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Impact of Dilute Formalin Solution (Madaran Sukudie) Use on Health-Related Quality of Life and Psychiatric Morbidity among Users in Zaria, North-Western Nigeria

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Abstract

Background: Madaran Sukudie, a dilute formalin-based psychoactive substance, has gained popularity as an unconventional and dangerous drug among youth in Nigeria. This study investigates its prevalence, psychiatric morbidity, and impact on health-related quality of life (HRQoL) in Zaria, North-Western Nigeria.

Method: A cross-sectional survey was conducted among 450 users using a multi-stage stratified sampling method. Participants completed the WHOQoL-BREF, Drug Use Disorders Identification Test (DUDIT), and the MINI Neuropsychiatric Interview for depression and generalized anxiety disorder. Data analysis included chi-square tests, independent t-tests, and binary logistic regression.

Result:The prevalence of Madaran Sukudie use was 67.5% (n=304/450). Psychiatric morbidity was high: 42.9% (n=193) had generalised anxiety disorder and 34.2% (n=154) had depressive episodes. Early initiation and prolonged use significantly predicted poor HRQoL, especially in the psychological and social domains ($p < 0.001$).

Conclusion: Users reported lower mean HRQoL scores compared to non-users across all domains. Madaran Sukudie use poses serious risks to mental health and well-being. Urgent culturally sensitive public health interventions are needed to address this emerging threat.

Keywords: Depression, Generalised Anxiety Disorder, Madaran Sukudie, New Psychoactive Substances, Quality of Life

Background

The proliferation of new psychoactive substances (NPS) presents a significant challenge to public health systems globally. Among these, Madaran Sukudie—a street name for a dilute solution of formalin—has emerged in Nigeria as a troubling trend among young adults, particularly in North-Western cities such as Zaria. Formalin, a solution of formaldehyde, is primarily used for embalming and tissue preservation, and its misuse for recreational purposes constitutes a severe toxicological hazard.

Although methamphetamine and opioids have been the focal point of substance abuse research in Nigeria,[1-3] anecdotal and preliminary reports from urban communities highlight an alarming surge in the misuse of Madaran Sukudie. Ingesting or inhaling formaldehyde is linked to neuropsychiatric toxicity, cognitive dysfunction, mucosal corrosion, and multi-organ failure. [4,5] These effects may further translate into long-term impairments in psychosocial functioning and quality of life.

Importantly, the link between substance use and psychiatric morbidity—especially depression and anxiety—has been well documented.[6-9] However, no formal scientific study to date has investigated the relationship between Madaran Sukudie use and these outcomes in Nigeria. Furthermore, while Health-Related Quality of Life (HRQoL) has emerged as a vital indicator of disease burden, it remains underexplored in relation to emerging substances.

This study seeks to fill this gap by assessing the prevalence of Madaran Sukudie use, associated psychiatric morbidity, and its impact on HRQoL in Zaria. By contextualising the findings within Nigeria's sociocultural and economic frameworks, this research aims to inform appropriate prevention and intervention strategies.

Method

Study Participants

The study population consisted of adults aged 18 years and above who had used Madaran Sukudie (dilute formalin solution) within the past year. Participants were residents of Zaria metropolis in Kaduna State, North-Western Nigeria—a region identified by relevant authorities as having a high prevalence of psychoactive substance use.

Study Design

This was a descriptive cross-sectional study conducted in Zaria, Kaduna State, between January and June 2024.

Sample Size Determination

The minimum sample size was calculated using Cochran's formula for cross-sectional studies, adjusting for a 10% non-response rate, leading to a final target of 450 participants. A multi-stage stratified random sampling technique was used to ensure representation across various socio-demographic strata and communities within Zaria. The sampling process involved the following steps:

Stage One – Cluster Selection: Zaria metropolis was divided into administrative wards. From these, five wards with known high-risk drug use based on local Nigeria Drugs Law Enforcement Agency (NDLEA) reports and community leader insights were purposively selected: Samaru, Tudun Wada, Sabon Gari, Gyellesu, and Kongo.

Stage Two – Stratification by Demographics: Within each ward, stratification was done based on age group (18–24, 25–34, 35+), gender, education level, and employment status to ensure inclusivity and diversity. Lists of potential participants were generated from community registers, rehabilitation centres, and youth groups.

Stage Three – Random Sampling: From each stratum, eligible participants were selected using simple random sampling. A sampling frame was created using prescreened lists of individuals

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known to use substances. A random number generator (Stat Trek Random Number Generator) was used to select names without replacement.

Eligibility Screening: Individuals selected were screened using a brief checklist: (a) aged 18 or older, (b) residing in Zaria for at least the past 12 months, (c) self-reported use of Madaran Sukudie in the last 12 months, and (d) capacity to give informed consent. Individuals who had severe cognitive impairment were excluded. All participants gave written informed consent before data collection.

Study Instruments

A questionnaire was used to collect key variables, including gender, age, marital status, ethnicity, employment status, estimate of income, nature of employment, educational level, and frequency of use. The Drug Use Disorders Identification Test (DUDIT) is an 11-item screening tool developed by Berman et al. and was used to identify patterns of drug use and potential abuse or dependence. It is suitable for both clinical and general population settings. Items are scored on a 0–4 Likert scale, with higher scores indicating more problematic drug use. A cut-off score of ≥6 for women and ≥8 for men was used to identify likely drug-related problems. The tool has been validated in Nigerian populations and shows good internal consistency (Cronbach's alpha > 0.85). The Severity of Dependence Scale (SDS) was used to measure psychological components of dependence on various substances. Scores range from 0 to 15, with higher scores reflecting greater severity. A cut-off score of ≥4 indicates possible dependence. The SDS has been shown to be reliable and valid across different cultures and

Study Procedure

The study was carried out between January 2024 and June 2024, spanning a six-month period. Participants were administered sociodemographic questionnaire, DUDIT, SDS, WHOQoL-BREF, and the MINI to obtain sociodemographic variables, identify patterns of Madaran Sukudie use, psychological components of dependence on Madaran Sukudie, participants quality of life, and psychiatric morbidity among participants (depression and generalised anxiety disorder), respectively.

substances, including among African populations. The World Health Organisation Quality of Life Instrument – BREF (WHOQoL-BREF) The WHOQoL-BREF was used to assess the quality of life in four domains: physical health, psychological health, social relationships, and environment. Items are rated on a 5-point Likert scale (low score of 1 and high score of 5) to determine a raw item score. Subsequently, the mean score for each domain is calculated, resulting in a mean score per domain that is between 4 and 20. Finally, this mean domain score is then multiplied by 4 to transform the domain score into a scaled score, with a higher score indicating a higher QOL. When transformed by multiplying ×4, each domain score is then comparable with scores used in the original WHOQOL – 100. This instrument has been validated across cultures and is widely used in both clinical and research settings.

MINI International Neuropsychiatric Interview (MINI), version 7.0, was used to assess major Axis I psychiatric disorders based on DSM-5 criteria. In this study, only the modules for major depressive episode and generalised anxiety disorder were used. The MINI is brief (administered in approximately 15–20 minutes) and validated across multiple languages, including Hausa and English. It has demonstrated high inter-rater and test–retest reliability (kappa > 0.75). All instruments were translated into the Hausa language (the major spoken language in the study area) using the World Health Organisation's iterative back-translation technique. All instruments have been used and validated in the study area[2, 6,10]

The lead researcher and 8 research assistants (4 registrars and 4 senior registrars in psychiatry) are all indigenous Hausa and proficient bilingual persons with good command of both English and Hausa languages. The research assistants were

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trained in the use of MINI and the administration of the other instruments by two consultant psychiatrists, including the lead author. During the training sessions, the scoring system of each tool, the importance of unbiased observation, and the nuances in interpreting responses were explained and demonstrated by the trainers. The team engaged in role-playing exercises to simulate actual interviews with Madaran Sukudie users, allowing us to practise administering the questionnaires and scoring responses. Afterward, the lead researcher and the eight research assistants then assessed the psychiatric morbidity and quality of life among 45 Madaran Sukudie users in Unguwan Sarki, Kaduna, Nigeria. This constituted 10% of the sample size (not part of the main study and not in the same study location). The lead researcher and each of the research assistants independently assessed the same participants using the standardised tools. The results from this pilot study were then collated. Using Cohen's Kappa, a statistical measure of inter-rater agreement for categorical items, to calculate the consistency of ratings among the team members, the Cohen's Kappa score was found to be 0.75, indicating substantial agreement among the raters.

Each eligible participant in the main study was given a pencil, an eraser, and the four self-administered questionnaires (socio-demographic questionnaire, DUDIT, SDA, and the WHOQOL-BREF) while trained clinicians (8 trained resident doctors and the lead researcher) administered the major depressive and generalised anxiety modules of the Mini International Neuropsychiatric Interview (MINI) version. The Hausa-translated versions of the instruments were administered to participants who could not speak the English language. The self-administered questionnaires were filled in the presence of the trained clinicians, in case they needed further guidance or clarifications. The interview took an average of 20-25 minutes per participant to complete.

Ethical Consideration

Ethical approval was obtained from the Research Ethics Committee of Ahmadu Bello University Teaching Hospital, Shika-Zaria. Written informed consent was obtained from all respondents.

Statistical Analysis

Data were analyzed using SPSS version 29. Descriptive statistics summarized participant characteristics. Chi-square tests and independent t-tests assessed group differences, while logistic regression identified predictors of psychiatric morbidity. The test of significance was set at $p<0.05$ two-tailed and level of confidence set at 95% confidence interval.

Results

Study Participants

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Results

Table 1 summarizes the characteristics of the 450 participants. Most were male (71.1%, n=320) and aged 25–34 years (46.7%, n=210). The majority were single (64.4%, n=290) and unemployed

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(42.9%, n=193), while 44.0% (n=198) had completed secondary education.

Madaran Sukudie use was reported by 67.5% (n=304) of respondents. Among them, 43.3% (n=131) used it daily, 31.6% (n=96) weekly, and 25.1% (n=77) monthly (Table 2).

Among users, 42.9% (n=193) met the criteria for generalized anxiety disorder, while 34.2% (n=154) had major depression (Table 3).

Users of Madaran Sukudie had significantly lower WHOQoL-BREF scores across all domains. Mean psychological scores were particularly low (38.9 ± 12.1) compared to non-users (61.2 ± 10.7), $p < 0.001$ (Table 4).

Logistic regression revealed that early initiation (before age 18), daily use, and unemployment were significant predictors of psychiatric morbidity (Table 5).

Table 1: Sociodemographic Characteristics (N = 450)

Variable	Frequency	Percent (%)
Age 18–24	120	26.7
Age ≥25	210	46.7
Male	320	71.1
Female	130	28.9
Unemployed	193	42.9
Employed	257	57.1
Single	290	64.4
Married	160	35.6

Table 2: Frequency of Madaran Sukudie Use (N = 304)

Frequency of Use	Frequency	Percentage (%)
Daily	**131**	**43.3**
Weekly	**96**	**31.6**
Monthly	**77**	**25.1**

Table 3: Psychiatric Morbidity among Users (N = 304)

Diagnosis	Frequency	Percentage (%)
Depression	**154**	**34.2**
Generalized Anxiety Disorder	**193**	**42.9**

Table 4: WHOQoL-BREF Scores by Domain

Domain	Users Mean (SD)	Non-users Mean (SD)	p-value
Physical	45.1 (10.3)	62.5 (9.8)	<0.001
Psychological	38.9 (12.1)	61.2 (10.7)	<0.001
Social	42.3 (11.6)	58.9 (9.9)	<0.001
Environmental	47.0 (9.7)	60.3 (8.4)	<0.001

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Table 5: Logistic Regression – Predictors of Psychiatric Morbidity

Predictor	Odds Ratio (OR)	95% CI	p-value
Early initiation (<18)	2.6	1.7–4.0	<0.001
Daily use	3.2	2.1–5.1	<0.001
Unemployment	**1.9**	**1.2–3.0**	**0.005**

Discussion

This study offers novel insights into the mental health consequences and quality-of-life outcomes associated with *Madaran Sukudie* (dilute formalin solution) use in North-Western Nigeria. The findings reveal high levels of psychiatric morbidity and significantly impaired health-related quality of life (HRQoL) among users. These results are consistent with international and local studies on other psychoactive substances, particularly methamphetamine, volatile inhalants, and codeine syrup.

The prevalence of Madaran Sukudie use among the study population was 67.5%, with most users being male (71.1%), young, single, and unemployed. This male predominance suggests gender-specific vulnerabilities to substance use in this setting, which may be shaped by sociocultural norms, greater social freedom of males, peer group dynamics, and reduced stigma for male substance use compared to females[1].

These demographic patterns mirror previous studies in Nigeria, where drug misuse among young unemployed males has been attributed to peer pressure, economic hardship, and poor social support systems. Similar male-dominated patterns of use are also reported in other regions, including South Africa and Indonesia. For instance, Dumbili *et al.* found high prevalence of codeine and tramadol abuse among young, unemployed males in South-Eastern Nigeria, attributing it to peer pressure, economic stress, and lack of social support systems[1]. Similarly, a study in Lagos State reported that 71.8% of inhalant users were male youth aged between 18 and 30 years, citing similar social and environmental drivers[2].

Outside Nigeria, a study in South Africa identified glue and solvent abuse among adolescents as common in urban informal settlements, often co-occurring with poverty and educational drop-out[18]. Comparable findings were also observed in Indonesia, where youth abuse of formalin-based inhalants was associated with low employment and educational attainment[4]. Future interventions should consider gender-responsive strategies, including tailored mental health messaging and prevention programs for young males.

Psychiatric morbidity among users was considerable: 42.9% met criteria for generalized anxiety disorder (GAD), while 34.2% had major depressive episodes. These findings align with global evidence suggesting a high burden of psychiatric disorders among individuals who use psychoactive substances[5]. Polysubstance use, which is common among substance-using populations, may confound the associations observed in this study[6]. Although this study focused specifically on Madaran Sukudie, some participants may have concurrently used other

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substances, potentially influencing psychiatric and HRQoL outcomes.

These figures are comparable to findings by McKetin *et al*., who found that chronic methamphetamine users in Australia exhibited high rates of anxiety (37%) and depression (32%)[5]. Similarly, Aliyu *et al*. in Kano reported that 36.7% of tramadol users had clinically significant depressive symptoms[6]. Similarly, a comparable prevalence of mental disorders among substance users was also reported in a Ugandan study, where 40.1% had at least one current mood or anxiety disorder[7]. These psychiatric outcomes are often linked to the neurotoxic effects of substances, social disconnection, and stigma.

The toxicological profile of formalin (Madaran Sukudie) supports a biological basis for these psychiatric outcomes[8]. Formaldehyde exposure has neurotoxic effects that impair cognitive and emotional regulation. Repeated exposure may amplify psychiatric vulnerability through neuroinflammation and neurotransmitter disruption[8].

HRQoL was significantly reduced in users across all domains, especially psychological and social domains. These findings are in line with those by Brandová and Kajanová, who reported that women with substance use disorders in Eastern Europe had substantially poorer HRQoL, especially in mental health domains [9]. In Nigeria, Oshodi *et al*. found that adolescents abusing volatile solvents reported impaired social functioning, poor academic performance, and lower life satisfaction[10]. Likewise, a study among recovering addicts in Ibadan documented low HRQoL scores even months after detoxification, suggesting long-term residual impact[11].

Globally, Wang and Wu conducted a cross-sectional survey in the U.S. and found that substance users scored significantly lower across all HRQoL domains compared to non-users, with mental health status being the strongest mediator[12]. These findings emphasize the social and mental deterioration associated with chronic substance use. Gender-sensitive rehabilitation approaches may be important, given emerging evidence that male and female users experience and respond to interventions differently[10].

Early initiation (before age 18), daily use, and unemployment were significant predictors of psychiatric morbidity. These factors underline the importance of early prevention and targeted social support interventions for at-risk groups. These findings align with the global literature, where early substance initiation is linked to worse psychiatric outcomes and prolonged dependence[13]. For instance, UNODC has emphasized the association between early onset drug use and high-risk behaviours, cognitive deficits, and comorbid depression[14]. Similarly, Gossop *et al*. reported that frequency and pattern of use are better predictors of relapse and mental illness than demographic variables alone[15]. Unemployment, as a predictor, further underlines the socio-economic drivers of substance use. Studies in Kenya and South Africa have shown that youth unemployment, urban migration, and lack of social capital are major determinants of risky drug behaviour[16,17].

In addition, the sampling strategy, while stratified and community-based, may have underrepresented hidden or more severely affected users who are not listed in community registers or affiliated with known drug-using groups. Supplementing the current method with snowball sampling could improve coverage, especially of hidden or marginalized users. However, this would introduce limitations related to selection bias and generalizability, which must be carefully managed.

Conclusion

Madaran Sukudie is an emerging psychoactive substance with grave consequences for mental

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health and quality of life. Prevention and treatment strategies should prioritize this substance alongside better-known drugs. The findings of this study highlight an urgent need for public health responses to address *Madaran Sukudie* use. Prevention strategies must clearly underscore the importance of early prevention and targeted social support interventions for at-risk groups (i.e. male youth). Prevention strategies must involve community education on the dangers of formalin and other chemical inhalants, youth-targeted mental health services, particularly in schools and community centers, regulation and monitoring of access to formaldehyde and similar industrial chemicals, and socioeconomic interventions such as vocational training and employment opportunities to reduce vulnerability among unemployed youth. Furthermore, treatment centers should include HRQoL assessments as routine outcome measures for rehabilitation and reintegration programmes.

Limitation

This study has a number of limitations. The cross-sectional design limits causal inferences, and associations observed cannot establish temporality. The findings may also not be generalizable to broader populations beyond the study area.

Second, although efforts were made to ensure representative sampling, the sampling frame was based on community lists and known networks, potentially excluding highly marginalized or hidden users, such as those experiencing homelessness or severe dependence. Future studies may benefit from including snowball sampling techniques, while accounting for the potential biases they introduce.

Third, potential polysubstance use was not systematically assessed. Some participants may have used other psychoactive substances concurrently, potentially influencing psychiatric symptoms and HRQoL outcomes attributed solely to Madaran Sukudie.

Lastly, while validated tools were used, self-reported data are subject to recall and social desirability biases, which may underestimate true prevalence or severity.

CONFLICT OF INTEREST

The authors declare no competing interests.

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