American Journal of Medicine and Medical Sciences 2025, 15(4): 1067-1073
DOI: 10.5923/j.ajmms.20251504.44

Synthetic Cathinone Dependence and Suicidal Behavior: A Multi-Factor Analysis of Risk Factors

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Abstract Synthetic cathinones (SC) use has been associated with severe psychiatric consequences, including an increased risk of suicidal behavior. This study investigates the relationship between SC dependence and suicidality risk. **Methods**: a retrospective observational cohort study was conducted at the Republican Specialized Scientific-Practical Medical Center of Mental Health in Uzbekistan from 2022 to 2024. The study included 138 patients, divided into two groups: 98 individuals with synthetic cathinone dependence (ICD-10: F15.2) and 40 individuals dependent on other psychoactive substances (pregabalin, gabapentin, carbamazepine, tropicamide). Suicidality risk was assessed using the Columbia-Suicide Severity Rating Scale (C-SSRS), and statistical analyses included logistic regression models, linear regression, and forest plot analysis to identify key risk and protective factors. **Results**: unadjusted analysis indicated a significant association between Alfa-PVP use and increased suicidality risk (OR = 2.76, p = 0.026). Other substances showed no significant effects on suicidality. However, after adjusting for demographic and psychosocial factors, no psychoactive substance remained a significant predictor of suicidality. **Conclusions**: while synthetic cathinones contribute to psychiatric instability, their direct effect on suicidality is overshadowed by psychosocial determinants. The findings emphasize the importance of family-centered interventions, mental health education, and targeted prevention strategies to mitigate suicidality risk among individuals with substance use disorders.

Keywords Synthetic cathinones, Suicidality, Alfa-PVP, Pregabalin, Suicidal behavior, Substance use disorder, Psychosocial factors

1. Introduction

The emergence and increasing prevalence of new psychoactive substances (NPS) have become a growing global concern [1]. One particularly alarming aspect is the expansion of the NPS market, which persists despite stabilization or even reductions in the use of internationally controlled drugs. A crucial factor contributing to this trend is the role of the Internet, which facilitates the rapid dissemination of NPS, particularly among younger demographics [2]. Among the most commonly distributed NPS categories, synthetic cathinones (SCs) have gained significant traction in the illicit drug market [3]. Given the widespread and growing consumption of these substances, a comprehensive evaluation of their consequences is imperative.

In the past decade, synthetic cathinones have increasingly displaced traditional substances of abuse, drawing greater attention from researchers and public health officials [4]. Their widespread availability and affordability, coupled with misconceptions about their legality and perceived safety, contribute to their increasing use. Many users mistakenly believe that SCs pose minimal health risks, leading to an underestimation of their addictive potential and long-term consequences [5,6]. However, clinical observations frequently reveal that SC use often occurs alongside other substances,

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Received: Mar. 20, 2025; Accepted: Apr. 10, 2025; Published: Apr. 12, 2025
Published online at http://journal.sapub.org/ajmms

complicating both the clinical presentation and the severity of associated medical and social consequences [7]. Individuals consuming SCs often exhibit rapid-onset psychopathological changes, including neurotoxic damage to the central nervous system, personality deterioration, an increased likelihood of intoxication-induced psychosis, and severe behavioral disturbances [6].

SC consumption has been linked to a notable rise in mortality rates among dependent individuals. These fatalities are not always solely attributed to somatic complications but may result from external factors such as accidental overdoses, life-threatening behavioral consequences, or suicides, which remain underexplored in scientific literature [8,9]. This underscores the necessity of a more thorough examination of the risk factors associated with SC dependence, with a particular focus on suicidal tendencies among affected individuals.

Thus, the present study aims to examine the relationship between synthetic cathinone use and suicidal behavior.

2. Materials and Methods

Study Design

This study utilizes a retrospective observational cohort approach to examine the association between synthetic cathinone (SC) use and suicidal behavior. The research includes two patient groups who received treatment at the Republican Specialized Scientific-Practical Medical Center of Mental Health, under the Ministry of Health of the Republic of Uzbekistan, during the 2022–2024 period. Data were obtained from clinical records, patient questionnaires, and statistical analyses to ensure a comprehensive assessment.

Study Population

The study included 138 patients, stratified into two groups: main group included 98 patients diagnosed with dependence on synthetic cathinones (ICD-10 code F15.2); comparison group consisted of 40 patients with dependence on other substances (such as pregabalin, gabapentin, carbamazepine or tropicamide). Comparison group was selected based on the similarity of clinical effects. Patients were selected based on pre-defined inclusion and exclusion criteria.

Inclusion Criteria:

1. Verified diagnosis of dependence on psychostimulants (ICD-10 code F15.2), established according to ICD-10 criteria.
2. Age: Between 16 and 65 years.
3. Informed consent to participate in the study.

Exclusion Criteria:

1. Presence of severe comorbid somatic diseases in the decompensation stage.
2. Acute infectious diseases.
3. Specific mental disorders, including:
   - o Epilepsy.
   - o Schizophrenia, schizotypal, and delusional disorders (ICD-10 codes F20–F29).
4. Other psychotic disorders caused by alternative factors (e.g., traumatic brain injury).
5. Refusal to participate in the study.

Data Collection Methods

Data collection was conducted using multiple methodologies. Clinical records and documentation were reviewed retrospectively, including psychiatric evaluations, substance use history, and treatment outcomes. Additionally, questionnaires and structured clinical interviews were administered, incorporating standardized tools to assess substance use patterns, suicidality, and psychosocial factors. The Columbia-Suicide Severity Rating Scale (C-SSRS) was employed to evaluate suicidality risk, while additional questionnaires were used to collect demographic information and substance use history.

The confirmation of psychoactive substance use was based on a comprehensive verification process utilizing multiple data sources. Self-report questionnaires were initially used to document substance consumption patterns. To ensure objective validation, rapid urine drug screening was conducted to detect the presence of synthetic cathinones and other substances. Furthermore, medical records were examined to retrieve documented evidence regarding past substance use and prior treatment history.

Independent and Dependent Variables

The study analyzed multiple independent and dependent variables to explore the association between psychoactive substance use and suicidality risk. The independent variables included the type of psychoactive substances consumed, specifically Alfa-PVP, mephedrone, pregabalin, gabapentin, carbamazepine, and tropicamide. In addition, demographic characteristics such as age (evaluated both as a continuous and categorical variable) and gender (male/female) were taken into account.

The primary dependent variable was the risk of suicidality, categorized into high-risk and low-risk groups. Classification was based on psychiatric evaluations and scores obtained from the Columbia-Suicide Severity Rating Scale (C-SSRS).

Statistical Data Analysis

A multi-step analytical approach was employed to assess the relationship between synthetic cathinone (SC) use and suicidality risk. The analysis incorporated both unadjusted and adjusted statistical models, as well as visualization techniques to identify key predictors and potential risk factors.

1. Unadjusted Analysis

To establish a preliminary association between SC use and suicidality risk, odds ratios (ORs) and relative risks (RRs) were calculated. These measures provided insights into the likelihood of suicidal behavior among SC users compared to non-users. Additionally, chi-square tests were applied to assess differences between categorical variables, identifying significant demographic or behavioral patterns within the study population.

2. Adjusted Logistic Regression Models

To account for potential confounding factors, logistic regression models were implemented. These models controlled for key sociodemographic variables, including age, sex, education level, family environment, and marital status. By adjusting for these factors, the study aimed to isolate the independent effects of SC and other psychoactive substances on suicidality risk, while considering the influence of psychosocial determinants.

3. Linear Regression Analysis

Further statistical evaluation was conducted using linear regression models to explore predictors of suicidality severity. The model fit was assessed using R^2, adjusted R^2, and F-tests, ensuring that the explanatory variables contributed meaningfully to the variance in suicidality risk. Additionally, ANOVA tests were used to identify the most significant predictors among sociodemographic and behavioral factors, providing a deeper understanding of the underlying determinants of suicidal behavior.

4. Forest Plot Analysis

To visually represent key findings, forest plot analysis was used to illustrate the relative influence of protective and risk factors associated with suicidality. This approach allowed for a clear and intuitive comparison of the variables contributing to increased or decreased suicidality risk.

Statistical Significance and Limitations

A p-value < 0.05 was considered statistically significant for all analyses. While the study employed rigorous statistical techniques, multicollinearity was not explicitly tested, and sensitivity analysis was not conducted, which represents a limitation in the interpretation of the findings.

Use of Large Language Models (LLMs)

To refine the text in English and ensure proper citation formatting, Large Language Models (LLMs) were utilized.

3. Results and Discussion

Descriptive Statistics and Demographic Characteristics of the Sample

This study examined 138 patients, divided into two distinct groups based on their substance dependence. The main group consisted of 98 individuals diagnosed with synthetic cathinone dependence (ICD-10 code F15.2), while the comparison group included 40 patients with dependence on other psychoactive substances, such as pregabalin, gabapentin, carbamazepine, or tropicamide. By analyzing demographic factors, we aimed to identify potential differences between these groups.

Age Distribution. The patients' ages varied widely, with a median age of 29 years across the entire sample. A closer look revealed a slight difference between groups: the median age in the main group was 30 years (with an interquartile range of 26 to 35 years), while in the comparison group, it was 28.5 years (ranging from 24 to 35 years). However, statistical analysis indicated that these variations were not significant, suggesting a similar age profile between the two groups.

Sex Distribution. The vast majority of participants were male, accounting for 93.48% of the total sample. Specifically, men made up 90.82% of the main group and 100% of the comparison group. Interestingly, all nine female patients were found in the main group, with none in the comparison group. While this distribution suggests a possible trend, statistical analysis did not confirm a significant association between substance type and gender. Nevertheless, the predominance of male patients aligns with existing research indicating that men are more frequently diagnosed with substance dependence.

Education Level. Educational backgrounds varied among the participants, with the majority having completed secondary special education (57.97%). A smaller portion had attained higher education (14.49%), while 20.29% had completed only secondary education. Additionally, 7.25% of patients had some incomplete higher education. When comparing the groups, the proportion of individuals with a university degree was slightly higher in the comparison group (20.00%) than in the main group (12.24%), though this difference was not statistically significant. These findings suggest that education level does not appear to play a decisive role in determining the type of substance a person becomes dependent on.

Marital Status. The analysis of family status revealed that slightly more than half of the participants were married (52.90%), while a significant proportion remained single (36.96%). Additionally, 6.52% of the sample had experienced divorce, and 3.62% had remarried. When comparing the two groups, no meaningful statistical differences emerged, indicating that relationship status was not a distinguishing factor between patients with different substance dependencies.

Substance Use and Suicidality Risk (Unadjusted Analysis)

The initial analysis assessed the unadjusted associations between six substances and binary suicidality. Key results are summarized in **Table 1**, which reports odds ratios (OR), relative risks (RR), and the number needed to treat (NNT).

Alfa-PVP: A Significant Risk Factor

Among the substances studied, Alfa-PVP emerged as a strong predictor of increased suicidality. Statistical analysis indicated that individuals using Alfa-PVP had a significantly higher risk of experiencing severe suicidal tendencies (OR = 2.76, 95% CI: 1.19–6.39, p = 0.026; RR = 2.07, 95% CI: 1.09–3.95, p = 0.026). Moreover, this substance exhibited a harmful effect, as reflected in the number needed to treat for harm (NNT harm) of 4.97. This means that for every five individuals exposed to Alfa-PVP, one additional case of high suicidality occurs. These findings underscore the dangers associated with Alfa-PVP use and highlight the urgent need for targeted interventions to address its mental health consequences.

Table 1. Unadjusted Analysis of Substances' Impact on Binary Suicidality

Substance	Yes (High)	Yes (Low)	No (High)	No (Low)	Odds Ratio (95% CI)	Chi²	p-Value	Relative Risk (95% CI)	NNT (Benefit / Harm)	Interpretation
Alfa-PVP	35	55	9	39	2.76 (1.19–6.39)*	4.96	0.026	2.07 (1.09–3.95)*	4.97 (Harm)	Significant association; harmful effect.
Mefedron	5	7	39	87	1.59 (0.48–5.33)	0.19	0.662	1.35 (0.66–2.76)	9.33 (Harm)	No significant effect.
Pregabalin	6	32	38	62	0.31 (0.12–0.80)*	5.27	0.022	0.42 (0.19–0.90)*	-4.50 (Benefit)	Significant association; protective effect.
Gabapentin	0.5[1]	8	44	86	0.12 (0.01–2.18)	1.72	0.189	0.17 (0.01–2.59)	-3.58 (Benefit)	No significant effect.
Carbamazepine	0.5[1]	4	44	90	0.26 (0.01–4.94)	0.21	0.647	0.34 (0.03–4.67)	-4.60 (Benefit)	No significant effect.
Tropicamide	1	5	43	89	0.41 (0.05–3.65)	0.14	0.711	0.51 (0.08–3.11)	-6.29 (Benefit)	No significant effect.

Note: *p < 0.05 indicates statistical significance.
[1] represent 0.5 adjustment for zero values
Key Findings: Substance Use and Suicidality Risk

Pregabalin: A Potential Protective Effect

In contrast, Pregabalin demonstrated a protective role against suicidality. The statistical analysis showed a significant reduction in risk for those using Pregabalin (OR = 0.31, 95% CI: 0.12–0.80, p = 0.022; RR = 0.42, 95% CI: 0.19–0.90, p = 0.026). This protective effect is further emphasized by the NNT (benefit) of -4.50, meaning that for every five individuals taking Pregabalin, one case of high suicidality is prevented. These results suggest that Pregabalin may have stabilizing effects on mood, warranting further investigation into its potential therapeutic applications for individuals at risk of suicidal behavior.

Other Substances: No Significant Association

The study also assessed the impact of Mephedrone, Gabapentin, Carbamazepine, and Tropicamide on suicidality risk. However, no statistically significant associations were found for these substances, as indicated by their wide confidence intervals crossing 1. This suggests that, within the studied sample, these substances neither increased nor decreased the likelihood of high suicidality in a meaningful way.

Implication

These findings highlight Alfa-PVP as a substance of concern, potentially exacerbating suicidality, while Pregabalin may serve as a protective factor. However, further exploration in adjusted models is necessary to validate these initial observations.

Multivariate Logistic Regression Analysis (Adjusted Model)

A binomial logistic regression model was applied to assess the relationship between substances and suicidality, adjusted for the effects of other substances. The results are detailed in **Table 2**, which presents the adjusted odds ratios and p-values for each predictor.

Implication

Substance-specific effects on suicidality may be mediated or moderated by broader psychosocial and demographic factors. This necessitates a more comprehensive model that includes additional predictors beyond substance use.

Psychosocial Predictors of Suicidality (Adjusted Model)

The final model incorporated demographic, family, and psychosocial factors alongside substance use. This model explained a substantial portion of the variance in suicidality (R^2McFadden = 0.41), as shown in **Table 3**. Key predictors are visualized in the accompanying forest plot (Figure 1), which highlights the most impactful variables.

Education: Lower Educational Attainment as a Protective Factor

Surprisingly, individuals with a lower level of education (secondary education compared to higher education) were found to have a significantly lower risk of suicidality (OR = 0.01, 95% CI: 3.18E-04–0.33, p = 0.01). This unexpected finding may reflect reduced exposure to high-stress environments, such as demanding professional settings, or differences in social expectations that accompany various educational levels. While further research is needed to explore this relationship, the results suggest that education-related stressors could be a contributing factor to suicidality risk.

Family Environment: A Strong Protective Influence

One of the most notable protective factors in this study was a positive family environment, which significantly reduced the odds of suicidality (OR = 0.089, 95% CI: 0.015–0.515, p = 0.007). This finding reinforces the well-documented role of emotional and social support in mental health, emphasizing that stable and supportive family dynamics can serve as a

crucial buffer against psychological distress. Individuals who experience nurturing family relationships may be better equipped to handle stress and cope with life's challenges, reducing their vulnerability to suicidal thoughts and behaviors.

Table 2. Summary of Adjusted Logistic Regression (All Substances)

Predictor	Estimate (β)	SE	Odds Ratio (95% CI)	Z	p-Value	Interpretation
Intercept	-1.26	1.16	0.28 (0.03–2.76)	-1.09	0.277	Not significant.
Alfa-PVP	0.78	1.15	2.19 (0.23–20.74)	0.68	0.496	No significant effect.
Mefedron	0.66	0.97	1.93 (0.29–13.02)	0.68	0.499	No significant effect.
Pregabalin	-0.08	1.23	0.93 (0.08–10.31)	-0.06	0.949	No significant effect.
Gabapentin	-15.63	1307.05	1.62E-07 (0–Inf)	-0.01	0.990	No significant effect.
Carbamazepine	-14.50	1670.53	5.05E-07 (0–Inf)	-0.01	0.993	No significant effect.
Tropicamide	-0.28	1.19	0.76 (0.07–7.78)	-0.24	0.814	No significant effect.

Key Findings

1. Substance Effects:

- None of the substances, including Alfa-PVP (OR = 2.19, p = 0.496) and Pregabalin (OR = 0.93, p = 0.949), remained significant after adjustment (Table 2).
- This suggests that the initial associations observed in the unadjusted analysis were likely confounded by other variables or co-occurrence with other substances.

Table 3. Adjusted Logistic Regression (All Variables)

Predictor	Estimate (β)	SE	Odds Ratio (95% CI)	Z	p-Value	Interpretation
Education: Secondary vs. Higher	-4.58	1.77	0.010 (0.00–0.33)*	-2.59	0.01	Significant protective factor.
Family Environment: Positive vs. Negative	-2.42	0.90	0.089 (0.015–0.515)*	-2.70	0.007	Significant protective factor.
Family Status: Divorced vs. Single	3.49	1.58	32.80 (1.49–724.09)*	2.21	0.027	Significant risk factor.
Family Status: Remarried vs. Single	8.71	2.84	6059.25 (23.11–1.59x10^6)*	3.07	0.002	Extremely high risk; interpret cautiously.
Children: Yes vs. No	-2.30	0.98	0.10 (0.015–0.676)*	-2.36	0.018	Significant protective factor.
Age	-0.02	0.045	0.98 (0.90–1.07)	-0.48	0.633	Not significant.
Sex: Male vs. Female	0.41	1.19	1.50 (0.15–15.52)	0.34	0.732	Not significant.

Note: *p < 0.05 indicates statistical significance.

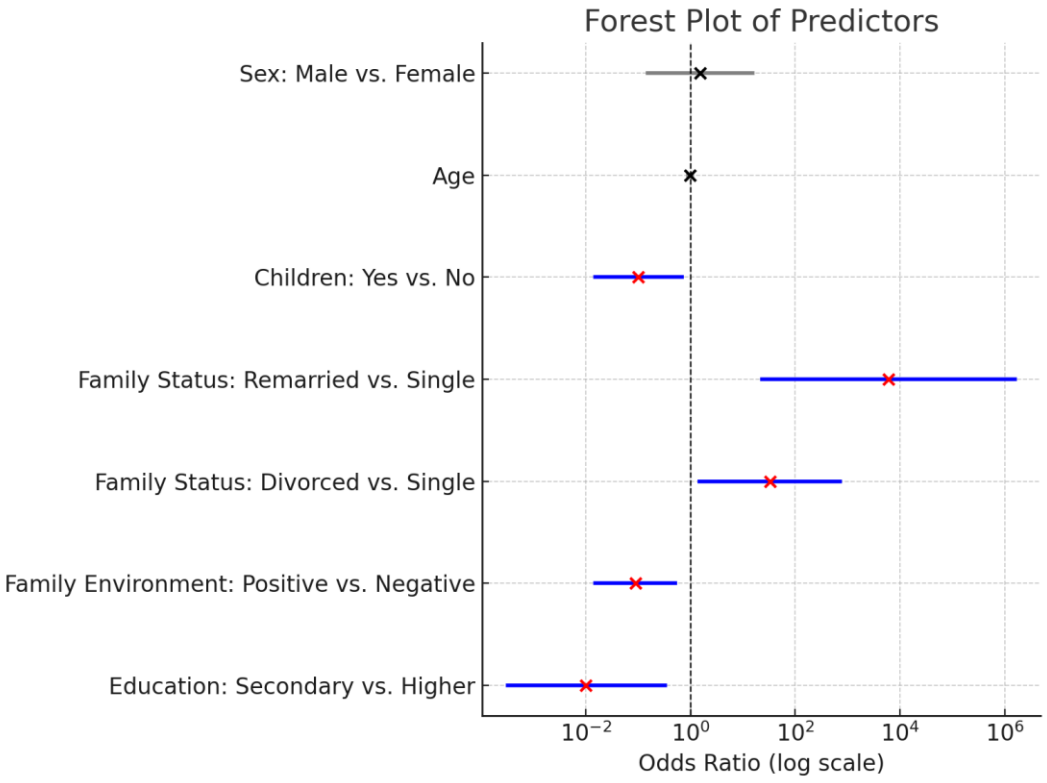

Figure 1. Forest Plot of Key Predictors from Fully Adjusted Model

Family Status: Divorce and Remarriage as High-Risk Factors

Marital status also emerged as a significant predictor, with divorced individuals showing a substantially higher risk of suicidality compared to those who were single (OR = 32.80, p = 0.027). However, the most extreme risk was associated with remarriage, which exhibited an exceptionally high odds ratio (OR = 6059.25, p = 0.002). While this figure suggests a strong association, the wide confidence intervals indicate a need for cautious interpretation. It is possible that individuals who remarry after experiencing major emotional distress may still carry underlying psychological vulnerabilities, contributing to heightened suicidality risk.

Children: A Protective Factor Against Suicidality

Having children was another factor associated with lower suicidality risk (OR = 0.10, 95% CI: 0.015–0.676, p = 0.018). This effect may be attributed to the sense of responsibility and social support that comes with parenting. Individuals with children often experience a greater sense of purpose and a stronger motivation to maintain their well-being. Additionally, the presence of a stable family structure may provide a critical emotional support system, reducing the likelihood of suicidal thoughts or behaviors.

Non-Significant Predictors

- Substance use, age, sex, financial situation, and recent stress events were not significant in the fully adjusted model (Table 3, Figure 1). This indicates that substance effects may be overshadowed by broader family and demographic factors.

Discussion

While substance abuse, particularly with synthetic cathinones, has been associated with significant risks for suicidal ideation and behavior, these effects often become overshadowed by stronger predictors such as socio-environmental and psychological factors.

The data from this study highlight that the direct contribution of substances like Alfa-PVP, Mefedron, and Pregabalin to suicidal behavior was statistically non-significant. For instance, predictors such as the environment in the parents' family, quality of familial relationships, and sexual satisfaction had more robust associations with suicidality severity. These findings align with prior research suggesting that the psychosocial environment plays a pivotal role in modulating the risks associated with substance abuse.

Substances may act as amplifiers rather than primary drivers of suicidality. Their use exacerbates existing vulnerabilities but does not independently predict behavior. The high neurotoxic effects of synthetic cathinones on the CNS contribute to rapid cognitive and social decline, potentially setting the stage for suicidal thoughts.

However, it is the interaction with chronic familial dysfunction, absence of protective factors like children, and negative life events that ultimately pushes individuals toward suicidal crises.

Moreover, socio-environmental variables such as education level, positive family dynamics, and satisfactory sexual life emerged as significant protective factors. These results underline the multifaceted nature of suicidality, where substance abuse is one element within a broader context of interpersonal, environmental, and psychological influences.

The findings advocate for a nuanced understanding of suicidality among individuals with substance use disorders. Interventions must target stronger predictors, such as improving familial relationships, promoting socio-educational opportunities, and addressing co-occurring psychological issues, rather than focusing solely on substance use cessation. Addressing these broader factors can dilute the exacerbating effects of drug abuse on suicidality and create more resilient protective frameworks for at-risk populations.

4. Conclusions

The study highlights the multifaceted nature of suicidality, demonstrating that substance use alone is not a direct predictor but rather a factor that interacts with underlying social and psychological vulnerabilities. The strong impact of family dynamics, marital status, and parental roles suggests that addressing suicidality requires a shift from an individual-centered approach to a family-centered one.

From a policy perspective, the findings emphasize the need for targeted prevention programs focusing on both substance use education and family resilience. In clinical practice, integrating family assessments into psychiatric care could enhance early detection and intervention for at-risk individuals. Finally, further research is needed to understand the long-term trajectories of suicidality, particularly in relation to early-life experiences and socio-cultural influences.

By acknowledging the complex interplay of biological, psychological, and social factors, future interventions can become more effective, personalized, and impactful, ultimately reducing the burden of suicidality among vulnerable populations.

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