

Toxicological and biological profile of patients with psychoactive substance use disorders at the psychiatric unit of Point G University Hospital, Bamako, Mali

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ABSTRACT

Psychoactive substance (PAS) use among young people represents a major global public health problem, particularly in Sub-Saharan Africa. This study assessed the biological and toxicological profiles of patients admitted to the tertiary psychiatric care unit of Point G University Hospital, Bamako, Mali, with PAS-related psychiatric disorders. A prospective cross-sectional study was conducted among 100 patients admitted for PAS-related disorders. Urine samples were tested for cannabis, cocaine, amphetamines, alcohol, and opiates, while blood tests were performed to evaluate biochemical and hematological parameters. Males represented 97% of the population, with cannabis and alcohol being the most commonly self-reported substances. Toxicology tests confirmed the presence of cannabis, amphetamine, and cocaine, with a significant difference between the patient's self-reported data and the laboratory results. Biochemical markers revealed abnormalities with $p < 0.05$ for transaminases and creatinine. The mismatch between self-reports and toxicological results underscores the need for systematic biological monitoring. The establishment of a poison control centre, psychosocial support, and prevention strategies are necessary to tackle PAS abuse.

INTRODUCTION

Psychoactive substances (PAS) use is a major global public health problem, contributing to global morbidity, mortality, and social disruption. According to the World Drug Report 2023, 292 million people worldwide were using illicit drugs in 2021, a 20% increase from the previous decade, with 64 million people diagnosed with substance use disorders. In Sub-Saharan Africa, the burden of PAS uses rapidly increased, driven by socioeconomic vulnerabilities, urbanization, and limited access to prevention and curative services [1, 2]. PAS use is associated with increased risk behaviors, including violence and unprotected sex, and serious health outcomes, such as sexually transmitted infections, mental health problems, and chronic diseases [3-5]. The consequences extend beyond the individual and affect families and society.

PAS use is generally defined as the regular use of any natural or synthetic substance for its psychoactive properties in amounts that cause harm to users or others [6]. In sub-Saharan Africa, particularly in Mali, this use has reached alarming levels [3, 7]. In 2022, 161 patients sought treatment for drug use at the psychiatry unit of the Point G University Hospital (CHU Point G) in Mali [8]. Our previous work has shown that addictive substances accounted for 5.2% of poisoning between 2000 and 2010, with an



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average age of use of 24 years and motivations mainly recreational or performance-related [7, 9].

Most previous studies have been limited in scope, focusing primarily on analyzing the epidemiological profile of PAS use. Few studies, however, have explored the detection of these substances in biological matrices. Thus, the present study characterizes the sociodemographic and substance use profiles, assesses biochemical and AST parameters to evaluate the physiological impact of PAS use in patients admitted to the psychiatry department of CHU Point G for PAS-related disorders.

MATERIALS AND METHODS

Study design

We conducted a prospective cross-sectional study from May 2024 to November 2025 at the psychiatry department of CHU Point G, the primary mental health care provider within Mali's conventional health system. Patients admitted for PAS-related disorders during the study period were eligible for inclusion. All patients admitted for PAS-related disorders during the study period were invited to attend. Exclusion criteria included inability or refusal to give informed consent or refusal, serious psychiatric conditions that would impair participation, and pre-existing medical conditions (diabetes mellitus, obesity, hypertension, or other systemic diseases) that might interfere with biochemical and hematological parameters.

Ethical consideration

Approval of the study was obtained from the Protocol Review Committee of the School of Pharmacy and the Department of Psychiatry (No. 2024/170/FAPH-DECANAT). Informed consent was obtained from all participants. For patients under the age of 18, consent from a parent or legal guardian, as well as the participants' assent, was obtained. Study data were processed anonymously and confidentially.

Sample collection and analysis

The samples were analyzed at the Department of Pharmacology and Toxicology (SPT) of the National Institute of Public Health (INSP). Urine and blood samples were collected within 48 hours of admission. Urine samples were screened for delta-9-tetrahydrocannabinol (THC) (Siemens Healthcare Diagnostics, USA, Ref 9N039UL), cocaine metabolites (Siemens Healthcare Diagnostics, USA, Ref 9H03UL), opioids (Siemens Healthcare Diagnostics, USA, Ref 9B039UL), and amphetamines (Siemens Healthcare Diagnostics, USA, Ref 9C039UL/) using the enzyme-multiplied immunoassay technique (EMIT) with the Viva-ProE instrument. This equipment allows qualitative and/or quantitative determination of medications as well as psychoactive substances (alcohol, cannabis, cocaine, amphetamine, etc.) in urine, whole blood, serum, or cerebrospinal fluid. Positivity thresholds were established for THC 20 ng/mL, cocaine 150 ng/mL, opioids 300 ng/mL, and amphetamines 500 ng/mL, consistent with manufacturer recommendations. The concentration of psychoactive substances was determined using the following formula:

$$C = F \times Abs$$

Where C: concentration of the substance in ng/mL; F: fixed factor (the ratio of the standard concentration to the standard absorbance); and Abs: absorbance of the sample.

Biochemical parameters such as creatinine, blood glucose, alanine aminotransferase (ALT), and AST (aspartate aminotransferase) were measured using the Kenza 240 THX biochemical analyzer (Biosystems, Spain). Complete blood count (CBC) was performed using the Atellica Hema 850 analyzer (Siemens Healthineers, Germany). All analyses were conducted according to ISO 15189 protocols.

Statistical analysis

Data were entered using Word and Excel 2016 for Windows. Analysis and processing were performed using R software, version 4.4.1. Spearman's correlation was applied to assess associations between cannabis concentrations and biological parameters in patients who tested positive. The *chi*-square test was used to compare categorical variables. Since the biological parameters did not follow a normal distribution, the Wilcoxon test was applied. Linear regression was performed on biological parameters (ALT, AST, creatinine, and plasma glucose) to assess association with cannabis positivity while controlling for age, self-reported alcohol consumption, and poly-substance use. The significance level was set at $p < 0.05$.

RESULTS

Demographic characteristics and distribution of participants

Analysis of the sociodemographic data (Table 1) reveals a typical profile of patients treated for PAS-related disorders at CHU Point G. The population is overwhelmingly male (97%), and those under 31 years of age accounted for 82% of the total. High school and university students accounted for 27%, and 36% of patients had a college education or higher.

As shown in Table 2, self-reported substance use revealed multiple substances, with cannabis being the most prevalent (76), followed by alcohol (48) and tobacco (30), while homemade mixtures containing promethazine and codeine were reported by 4 participants. Polysubstance use was reported by 62 participants.

Table 1. Demographic characteristics and distribution of participants.

Variable	Number (N)
Sex	
Male	97
Female	3
Age (years)	
14-19	14
20-25	42
26-30	26
31-35	11
36-40	4
41-45	4
Marital status	
Married	8
Separated	1
Single	91
Education	
Quranic school	3
Non-scholarized	8
Primary school	25

High school	27
Above high school	36
Profession	
Unemployed	27
Employed	66
Students	17
Location	
Bamako	66
Regions	44

Table 2. Distribution of self-reported psychoactive substances among patients.

Substances	Type	Addictive molecule	Classes
Cannabis (N=76)	Natural	Tetrahydrocannabinoid	Psychodysleptic
Alcohol (N=48)	Semisynthetic	Ethanol	Psycholeptic
Tobacco (N=30)	Semisynthetic	Nicotine	Psychoanaleptic
Tramadol (N=26)	Semisynthetic	Opioid	Psycholeptic
Cocaine (N=18)	Natural	Methylbenzolecgonine	Psychodysleptic
Amphetamines (N=10)	Semisynthetic	Methylphenethylamine	Psychoanaleptic
Déri(Phenergan + Neocodion) (N=4)	Synthetic	Promethazine + Camphosulfonate codein	Phenothiazine + Antitussif opioid

Comparison of self-report and toxicological confirmation of participants

Laboratory toxicology testing detected cannabis in 30/100 urine samples, amphetamines and cocaine in one sample each. No opioids were detected. Comparison of self-report versus toxicological confirmation revealed notable discrepancies. Among 70 participants reporting cannabis use, 38.6% tested positive; conversely, 3 participants tested positive for cannabis despite not reporting its use. For amphetamines, 9 participants reported use but tested negative, while one tested positive without reporting use (Figure 1).

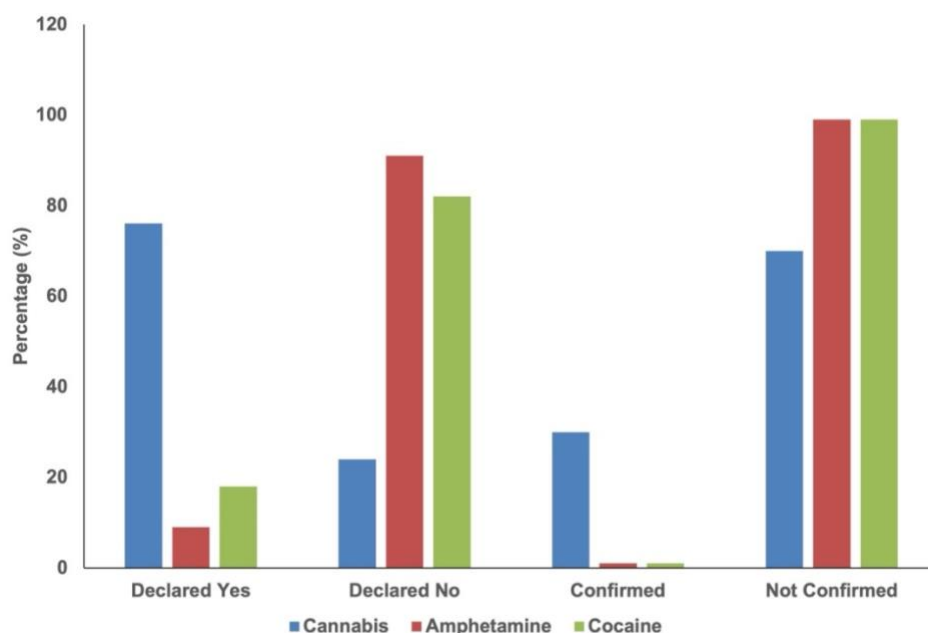


Figure 1. Discordance between self-reported psychoactive substance use and toxicological confirmation among participants.

Biochemical profile of participants

Biochemical analysis (n=69) revealed abnormalities in multiple parameters. Elevated ALT was observed in 36.2% of patients, and elevated AST in 31.9%. Hyperglycemia was present in 14.5%, while 23.2% had hypoglycemia. Creatinine levels were elevated in only 2.9% of patients (Table 3).

Table 3. Assessment of biochemical parameters.

Parameter	Category	N	Interpretations
Plasma glucose (mmol/L)	< 4.10	16	Low
	[4.10 – 6.10]	43	Normal
	> 6.10	10	High
Creatinine (μmol/L)	< 62	19	Low
	[62 - 120]	48	Normal
	> 120	2	High
ALT (U/L)	[0 - 45]	44	Normal
	> 45	25	High
AST (U/L)	[0 - 40]	47	Normal
	> 40	22	High
TOTAL		69	

Biochemical profile by cannabis status and self-reported use frequency of participants

Patients testing positive for cannabis demonstrated significantly lower mean ALT (24.65±17.83 vs 52.50±35.17 U/L, $p<0.001$) and AST (23.30±20.81 vs 48.39±51.16 U/L, $p=0.006$) compared to cannabis-negative patients. Mean creatinine was significantly higher in cannabis-positive patients (81.17±26.66 vs 70.33±19.45 μmol/L, $p=0.045$). No significant differences were observed for blood glucose, red blood cell count (RBC), white blood cell count (WBC), or platelet count (PLT) (Table 4).

There is no statistically significant relationship between the frequency of cannabis use and the normality of biochemical parameters (Table 5). Also, the frequency of cannabis use is not associated with the normality of patients' hematological parameters ($p > 0.05$). Frequency (whether once a day or more than three times a day) does not influence the normality of laboratory results in this study.

Table 4. Association between cannabis toxicology status and biological parameters.

Parameter	Cannabis		
	Positive Mean ± SD	Negative Mean ± SD	p-value
ALT (U/L)	24.65±17.83	52.50±35.17	<0.001*
AST (U/L)	23.30± 20.81	48.39±51.16	0.006*
Creatinine (μmol/ L)	81.17±26.66	70.33±19.45	0.045*
Plasma glucose (mmol/L)	6.622±6.883	5.39±4.20	0.91
RBC (g/dl)	5.11± 0.74	4.88±0.64	0.223
WBC (10 ³ /mm ³)	7.08± 3.32	6.53±2.84	0.48
PLT (10 ³ /mm ³)	245± 61.56	273.6±97.87	0.42

RBC, Red blood cells; WBC, White blood cells; CREAT, creatinine; PLT, platelets; PCT, plateletcrit; ALT/AST, Transaminases. Wilcoxon test was used, N=69. * $p<0.05$ is considered significant.

Table 5. Association between self-reported frequency of cannabis use and biochemical and hematological parameters.

Frequency	Status	ALT	AST	CREAT	GLU	RBC	WBC	PLT
Once/day	Conformed	7	11	12	10	15	12	14
	Not conformed	8	4	3	5	0	3	1
Once/month	Conformed	0	1	0	1	1	0	1
	Not conformed	1	0	1	0	0	1	0
Once/Week	Conformed	0	0	1	1	1	0	1
	Not conformed	1	1	0	0	0	1	0
Twice/day	Conformed	8	7	7	8	9	9	10
	Not conformed	3	4	4	3	2	2	1
3 times/day	Conformed	10	12	10	9	14	14	12
	Not conformed	6	4	6	7	1	1	3
>3 times/day	Conformed	11	11	11	10	15	12	12
	Not conformed	5	5	5	6	1	4	4
Test Chi ² (p-value)		0.140	0.426	0.779	0.922	0.622	0.068	0.842

RBC (g/dl), Red blood cells; WBC (10³/mm³), White blood cells; CREAT (μmol/L), creatinine; PLT (10³/mm³), platelets; PCT (10³/mm³), plateletcrit; ALT/AST (U/L), Transaminases; GLU (mmol/L), plasma glucose; and Chi² test was used, N=100.

Association between cannabis use and hepatic and renal biomarkers in participants

Figure 2, as shown below, allows for the rapid identification of internal correlations between biological parameters and a positive cannabis test result. There is no correlation between cannabis concentration in patients who tested positive and biological parameters.

After adjusting for age, alcohol consumption, and poly-substance use (Model 2), a positive cannabis test result was associated with a decrease in log-ALT ($\beta = -0.770$, $p < 0.001$) and log-AST ($\beta = -1.176$, $p = 0.007$), while it was associated with an increase in creatinine ($\beta = 0.138$, $p < 0.026$). No significant association was observed for blood glucose levels and cannabis positivity (Table 6).

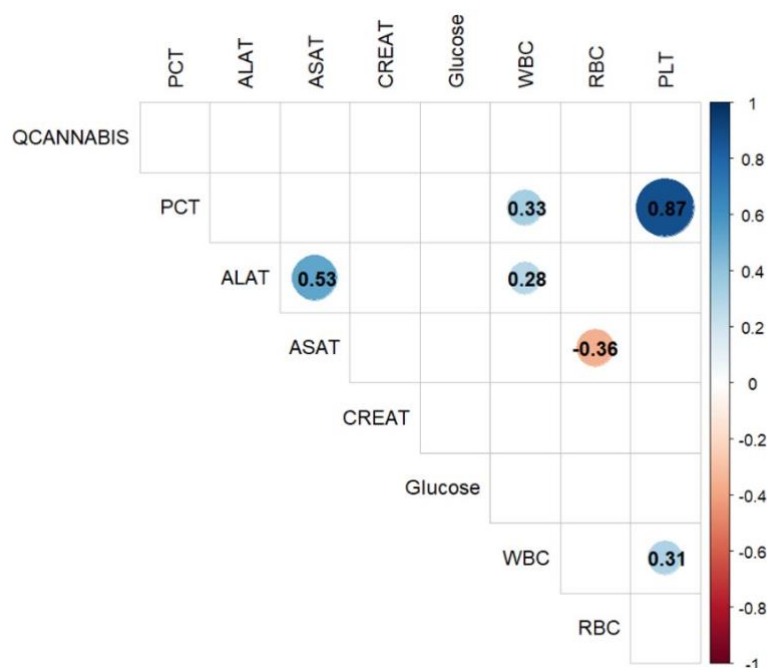


Figure 1. Spearman's correlation matrix between cannabis toxicological positivity and key biological parameters in cannabis-positive patients. RBC (g/dl), Red blood cells; WBC (10³/mm³), White blood cells; CREAT (μmol/L), creatinine; PLT (10³/mm³), platelets; PCT (10³/mm³), plateletcrit; ALT/AST (U/L), Transaminases; GLU (mmol/L), plasma glucose; Chi² test was used, N=69.

Table 6. Association between cannabis status and transaminases, creatinine, and plasma glucose.

	Cannabis	
	β (95 % IC)	p-value
Log (ALT)		
Model 1	-0.746 (-1.121; -0.371)	< 0.001*
Model 2	-0.770 (-1.16; -0.378)	< 0.001*
Log (AST)		
Model 1	-1.118 (-1.927; -0.310)	0.007*
Model 2	-1.176 (-2.022; -0.330)	0.007*
Log (Creatinine)		
Model 1	0.132 (0.015; -0.250)	0.028*
Model 2	0.138 (0.017; -0.260)	0.026*
Log (Plasma glucose)		
Model 1	+0.089 (-0.144; -0.322)	0.449
Model 2	+0.099 (-0.145; -0.342)	0.420

Model 1: crude model. Model 2: adjusted for age (years), self-reported alcohol consumption, and poly-substance use. Data are presented as β (95% CI). N= 69; *P < 0.05 is considered significant.

DISCUSSION

To date, no study has provided a comprehensive biological and toxicological characterization of patients with PAS use disorders in Mali. The current findings reveal a predominantly young male population with high rates of polysubstance use, significant discordance between self-reported and biologically confirmed substance use, and notable biochemical abnormalities suggesting physiological impact, particularly on hepatic function.

The study population was predominantly male (97 %), and more than 80 % of patients were under 31 years of age, with a mean age of 25 years. This profile is consistent with observations made in other sub-Saharan African countries, such as that reported by J Ebrahim, J Adams [10], where prevalence ranged from 27% to 12% among young people under 24 years of age. Similarly, in Kenya, a study of street children found that their average age was 13 years. Similarly, in Burkina Faso, men constituted the majority (95%) with an average age of 27 [11]. We found that 66% of patients were from urban areas, which is slightly lower than in a previous study conducted by SP Coulibaly, H Dolo [12], which was 57%. This result suggests that gender and the urban environment, with its socioeconomic constraints and opportunities for access to substances, play a decisive role in PAS use.

Cannabis emerged as the predominant substance (76 cases), confirming its central role in substance use disorders in sub-Saharan Africa, as highlighted by several regional studies [7, 10]. The prevalence of alcohol (48 cases), tobacco (30 cases), and tramadol (28 cases) was similar to the findings reported by S Coulibaly, A Traore [8]. In another study involving 1,105 participants, tobacco ranked first at 32%, followed by cannabis and alcohol [12], while the most commonly used substances were amphetamines, cocaine, opioids, and cannabis. Similarly, the use of homemade mixtures (Phenergan and Neocodion) indicates a shift toward semisynthetic and diverted substances, increasing the complexity of treatment [13, 14].

A critical finding is discordance between self-reported use and toxicological confirmation. Only 38.6% who self-reported using cannabis tested positive, while 3 patients who tested positive reported no use. This discrepancy exceeds that reported in trauma patients [15]. This difference can be attributed to many factors, including the limited detection window of the tests, individual variability of metabolism, reporting bias, methods of administration, sample storage, the type of sample collected, and the time interval between use and testing [16-18]. This discordance underscores the limitation of relying

on self-reported data alone in clinical and research settings and supports the inclusion of routine toxicological testing.

PAS are known to interfere with biological parameters. We observed changes in biochemical and hematological markers among the participants. Studies have shown that chronic intake of PAS is associated with increased ALT levels and leukocyte counts [19]. For example, alcohol consumption is known to affect CYP2E1, causing oxidative stress and hepatic inflammation, leading to increased levels of transaminases [20-22]. Accumulation of oxidative stress is linked to chronic inflammation, which can lead to liver cancer [21, 23].

The finding that cannabis positive patients had significantly lower mean transaminase levels than cannabis negative patients was unexpected and contradicts results of studies from Pakistan [24] and Iraq [25], which observed a modest elevation in AST and ALT. However, elevated transaminases were observed in 36.2% for ALT and 31.9% for AST of our overall cohort, suggesting hepatic impact. Similarly, D Guzel, AB Yazici [26] found that cannabis smokers had significant alterations in hematological parameters compared with non-smokers. The lower biochemical parameters observed in our sample could result from several co-factors, including liver enzyme inhibition, confounding factors such as diet, and individual variability. Higher creatinine in cannabis positive patients may suggest early impact on the kidneys, although within normal ranges.

Strengths of this study include the systematic biological confirmation of substance use, biochemical and hematological tests, and the focus on an underrepresented population in Sub-Saharan Africa. Nevertheless, this study has some limitations. The cross-sectional design prevents causal inference; the single-center setting limits generalizability to other Malian regions; the limited sample size may reduce statistical power for subgroup analyses; the detection window of immunoassays in urine and their susceptibility to give false-positive or false-negative results can lead to an underestimated substance use prevalence.

CONCLUSIONS

Psychoactive substance use in Mali primarily affects a young, male population that is socioeconomically and medically vulnerable. Cannabis remains the primary substance, but poly-substance use is also present. The biochemical abnormalities observed suggest the physiological impact of PAS. The discrepancy between patients' reports and laboratory results highlights the limitations of self-assessment and the importance of toxicological testing. These findings highlight the need for a poison control center and a multidisciplinary approach integrating biological screening, psychosocial support, and prevention strategies that are adapted to the sociocultural context of Mali and Sub-Saharan Africa.

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AUTHOR CONTRIBUTIONS

TD and FB conceived and designed the research; MF and FB performed the research and acquired the data; MF, FB, and KK analysed the data; TD and MF interpreted the data

and wrote the manuscript; and TD, SPC, and SKC had primary responsibility for the final content. All authors were involved in drafting and revising the manuscript.

CONFLICTS OF INTEREST

There is no conflict of interest among the authors.

DATA AVAILABILITY

Research data includes sensitive or confidential information such as patient data.

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