Middle East Current Psychiatry

RESEARCH

Open Access

Comparative analysis of addiction severity and renal functions in patients with synthetic cannabinoid use disorder versus cannabis use disorder

Rana Walid Hamimy[1*], Momtaz Mohamed Abd El Wahab[1] and Rania Mamdouh Mohamed[1]

Abstract

Background The use of synthetic cannabinoids (SC) has become a concerning public health issue due to their potential adverse effects on both physical and mental health. Understanding the effect of cannabis and synthetic cannabinoids use on kidney functions and creatinine phosphokinase-total (CPK) levels is essential for targeted intervention and patient care.

Methods This cross-sectional study aimed to assess addiction severity using the Addiction Severity Index (ASI) and kidney functions in 45 patients with SC use disorder and compare them to 45 patients with cannabis use disorder (CUD). Participants were recruited from the addiction outpatient clinics and inpatient ward of the addiction psychiatry unit at "Kasr Al Aini Hospital," Cairo University.

Results There was a statistically significant difference between the 2 groups regarding the Addiction Severity Index domains, where patients with SC use disorder had higher scores in all domains of the ASI.

Regarding kidney functions and CPK-total levels, there was a significant difference in the serum CPK-total level ($p < 0.05$) between the 2 groups; however, there was no significant difference regarding the other kidney function tests (serum creatinine, urea, blood urea nitrogen, and estimated glomerular filtration rate).

As for the correlative analysis, there was a significant correlation between some domains of the ASI and the kidney function tests in both patient groups.

Conclusion Our results strongly suggest that SC may have a more hazardous and detrimental impact on individuals, encompassing various aspects of addiction severity such as physical health, psychological well-being, social functioning, and overall quality of life. Our findings also highlight the potential risk of elevated CPK-total levels in patients with SC use disorder; therefore, regular monitoring of kidney function in patients with synthetic cannabinoid use disorder is crucial for guiding appropriate treatment interventions and mitigating adverse health outcomes.

Keywords Synthetic cannabinoids, Cannabis, Cannabis use disorder, Addiction Severity Index, Kidney functions, Creatinine phosphokinase

Introduction

Synthetic cannabinoids (SC), also known as "Spice" or "K2," are a class of designer drugs designed to mimic the effects of natural cannabis. They are synthetic compounds that bind to the same cannabinoid receptors as delta-9-tetrahydrocannabinol (THC), the main

*Correspondence:
Rana Walid Hamimy
rana-walid@kasralainy.edu.eg
[1] Department of Psychiatry, Cairo University, Giza, Egypt

psychoactive component of cannabis. Unlike THC, which has only weak partial agonist action at the Cannabinoid 1 receptor, most SCs act as full agonists. Consequently, SCs are significantly more potent, with a 4–5 times greater affinity and a potency that ranges from 40 to 660 times higher than THC [1].

Over the past decade, the use of SCs has increased globally due to their easy accessibility, low cost, and the misconception that they provide a legal and safer alternative to cannabis. In the annual statistical analysis done by the United Nations Office on Drugs and Crime, the lifetime prevalence of SC use globally ranged from 0.2 to 2.8%, with the highest percentage in Latvia (2.8% in 2015), Australia (2.8% in 2015), and Chile (2.5% in 2016) [2].

In the recent update of the National Survey for Addiction in Egypt, cannabis (natural and synthetic) was one of the most regularly used drugs, where the prevalence of cannabis use was 3.9% and that of SC use was 0.2% [3].

The adverse effects of SC consumption have raised significant concerns among healthcare professionals. Numerous case reports and small-scale studies have linked SC use to various psychiatric complications, including anxiety, panic attacks, agitation, hallucinations, paranoia, and acute psychotic episodes [4–6].

Apart from psychiatric complications, chronic drug abuse, including SC, may also exert detrimental effects on various organ systems, including the kidneys [7]. SC-related acute kidney injury is a growing public health concern.

In a recent systematic review examining instances of acute kidney injury (AKI) among users of SCs, researchers found a total of 55 reported cases. The causes of SC-related AKI were primarily attributed to acute tubular damage, acute tubulointerstitial nephritis, and acute interstitial nephritis, with decreasing frequency of occurrence [8]. However, the impact of chronic SC use on kidney function and its comparison to cannabis use disorder patients have not been comprehensively investigated.

Considering the growing prevalence of SC use and its potential harmful effects, assessing kidney function in SC use disorder patients is essential for understanding the overall health implications of SC consumption.

In this study, we hypothesized that regular SC use might cause kidney injury (elevation in renal function tests; blood urea nitrogen, urea, creatinine, estimated glomerular filtration rate (eGFR), and CPK-total). The work aims to assess addiction severity using the Addiction Severity Index and to measure kidney functions and CPK-total in patients with SC use disorder and those with cannabis use disorder and to assess the correlation between kidney functions and addiction severity.

Methods

Study design

A cross-sectional study was conducted at the Addiction Psychiatry Unit of the Psychiatry Department at Kasr Al Aini Hospital, School of Medicine, Cairo University. The study utilized a convenient sample of individuals diagnosed with cannabis use disorder and SC use disorder. Data collection took place between December 2021 and December 2022.

Participants

The study included 90 participants, divided into two groups. Group I consisted of 45 individuals aged 18 to 35, who met the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria for SC use disorder as their primary addictive substance. Group II comprised 45 individuals aged 18 to 35, who met the DSM-5 criteria for cannabis use disorder as their primary addictive substance.

Patients with chronic medical conditions such as cardiac, hepatic, renal, and neurological diseases were excluded from the study. Uncorrected visual and hearing impairments were also excluded.

Patients with positive urine drug screening for substances other than the main substance (using ABON Multi-Drug One Strip Screen Test Panel) were excluded as well.

Before participating in the research, each participant was required to complete and provide written informed consent.

Procedure

Recruitment began in December 2021 in the Addiction Psychiatry inpatient unit and outpatient clinic of Kasr Al Ainy Psychiatry and Addiction Hospital.

Once consent was obtained, a urine sample was collected for urine toxicology screening. Participants who tested positive for substances other than the main substance of each group were excluded.

Patients with SC use disorder who tested negative for SCs but reported regular use were not included in the study. Only those who tested positive were included.

Clinical interviews (including detailed substance history) and tests lasted between 60 to 90 min, with breaks allowed as needed. Some subjects required two sessions to complete the interview.

After the interview, blood samples were collected from participants with their consent.

The recruitment phase ended in December 2022.

Ethical approval

The proposal was approved by the Scientific and Ethical Committee of the Department of Psychiatry at Kasr

Al-Ainy in September 2021. Subsequently, the research received approval from the Ethical Committee of Cairo University in October 2021 (Registration number: MD-298–2021).

Measures

Psychometric tools

(1) Structured Clinical Interview for DSM IV-TR Axis I Disorders (SCID I) [9]: Arabic version[10].

The SCID is a diagnostic interview designed for use by mental health professionals to evaluate thirty-three psychiatric disorders outlined in the fourth edition of the DSM-IV by the American Psychiatric Association (APA). In this study, the SCID I was used to confirm the diagnosis of substance dependence.

(2) Addiction Severity Index (ASI) version 5 [11], Arabic Version [12].

The ASI is a semi-structured interview that provides a comprehensive assessment of the challenges faced by individuals with substance use disorders. It consists of seven subscales, designed to measure the severity of issues across various domains, including medical, employment, alcohol and drug use, legal, family/social, and psychiatric problems.

Laboratory investigations

Urine drug screen

Urine samples were collected from all subjects at the time of assessment, and tested for the presence of SCs (Strox), tramadol, morphine, amphetamine, barbiturates, benzodiazepines, and cannabis using ABON Multi-Drug (One Strip Screen Test Panel and ABON SCs Strip Screen Test Panel (Urine), Product by: ABON Bio pharm (Hangzhou) Co., Ltd.).

Blood tests

Three milliliters of venous blood was drawn into a sterile, properly labeled tube. After collection, the blood was allowed to clot, followed by centrifugation at 3000 rpm for 10 min. The resulting serum was then carefully extracted and stored at − 20 °C until ready for assay. The following investigations will be measured:

- Serum urea, blood urea nitrogen, creatinine.
- Creatinine phosphokinase-total.

Based on the results of the blood investigations, the estimated glomerular filtration rate was calculated using Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) Eq[13].

Statistical analysis

The data underwent coding and entry using the Statistical Package for the Social Sciences (SPSS) version 25 (IBM Corp., Armonk, NY, USA). Quantitative data were summarized using mean, standard deviation, median, minimum, and maximum values, while categorical data were summarized using frequency (count) and relative frequency (percentage).

Comparisons between quantitative variables were conducted using the non-parametric Kruskal–Wallis and Mann–Whitney tests [14]. For comparing categorical data, the chi-square (χ[1]) test was employed, with the exact test being utilized when the expected frequency was less than 5 [15].

Correlations between quantitative variables were assessed using the Spearman correlation coefficient [16]. A significance level of $p < 0.05$ was adopted to determine statistical significance.

Results

The participants in both groups were matched regarding age, education, occupation, marital status, and residency.

As for the substance data, the age of onset of substance use in patients with SC use disorder was 22.6 ± 4.5 years, with a total duration of use of 3.5 ± 2.4 years. For those with cannabis use disorder, the age of onset was 17.8 ± 2.5 years, with a total duration of use of 11.5 ± 5.6 years. The average dose of SC used per day was 5 ± 2.6 cigarettes as reported by patients in the SC group while the average dose of cannabis was 3 ± 1.5 cigarettes in the cannabis group. There was a significant difference between the two groups regarding these parameters (*p*-value < 0.001, < 0.001, < 0.001, respectively) (Table 1).

Table 1 Substance use data among both groups

	Group I SC group *N* = 45		Group II Cannabis group *N* = 45		*P*-value
	Mean	± SD	Mean	± SD	
Age of onset	22.6	4.5	17.8	2.5	< 0.001*
Duration of use/years	3.5	2.4	11.5	5.6	< 0.001*
Dose (average) (no. of cigarettes)	5	2.6	3	1.5	< 0.001*

* *P*-value < 0.05 is significant

Regarding the Addiction Severity Index, Table 2 shows a significant difference in the 7 domains (medical, employment status, drug abuse, legal status, family status, family history, and psychiatric illness) of the ASI between

both groups ($p = < 0.001$, 0.005, 0.005, < 0.001, < 0.001, 0.002, and 0.008, respectively).

Table 3 indicates no significant difference in kidney function tests between the two groups, including serum urea level, serum creatinine level, blood urea nitrogen, and estimated glomerular filtration rate.

Additionally, Table 3 shows a significant difference in creatinine phosphokinase-total (CPK) levels between the two groups (p-value = 0.009). However, most of the CPK-total measurements in both groups were within the normal range, apart from one finding in the SC group that was 6795 U/L and was excluded from the data analysis as it would have highly affected the mean value of the results.

To better analyze the difference in the CPK-total levels in patients with SC use disorder, Table 4 is created. It shows that 86.7% of patients had a CPK-total level within the normal laboratory range (0 to 191). However, 13.3% of patients had values above the normal range, with one case reaching an extreme value of 6795.

Table 2 Addiction Severity Index in patients with synthetic cannabinoids use disorder (group I) compared to patients with cannabis use disorder (group II)

	Group I SC group $N = 45$		Group II Cannabis group $N = 45$		*P*-value
	Mean	± SD	Mean	± SD	
Medical	4.022	2.22	1.8667	2.117	< 0.001*
Employment status	5.756	2.1014	4.422	2.251	0.005*
Drug abuse domain	7.133	1.659	5.889	2.3665	0.005*
Legal status	2.622	3.505	0.400	1.175	< 0.001*
Family status	6.689	1.7558	4.6889	2.1828	< 0.001*
Family history	3.244	1.747	1.911	2.224	0.002*
Psychiatric illness	5.5778	1.9597	4.133	2.95112	0.008*

* *P*-value < 0.05 is significant

Table 4 The range of CPK levels in patients with synthetic cannabinoid use disorder

Range of CPK	No. of patients	%
0 to 191	39	86.7%
191 to 1000	5	11.1%
Above 1000	1	2.2%
Total	45	100%

In Table 5, which examines the correlation between kidney functions and Addiction Severity Index domains in both patient groups, a positive correlation was found between the family status domain, psychiatric illness domain, and urea levels (p-value = 0.004, 0.012, respectively). Additionally, a positive correlation was observed between the family status domain, psychiatric comorbidity domain, and blood urea nitrogen levels (p-value = 0.004, 0.012, respectively). Furthermore, a positive correlation was noted between the substance domain and CPK-total levels (p-value = 0.025) (Fig. 1), along with a negative correlation between the employment status domain and eGFR (p-value = 0.041).

Table 6 explores the correlation between substance use data and kidney functions in patients with SC use disorder. It revealed a significant negative correlation between the age of onset of SC use and the eGFR (p-value < 0.000) (Fig. 2). Moreover, a significant positive correlation was found between the duration of SC use and CPK-total levels (p-value = 0.048) (Fig. 3). Additionally, a significant positive correlation was observed between the average number of SC cigarettes, and creatinine level (Fig. 4) as well as a negative correlation between the average number of cigarettes and the eGFR (p-value = 0.011, 0.003, respectively).

Table 3 Kidney function tests and creatinine phosphokinase-total in both groups

	Group I SC group $N = 45$				Group II Cannabis group $N = 45$				*P*-value
	Mean	± SD	Min	Max	Mean	± SD	Min	Max	
Serum urea level Mg/dl (normal range = 15–45)	23.20	6.51	13	40	22.53	6.16	8	36	0.619
Serum creatinine level Mg/dl (normal range = 0.7–1.3)	0.871	0.1203	0.66	1.13	0.829	0.199	0.48	1.25	0.226
Blood urea nitrogen level Mg/dl (normal range = 6–24)	10.824	3.038	6.07	18.67	10.521	2.875	3.73	16.80	0.629
Creatinine phosphokinase-total U/L (normal range = 46–171)	137.84	70.239	60	510	106.889	32.857	24	174	0.009*
Estimated glomerular filtration rate (mL/min/1.73m[1]) (normal > 90 or 60– > 90)	118.178	17.103	86	192	117.422	18.273	78	149	0.840

* *P*-value < 0.05 is significant

Table 5 The correlation between kidney functions and Addiction Severity Index domains in both patient groups

Patient ASI score		Kidney function tests				
		Urea	Creatinine	BUN	CPK	eGFR
Medical	*R*	−0.079	0.082	−0.078	−0.065	−0.037
	P-value	0.461	0.445	0.467	0.544	0.731
Employment	*R*	0.125	0.123	0.125	0.151	−0.216
	P-value	0.241	0.247	0.240	0.158	0.041*
Substance domain	*R*	0.166	0.167	0.167	0.237	−0.058
	P-value	0.118	0.115	0.116	0.025*	0.588
Legal status	*R*	0.025	−0.016	0.025	0.302	−0.075
	P-value	0.813	0.880	0.814	0.464	0.482
Family status	*R*	0.304	0.156	0.303	0.158	−0.054
	P-value	0.004*	0.142	0.004*	0.140	0.610
Family history	*R*	0.045	0.080	0.046	0.036	−0.011
	P-value	0.675	0.455	0.669	0.738	0.917
Psychiatric illness	*R*	0.263	0.052	0.263	0.021	−0.004
	P-value	0.012*	0.625	0.012*	0.845	0.973

* *P*-value < 0.05 is significant

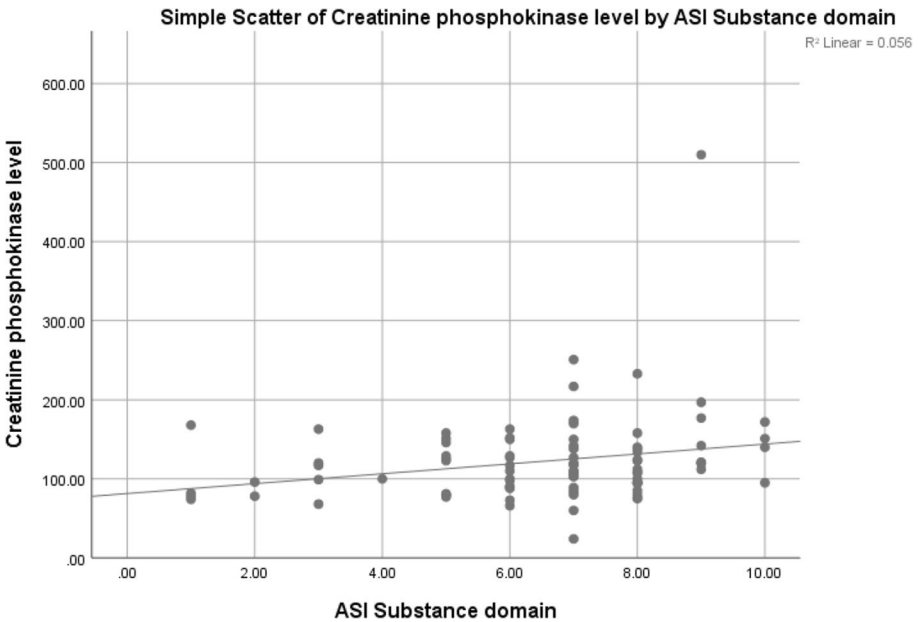

Fig. 1 The correlation between serum CPK and ASI substance use domain

Discussion

The purpose of the current study was to assess addiction severity using ASI and measure renal functions, and CPK-total in patients with SC use disorder in comparison to patients with cannabis use disorder.

Substance use data

Table 1 shows that patients with synthetic cannabinoid use disorder consumed a significantly higher dose compared to those with cannabis use disorder. Noteworthy, the average daily dose of the main substance was approximately measured using the number of cigarettes (containing the main substance) smoked as reported by patients, as it was difficult to calculate the precise dose retrospectively. *However, this finding can be explained* by the high affinity of synthetic cannabinoids for cannabinoid receptors, its higher potency, severe withdrawal symptoms, shorter duration, and peak earlier which render it more addictive when compared to cannabis [1, 17].

Table 6 The correlation between substance use data and kidney function tests in patients with synthetic cannabinoids

Patient substance use data		Kidney function tests				
		Urea	Creatinine	BUN	CPK	eGFR
Age of onset	*R*	−.111	.186	−.110	.090	−.597
	P-value	.466	.222	.470	.561	.000*
Duration of use	*R*	.086	−.081	.087	.300	−.125
	P-value	.575	.598	.568	.048*	.413
Average dose (number of cigarettes per day)	*R*	.083	.375	.082	−.027	−.437
	P-value	.588	.011*	.593	.864	.003*

* *P*-value < 0.05 is significant

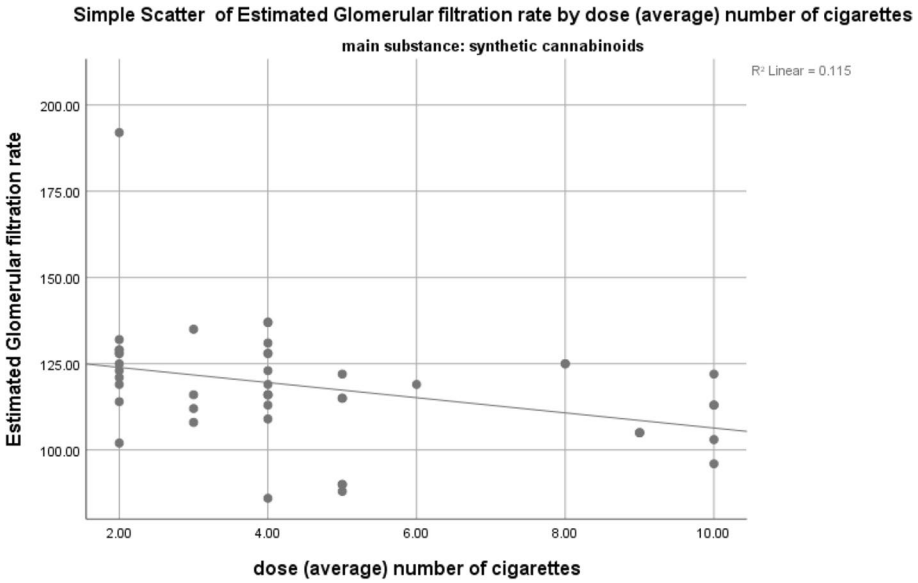

Fig. 2 The correlation between the average no. of SC cigarettes per day and the eGFR

Addiction severity index

Table 2 shows a statistically significant difference between the SC group and the cannabis group in terms of the 7 domains of the ASI. The greater addiction severity observed in patients with SC use disorder may be attributed to several factors. SCs are known for their high potency and unpredictable effects on the central nervous system, which can lead to more intense and dysregulated substance use patterns.

Patients with SC use disorder exhibited more severe scores in the medical status domain compared to those with cannabis use disorder. The medical problems reported by patients in the SC group ranged from intoxication symptoms to lack of physical fitness and easy fatiguability; however, no chronic illnesses or hospitalizations for medical reasons were reported by either group.

Our findings are consistent with previous research that concluded SC had more medical complications, including seizures, cardiovascular events, acute kidney injuries, and hypokalemia, compared to natural cannabis users [17–19].

Secondly, in terms of the employment subscale of the ASI, most patients in the SC group had moderate to severe occupational problems, ranging up to losing their jobs. This may indicate the negative effects of SC on work performance. Currently employed subjects reported problems ranging from warnings of termination to issues with absenteeism. However, most patients with cannabis use disorder had mild to moderate occupational problems.

These findings are also consistent with studies showing that drug use can impact not only employment probability but also the quality and sustainability of work [20]. Substance use problems affect work in many ways, especially an individual's cognition and their relationships with their coworkers [21]. Another study on 166 male SC

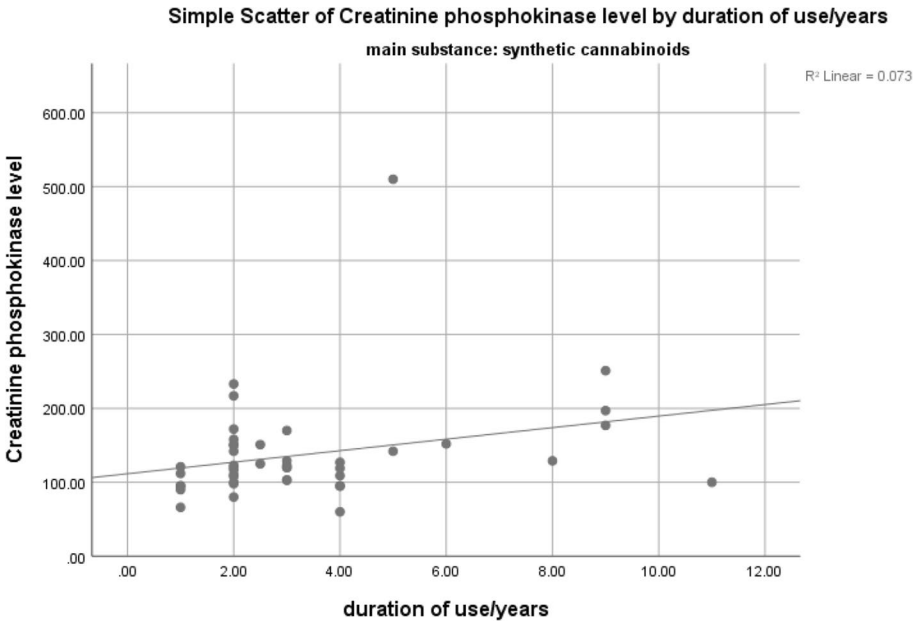

Fig. 3 The correlation between the duration of use and the CPK in patients with SC use disorder

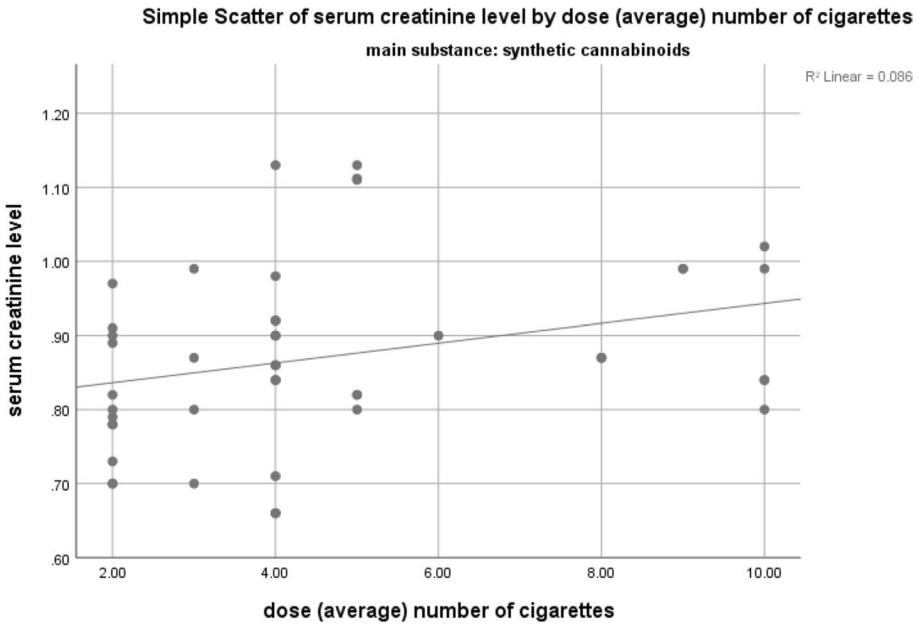

Fig. 4 The correlation between the average no. of SC cigarettes per day and the serum creatinine level

users found that the unemployment rate among SC users was 40.4% [22] indicating that individuals using SCs may face challenges in maintaining stable employment and have limited social support systems.

Thirdly, in the legal problem subscale of the ASI, all patients in this study faced legal issues. In the SC group, 64.4% of patients had mild legal problems, while the rest had problems ranging from moderate to severe (35.6%). In the cannabis group, 89% had mild legal problems. The majority of the legal issues reported were linked to aggressive behavior towards others, including family members or neighbors, as well as engaging in theft to acquire funds for purchasing the

substance. Additionally, possessing an illegal substance was a common legal problem reported by participants.

These findings align with previous research by Öznur et al., who discovered that one in every three SC users encountered legal problems and resorted to illegal actions to obtain SCs [22]. Similarly, another study noted that SC users faced a higher prevalence of legal issues compared to users of other substances, suggesting that criminal records could serve as an indicator for predicting SC use [23].

Furthermore, in the family history subscale of the ASI, the majority of patients with SC use disorder (86.7%) had a positive family history of substance use compared to 55.6% of the cannabis use disorder group. The positive family history of substance use can be explained by genetic factors, learned behavioral patterns, and the availability of the substance [24].

Additionally, the results of the family/social domain of the ASI in this study showed that more than a quarter (37.8%) of patients with SC use disorder had severe social problems, while the rest had social problems ranging from mild to moderate. In the cannabis group, the majority of cases had social problems ranging from mild to moderate. This indicates that both cannabis and SCs have a negative effect on the social function of patients. However, SC use may lead to behavioral changes and strained family dynamics, contributing to a more detrimental impact on social relationships.

In Egypt, addiction carries a social stigma that not only affects those who suffer from it but also extends to their families. Egyptian culture values strong family ties, which means that addiction-related issues, such as drug-seeking behaviors, occupational struggles, and marital conflicts, have significant impacts on the families of those affected [25].

Regarding the psychiatric status of the ASI, all patients in the study had psychiatric problems ranging from mild to severe. However, 95.6% of patients with SC use disorder reported moderate to severe psychiatric problems, compared to patients with cannabis use disorder, where 24.4% had mild psychiatric problems and 40% had moderate psychiatric problems. The potent effects of SCs on the central nervous system may contribute to the development or exacerbation of psychiatric disorders.

These results align with previous research that has highlighted the psychiatric effects and comorbidities associated with SC use, showing the frequency of these effects is higher compared to those with cannabis use [4].

Kidney function tests

Regarding kidney functions, our initial hypothesis posited that SCs would negatively impact kidney function and increase CPK-total levels. However, our findings in Table 3 revealed that kidney functions were within the normal range in both groups with no significant difference. Interestingly, patients with SC use disorder exhibited slightly elevated CPK-total levels compared to those with CUD.

Several factors might explain the absence of observed kidney dysfunction in our study. First, the sample size may have been too small to detect significant differences in kidney function between the groups. Additionally, the duration and dosage of SC use among our participants might not have been sufficient to induce detectable renal changes. Furthermore, the variability in SC compounds, each with different pharmacological properties, could contribute to inconsistent outcomes across studies.

There are limited studies in the literature exploring the effects of chronic SC use on kidney functions. A study on the clinical characteristics of SC users in Upper Egypt found that 4% of the study population had elevated urea and creatinine levels [26]. Additionally, there are multiple case reports and case series documenting acute kidney injuries induced by SC intoxication [7, 8, 27–30]. While the exact mechanism of kidney damage remains unclear, nephrotoxicity seems to be the most likely cause of AKI associated with SCs.

Moreover, recent studies on the impact of long-term cannabis use on kidney functions demonstrated that cannabis does not affect kidney functions in patients without CKD [31, 32], but it was linked to a faster annual eGFR decline among participants with CKD [32].

Creatinine phosphokinase-total levels

It is important to note that CPK-total is not a specific test for kidney affection, as it can indicate either muscle damage or heart or brain injury [33]. However, in the context of SC use, elevated CPK-total level is probably due to muscle damage which may occur due to various factors such as seizures, agitation, and muscle rigidity [8], potentially leading to kidney damage. Our results align with multiple case reports of AKI due to rhabdomyolysis [29, 30], along with clinical experience of 2 cases of AKI due to SC use in the Addiction Psychiatry Unit in Kasr Al Aini Hospital (awaiting publication).

Correlation between kidney functions and Addiction Severity Index domains

In Table 5, the observed correlation between the domains of the ASI and the different kidney functions might suggest that individuals with more severe addiction-related challenges might also experience greater physical strain and potential muscle damage, as indicated by elevated CPK-total levels. It might also reflect that the more severe the domains of the addiction, the more physical health impairment might occur.

According to our knowledge, there were no previous studies that examined the correlation between addiction severity, substance use data, and kidney functions in patients with SC use disorder. However, exposure to SCs has been described in various reports from poison centers and information services, as well as in a recent review of cases and reports identified in the literature. These sources indicate a predominance of neurological (37%), psychiatric (25.6%), cardiorespiratory (44.1%), and gastrointestinal (13.2%) effects, with varying degrees of severity [7, 34], in addition to renal affection and multiple case reports that linked acute kidney injury and SC intoxication [8]. Most of these effects were not life-threatening and generally resolved within 8 h with conventional supportive care [35]. However, compared to cannabis, exposure to SCs appears to result in more severe outcomes.

Limitations

One limitation of the study is the cross-sectional study design, which does not allow for establishing a definite temporal relationship between substance use disorders and kidney function impairment. This highlights the importance of future longitudinal studies to establish a temporal relationship.

Conclusion

To conclude, this study showed that patients with SC use disorder exhibited elevated CPK-total levels compared to those with cannabis use disorder. This observation points to the potential impact of SCs on kidney function.

The study also revealed that patients with SC use disorder had higher scores in all domains of the Addiction Severity Index than those with cannabis use disorder. This strongly suggests that SCs may have a more hazardous and detrimental impact on individuals, encompassing various aspects of addiction severity such as physical health, psychological well-being, social functioning, and overall quality of life.

Additionally, the study showed significant correlations between some domains of the ASI and the kidney function tests in both patient groups. This further highlights the hazardous impact of using cannabis and SCs on kidney functions.

In light of this research, it is recommended to screen for kidney functions and CPK-total levels in patients with SC use disorder, and it is also recommended to further study the physical and psychiatric hazards of both SC use and cannabis use on a multicenter level.

Abbreviations

AKI	Acute kidney injury
ASI	Addiction Severity Index
BUN	Blood urea nitrogen
CKD-EPI	Chronic Kidney Disease Epidemiology Collaboration Equation
CPK	Creatinine phosphokinase
CUD	Cannabis use disorder
DSM-5	Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
eGFR	Estimated glomerular filtration rate
SC	Synthetic cannabinoids
SCID I	Structured Clinical Interview for DSM IV-TR Axis I Disorders
SPSS	Statistical Package for Social Sciences
THC	Tetrahydrocannabinol

Acknowledgements

None to declare

Authors' contributions

Rana Walid Hamimy, data curation, methodology, investigation, writing original draft; Momtaz Mohamed Abd El Wahab, supervision, validation; Rania Mamdouh Mohamed, conceptualization, formal analysis, methodology, supervision, validation, writing review and editing.

Funding

This research didn't receive grants from any funding agency.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The proposal received approval from the Scientific and Ethical Committee of the Department of Psychiatry at Kasr Al-Ainy in September 2021. Subsequently, the research was approved by the Ethical Committee of Cairo University in October 2021 (Registration number: MD-298–2021).

Consent for publication

Not applicable.

Competing interests

There is no conflict of interest to declare.

Received: 30 April 2024 Accepted: 16 June 2024
Published online: 15 July 2024

References

1. Akram H, Mokrysz C, Curran HV (2019) What are the psychological effects of using synthetic cannabinoids? A Syst Rev J Psychopharmacol 33(3):271–283. https://doi.org/10.1177/0269881119826592
2. UNODC (2023) World Drug Report (United Nations publication, 2023)
3. Egyptian National Addiction Survey (2021) National Addiction Survey Report. National Center for Social & Criminological Research, The General Secretariat of Mental Health and Addiction Treatment (GSMHAT)
4. Grigg J, Manning V, Arunogiri S, Lubman DI (2019) Synthetic cannabinoid use disorder: an update for general psychiatrists. Australas Psychiatry 27(3):279–283. https://doi.org/10.1177/1039856218822749
5. Bassir Nia A, Medrano B, Perkel C, Galynker I, Hurd YL (2016) Psychiatric comorbidity associated with synthetic cannabinoid use compared to cannabis. J Psychopharmacol 30(12):1321–1330. https://doi.org/10.1177/0269881116658990
6. Cooper ZD (2016) Adverse effects of synthetic cannabinoids: management of acute toxicity and withdrawal. Curr Psychiatry Rep 18(5):52. https://doi.org/10.1007/s11920-016-0694-1
7. D'Errico S, Zanon M, Radaelli D, Concato M, Padovano M, Scopetti M, Frati P, Fineschi V (2022) Acute kidney injury (AKI) in young synthetic cannabinoids abusers. Biomedicines 10(8):1936. https://doi.org/10.3390/biomedicines10081936
8. Tait RJ, Caldicott D, Mountain D, Hill SL, Lenton S (2016) A systematic review of adverse events arising from the use of synthetic cannabinoids and their associated treatment. Clin Toxicol 54(1):1–13. https://doi.org/10.3109/15563650.2015.1110590

9. First MB, Spitzer RL, Gibbon M, Williams JB (2002) Structured Clinical Interview for DSM-IV-TR Axis I Disorders, research version, patient edition (SCID-I/P). Biometrics Research, New York State Psychiatric Institute, New York
10. Hatata H, Abou ZM, Khalil A, Assad T, Okasha T (2004) Dual diagnosis in substance abuse, a study in an Egyptian sample. MD thesis Ain Shams University
11. McLellan AT, Cacciola JS, Alterman AI, Rikoon SH, Carise D (1992) The fifth edition of the Addiction Severity Index. J Subst Abuse Treat 9(3):199–213
12. Qassem T, Bishry Z, Assad A (2003) Arabic version of Addiction Severity Index (ASI). Ain Shams University
13. Levey AS, Stevens LA, Schmid CH, Zhang YL, Castro AF, Feldman HI, Kusek JW, Eggers P, Lente FV, Greene T, Coresh J (2009) A new equation to estimate glomerular filtration rate. Ann Intern Med 150(9):604–612. https://doi.org/10.7326/0003-4819-150-9-200905050-00006
14. Chan YH (2003) Biostatistics102: quantitative data – parametric & non-parametric tests. Singapore Med J 44(8):391–396
15. Chan YH (2003) Biostatistics 103: qualitative data – tests of independence. Singapore Med J 44(10):498–503
16. Chan YH (2003) Biostatistics 104: correlational analysis. Singapore Med J 44(12):614–619
17. Winstock AR, Barratt MJ (2013) Synthetic cannabis: a comparison of patterns of use and effect profile with natural cannabis in a large global sample. Drug Alcohol Depend 131(1–2):106–111
18. Fattore L (2016) Synthetic cannabinoids—further evidence supporting the relationship between cannabinoids and psychosis. Biol Psychiat 79(7):539–548. https://doi.org/10.1016/j.biopsych.2016.02.001
19. Darke S, Duflou J, Farrell M, Peacock A, Lappin J (2020) Characteristics and circumstances of synthetic cannabinoid-related death. Clin Toxicol 58(5):368–374. https://doi.org/10.1080/15563650.2019.1647344
20. Zuvekas S (2005) Recent trends in stimulant medication use among U.S. children. Am J Psychiatry 163:579–585
21. Michael K, Ben-Zur H (2006) Risk-taking among adolescents: associations with social and affective factors. J Adolesc 30(1):17–31
22. Öznur T, Öznur H, Bolu A, Çelik C, Özmenler KN (2018) Sociodemographic and clinical features of young adult males using synthetic cannabinoid. Turkish Journal of Clinical Psychiatry 21:15–23
23. Nurmedov S, Metin B, Ekmen S, Noyan O, Yilmaz O, Darcin A, Dilbaz N (2015) Thalamic and cerebellar gray matter volume reduction in synthetic cannabinoids users. Eur Addict Res 21:315–320
24. Ducci F, Goldman D (2012) The genetic basis of addictive disorders. Psychiatr Clin North Am. 35(2):495–519. https://doi.org/10.1016/j.psc.2012.03.010. (PMID: 22640768; PMCID: PMC3506170.)
25. Hamdi E, Tarek G, Aref Kh, Albert ES, Dalal A, Rania M, Heba F, Nasser L (2013) Lifetime prevalence of alcohol and substance use in Egypt: a community survey. Substance Abuse 34:97–104
26. Abdelmoneim WM, Ghandour NM, Fawzy M, Mohammed MKh, Ramadan AG, Abdellah NZ (2022) Clinical pattern of synthetic cannabinoids users in Upper Egypt: cross-sectional study. Middle East Current Psychiatry 29:24. https://doi.org/10.1186/s43045-022-00188-y
27. Curtis B, Mahat B, Macklin M, Mihalo J, Dakroub AH (2022) Acute kidney injury related to intoxication from synthetic cannabis: don't you know that you're toxic? Cureus 14(3):e23427. https://doi.org/10.7759/cureus.23427
28. Kamijo Y, Takai M, Fujita Y, Sakamoto T (2016) A multicenter retrospective survey of poisoning after consumption of products containing novel psychoactive substances from 2013 to 2014 in Japan. Am J Drug Alcohol Abuse 42:513–519
29. Kourouni I, Mourad B, Khouli H, Shapiro JM, Mathew JP (2020) Critical illness secondary to synthetic cannabinoid ingestion. JAMA Netw Open 3:e208516. https://doi.org/10.1001/jamanetworkopen.2020.8516
30. Adedinsewo DA, Odewole O, Todd T (2016) Acute rhabdomyolysis following synthetic cannabinoid ingestion. N Am J Med Sci 8:256–258
31. Bonnet U, Borda T, Scherbaum N, Specka M (2022) Long-term frequent cannabis use and related serum cannabinoid levels are not associated with kidney dysfunction. Cannabis and Cannabinoid Research 7(4):670–676. https://doi.org/10.1089/can.2021.0086
32. Rein JL, Zeng H, Faulkner GB, Chauhan K, Siew ED, Wurfel MM, Coca SG. (2022). A retrospective cohort study that examined the impact of cannabis consumption on long-term kidney outcomes. Cannabis and Cannabinoid Research. Advance online publication. https://doi.org/10.1089/can.2022.0141
33. Aujla RS, Zubair M, Patel R. Creatine Phosphokinase. [Updated February 27, 2024]. In: StatPearls. Treasure Island (FL): StatPearls Publishing; January 2024. Available from: https://www.ncbi.nlm.nih.gov/books/NBK546624/
34. Kacinko SL, Xu A, Homan JW, McMullin MM, Warrington DM, Logan BK (2011) Development and validation of a liquid chromatography-tandem mass spectrometry method for the identification and quantification of JWH-018, JWH-073, JWH-019, and JWH-250 in human whole blood. J Anal Toxicol 35(7):386–393. https://doi.org/10.1093/anatox/35.7.386. (PMID: 21871146)
35. Waugh J, Najafi J, Hawkins L, Hill SL, Eddleston M, Vale JA, Thompson JP, Thomas SHL (2016) Epidemiology and clinical features of toxicity following recreational use of synthetic cannabinoid receptor agonists: a report from the United Kingdom National Poisons Information Service. Clin Toxicol 54:512–518
36. ElSohly MA, Gul W, Wanas AS, Radwan MM (2014) Synthetic cannabinoids: analysis and metabolites. Life Sci 97:78–90. https://doi.org/10.1016/j.lfs.2013.12.212

Publisher's Note