitute consumption (alcohol after opioid withdrawal), the misuse of benzodiazepine prescriptions, and multiple concurrent social problems, etc. (Kiiru et al., 2022).

Recently, poly-consumption among young people has been a central topic of discussion. In the case of this study, 94.6% of subjects consume two or more psychoactive substances, the same result obtained in a study carried out in Sidi Bel Abbes in Algeria (Ismail et al., 2021), 76.1% consume three or more molecules, and 50% of subjects consume four or more molecules. **Figure 5** below presents the distribution of subjects according to the number of psychoactive substances consumed.

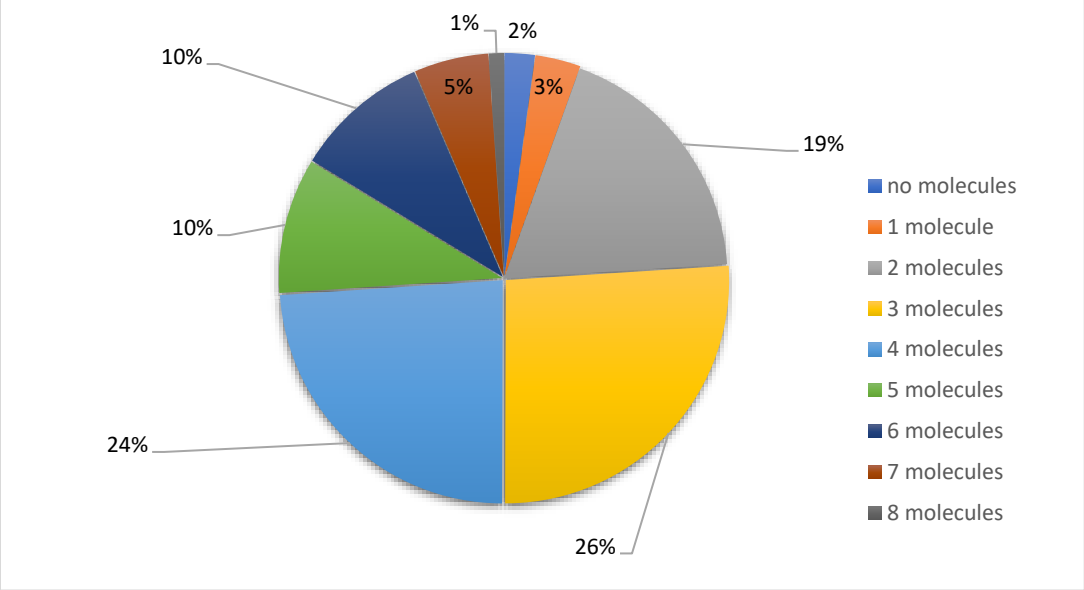

Figure 5: Distribution of prevalence of polydrug addiction

The analysis of the results regarding different combinations of psychoactive molecules among drug addicts, **Figure 6**, shows that the most common combination is that of gabapentinoids with cannabis. Consumption of these molecules alone is observed in 3.30% of cases. This percentage increases to 36.20% of subjects when considering their consumption with other molecules, where two types of cocktails are frequently consumed:

-Combination with opioids and other molecules (23% of subjects)
-Combination with benzodiazepines and other molecules (11% of subjects)

The second notable association is between opioids and benzodiazepines, observed in 24% of cases with other substances. This combination is highly prevalent worldwide (Jones et al., 2012).

It is worth noting that the consumption of all four families of substances alone (Ga, CA, BZD, Opi) was observed in 4.4% of subjects.

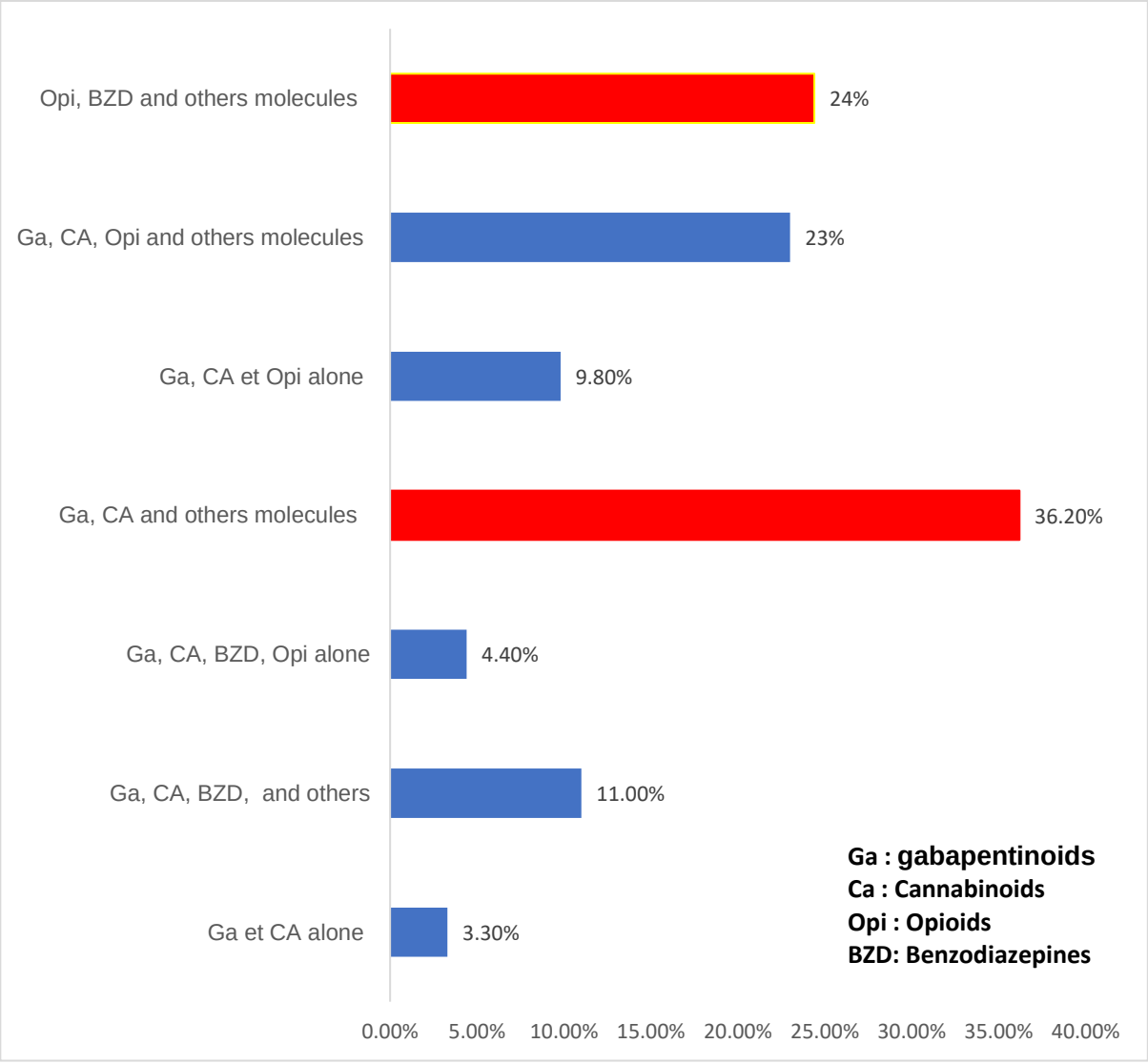

Figure 6: Most common combination of drugs observed among poly drug users

5. Conclusion:

Conducted in the Wilaya of Algiers, this study offers a comprehensive characterization of drug consumption profiles among addicts. With a margin of error of 9.35% concerning population size, it identifies pregabalin and THC as the two most consumed drugs, often combined in poly-drug use. Surprisingly, opioid consumption is notably high, especially when considering drug consumption by family, prompting concerns about a potential opioid crisis in Algiers. The study's detailed analysis provides insights

that could significantly contribute to the development of informed public health policies, targeted interventions, and tailored support systems, addressing the dynamic challenges presented by substance abuse in the city and adding valuable perspectives to the global discourse on substance addiction trends.

5.1 Limitations and suggestion

The limitation of this study is the relatively small number of analyzed samples, which could be increased, along with the geographic diversity of the sample locations, to provide a comprehensive overview of drug trends. This would allow us to examine drug consumption patterns not only in Algiers but throughout Algeria.

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