

Covid-19 Patients with First-Diagnosed Substance Use Disorders in Southern Thailand: A Study from a Field Hospital

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Abstract:

Objective: This retrospective study investigated usage patterns, withdrawal symptoms, and treatments provided to COVID-19 patients with first-diagnosed substance use disorders at a field hospital in southern Thailand in 2021.

Material and Methods: The medical records of all COVID-19 patients were reviewed, and descriptive statistics were calculated and reported. The process of analyzing data was carried out by utilizing Program R.

Results: Of the 2116 patients, 12.9% had a history of substance and/or alcohol use without any prior diagnosis. Most patients were male (94.9%), and the mean age was 31.7 years old. Tobacco and kratom were the substances most frequently used by COVID-19 patients. Withdrawal symptoms were observed in approximately half of all patients with substance use disorders, particularly those who used kratom and opioids. The most commonly reported withdrawal symptoms were insomnia and muscle aches, and chlorpromazine and amitriptyline were the most prescribed psychotropic medications. The majority of patients with substance use disorders (93.8%) did not report any complications related to their COVID-19 infection.

Conclusion: This study found that 12.9% of COVID-19 patients admitted to a field hospital in southern Thailand in 2021 had a newly diagnosed substance use disorder. The substances most commonly used by these patients were tobacco and kratom. Approximately half of the patients with substance use disorders experienced withdrawal symptoms, and kratom and opioids were the substances most frequently associated with these withdrawal symptoms.

Keywords: COVID-19, drug prescription, psychotropic drugs, substance use disorder

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Introduction

The COVID-19 pandemic was particularly challenging for patients with substance use disorders (SUDs) worldwide¹. Many of these patients with SUDs were also affected by underlying health conditions such as cardiovascular and lung diseases². Due to the pandemic, access to healthcare systems and support groups was significantly reduced. Consequently, individuals with SUDs may not have received adequate attention for their unique health and medical requirements¹.

Alcohol consumption has been linked to neurodegenerative disorders, liver damage, and inflammation of the pancreas³. The release of inflammatory cytokines caused by alcohol consumption can lead to excessive inflammatory responses in COVID-19 patients. Alcohol-induced damage to the spleen can weaken the immune response to COVID-19 by reducing the production of antibodies and lymphocytes against the virus⁴. The nicotine in tobacco is associated with arterial thrombosis, atherosclerosis in the heart, an increased risk of pulmonary disease, and emphysema in COVID-19 patients^{5,6}. The use of addictive psychostimulants such as amphetamines is associated with neuropsychiatric complications, including neurodegenerative changes in the brain and deficits in memory, concentration, and executive function⁷. Additionally, they have been linked to various cardiac pathologies such as hypertension, tachycardia, and cardiomyopathy⁸, reduced lung capacity, and constriction of blood vessels⁹, all of which can increase the severity of COVID-19 symptoms.

Marijuana (cannabis) is one of the most used substances of abuse. In Thailand, the use of cannabis for medical purposes is legal. The primary active ingredients in cannabis are two cannabinoids, namely 9-tetrahydrocannabinol (THC) and cannabidiol (CBD). CBD acts on most neuronal cells and mainly on immune responses such as cytokine release and blood pressure¹⁰.

THC is the component responsible for producing psychotropic effects¹¹ and affects the cardiovascular system, which has been linked to adverse cardiovascular events such as arrhythmias, myocardial infarction, cardiomyopathy, cardiac arrest, and stroke¹².

Kratom (*Mitragyna speciosa*), has been a newly legal substance for medical conditions in Thailand since 2021. Prior studies have reported the lifetime prevalence of kratom use in the Thai population was estimated to be between 2.5% and 3.0%^{13,14}. In another study, kratom use was associated with a higher risk of other SUDs, especially opioids, stimulants, and sedatives¹⁵. Another recent study reported that 85.3% of Thai males with SUDs used kratom, and 61.8% used kratom with another substance, most commonly methamphetamine¹⁶. Kratom is used recreationally as a homemade iced cocktail called “4x100” that consists of four basic ingredients: Coca-Cola, kratom, either codeine or diphenhydramine, and tranquilizers^{17,18}. The psychoactive substances in kratom can interact with other chemicals in the cocktail or with other drugs, and the physiological effects of such interactions can be fatal¹⁹. Therefore, these substances have a high risk of worsening COVID-19 symptoms into more critical conditions^{5,6}, leading to a negative prognosis and a higher mortality rate⁶.

The liberalization of kratom and cannabis by the Thai government in 2021 may have begun an increasing trend in the prevalence of both diagnosed and undiagnosed SUDs. The pattern of kratom and cannabis usage among the Thai adult general population may also be changing. Although there have been many studies on substance use in southern Thailand, particularly kratom, the focus of researchers and clinicians worldwide in the first years following the beginning of the COVID-19 pandemic was on collecting and sharing data on COVID-19. As a result, there have been few studies to date on the comorbidities of COVID-19 and SUDs.

This study aimed to investigate the pattern of substance use, withdrawal symptoms, and complications of SUDs, as well as the care provided to patients with COVID-19 and SUDs in a field hospital in southern Thailand, where kratom use is widespread and there were many admissions to field hospitals during the early years of the pandemic. The study findings could provide useful information for creating a screening program that can detect SUDs earlier and manage them effectively, particularly in low- and middle-income countries where professional care resources are limited. Additionally, the results may help clinicians prevent complications in COVID-19 patients who also have SUDs, especially in primary care or field hospital settings.

Material and Methods

A retrospective study was conducted after receiving approval from the Ethics Committee of the Faculty of Medicine, Prince of Songkla University (REC. 65-449-3-4). The medical records of all patients with SUDs and/or alcohol use disorders who were admitted to the largest field hospital for COVID-19 treatment in southern Thailand (Prince of Songkla University or PSU field hospital) during the first to the third waves of the pandemic in 2021 were reviewed. The researchers collected information on all patients with a COVID-19 infection from the medical records and selected those who had been first diagnosed with a SUD based on the ICD-10 (F10-F19), which were confirmed by a psychiatrist at the field hospital.

At the supra-tertiary level of the PSU hospital, all COVID-19 patients were assessed for psychiatric disorders and substance use disorders by their primary and secondary medical services before being transferred to our field hospital in 2021. Therefore, we can confirm that the PSU field hospital did not admit any patients currently diagnosed with a substance use disorder, based on our policy.

After being admitted, a doctor and a nurse reviewed the patient's mental health, including their history of substance use. Every patient who reported having regularly used substances or alcohol prior to their admission would be evaluated by at least one psychiatrist to determine if they had a substance use disorder and to provide clinical care for their condition. All diagnoses, pharmacological treatments, and psychosocial care were documented by the psychiatrists themselves.

Data collection

The data records were divided into three parts:

Personal and general demographic information, which included age, gender, ethnicity, occupation, religion, and marital status.

History of alcohol and/or substance use, which included type, duration of substance use, the time since last use and withdrawal symptoms, and co-morbid medical and psychiatric illnesses (including substance use disorders).

To evaluate the mental health of the patients in this section, such as the pattern of substance use, a direct interview was conducted by at least one board-certified psychiatrist at the field hospital. The notes from the nurses and other physician records were not taken into account in these evaluations.

History of medical conditions, drugs prescribed, and management, which included the duration of admission at the field hospital, O₂ saturation during admission, COVID-19 infection complications, and psychotropic and other medication prescriptions.

Statistical analysis

Demographic data, substance use patterns, withdrawal symptoms, treatment, and complications of substance use disorders were analyzed using descriptive statistics such as frequency, proportion, mean (standard deviation), or median (interquartile range). The process of

analyzing the data was carried out by utilizing Program R for descriptive purposes.

Results

Demographic characteristics and clinical outcomes

During the study period, 2116 patients with COVID-19 infection were admitted to the field hospital at Prince of Songkla University, including 273 patients (12.9%) with a confirmed diagnosis of SUDs by a psychiatrist at the field hospital, based on a history of alcohol and/or substance use without any prior SUDs diagnosis. Of the patients with SUDs, the mean age was 31.7 ± 10.3 (min-max: 15-62) years, and the median (IQR) age was 30 (23,37) years. Most were Thai (88.6%), male (94.9%), Buddhist (72.9%), single (52.4%), and an employee (74.4%). Most had no prior notable physical or psychiatric illness (91.9% and 99.6%, respectively). 59.0% of the patients utilized the Thai universal coverage scheme for their health needs (Table 1).

Among the patients with SUDs who reported a physical illness (8.1%), hypertension (2.2%), allergy (1.8%), and asthma (1.5%) were the most common. The mean length of stay of all of the newly-diagnosed SUD patients at the field hospital was $9.7 (\pm 2.1)$ days.

Most COVID-19 patients with SUDs reported no complications of the infection (93.8%). Only 10 patients with SUDs (3.7%) were transferred and required admission to the COVID-19 intensive care unit due to symptoms of dyspnea and/or low oxygen saturation, while 7 (2.6%) patients with SUDs were transferred to other hospitals for long-term care of SUDs, such as rehabilitation. 40.9% of the patients with SUDs did not receive any medications for their SUDs, although 31.5% of the patients were prescribed a psychotropic drug for withdrawal symptoms during their admission at the field hospital (Table 1).

Table 1 Demographic characteristics, clinical outcomes and management provided to COVID-19 patients with substance use disorders at the study field hospital (n=273)

Demographic characteristic	Number (%)
Gender	
Male	259 (94.9)
Female	14 (5.1)
Race	
Thai	242 (88.6)
Other	31 (11.4)
Religion	
Buddhist	199 (72.9)
Islam/Christian	65 (23.8)
No answer	9 (3.3)
Marital status	
Single	143 (52.4)
Married	130 (47.6)
Occupation	
Employee	203 (74.4)
Student/Unemployed	20 (7.3)
Other (government officer/merchant/self-employed/agriculture)	50 (18.3)
Health coverage	
Civil Servant Medical Benefit Scheme (CSMBS)	4 (1.5)
Universal Coverage Scheme (UCS)	163 (59.7)
Social Security Scheme (SSS)	86 (31.5)
Pay for their own/Migrant worker/No answer	20 (7.3)
Physical comorbidity	
No	251 (91.9)
Yes	22 (8.1)
Previous psychiatric illness	
No	272 (99.6)
Yes (antisocial personality disorder)	1 (0.4)
Duration of stay (days)	
median (IQR)	10 (10,10)
mean \pm S.D. (min-max)	9.7 \pm 2.1 (2,21)
Outcome of treatment	
Discharge	256 (93.8)
Transfer to COVID-19 intensive care unit	10 (3.7)
Transfer to other hospital	7 (2.6)
Level of O ₂ saturation during their stay	
96-100 %	222 (81.3)
90-95 %	44 (16.1)
80-89 %	7 (2.6)

Table 1 (continued)

Demographic characteristic	Number (%)
Number of psychotropic drugs	
No medications	111 (40.7)
No psychotropic drugs	4 (1.47)
One medication	86 (31.5)
More than one medications	72 (26.37)

Substance use patterns and withdrawal symptoms among patients with substance use disorders

Of the 2116 patients with COVID-19 infection, 7.4%, 4.0%, 1.6%, and 0.8% reported using kratom, opioids, amphetamine, and cannabis, respectively. The overall prevalence of tobacco and alcohol use among those who were admitted to the field hospital were 10.6% and 5.8%, respectively (Table 2)

Among the 273 patients with COVID-19 infection and SUDs, the most used substances were tobacco or cigarettes (82.1%), kratom (57.5%), alcohol (44.7%), opioids (31.1%), amphetamine (12.1%), and cannabis (6.2%). Of these 273 patients, 137 (50.2%) reported experiencing symptoms of

substance withdrawal during their stays at the field hospital for COVID-19 treatment. Kratom (72%) and opioids (71.8%) were the substances most frequently associated with withdrawal symptoms. The median duration of both kratom and opioid usage was 36 months. The most recent time they had used these substances was reported to be 1 day before their admission to the field hospital, with median times of 60 and 17.5 days for cannabis and amphetamine use, respectively, prior to the admission. (Table 2).

Among the patients with a confirmed first diagnosis of SUDs, the most commonly reported withdrawal symptoms were insomnia (39.2%), muscle aches (36.3%), and agitation or irritable mood (7.7%). (Figure 2). Kratom, opioids, and MDMA usage were found to be mainly associated with these symptoms. Patients who were amphetamine or cannabis users also reported experiencing insomnia (36.4% and 35.3%, respectively) and muscle aches (36.4% and 29.4%, respectively). When compared to opioids and kratom, withdrawal from amphetamines and cannabis manifested as more agitation (18.2%) or irritable mood (17.6%), respectively. (Table 3).

Table 2 Patterns of substance use among study patients with substance-related disorders (n=273)

Type	Prevalence of use n (%)	Duration of usage (months)	Most recent usage prior to admission (days)	Presence of withdrawal symptoms n (%)
Tobacco				
Median (IQR)	224 (82.1)	120 (60,147)	1 (1, 5.25)	113 (50.4)
Kratom				
Median (IQR)	157 (57.5)	36 (12,72)	1 (1, 3)	113 (72.0)
Alcohol				
Median (IQR)	122 (44.7)	48 (24,120)	5 (2, 21)	49 (40.2)
Opioid				
Median (IQR)	85 (31.1)	36 (12, 72)	1 (1, 3)	61 (71.8)
Amphetamine	33 (12.1)			
Median (IQR)		60 (24, 93)	17.5 (2.7, 730)	18 (54.5)
Cannabis				
Median (IQR)	17 (6.2)	54 (39, 60)	60 (8.5, 225)	9 (52.9)
MDMA	1 (0.4)	no answer	no answer	1 (100)

IQR=Interquartile range, MDMA=3,4-Methylenedioxymethamphetamine, n=the number of the sample size

Patterns of medical prescriptions for symptoms of substance withdrawal

In the detoxification phase of patients with SUDs at the field hospital, the most prescribed psychotropic agents were chlorpromazine (45.1%) and amitriptyline (22.7%) for relieving the withdrawal symptoms. Chlorpromazine was primarily prescribed for patients with MDMA, kratom, and opioid use (100%, 75.8%, and 81.2%, respectively), while amitriptyline was prescribed for patients with amphetamine

and opioid use (42.4% and 41.2%, respectively). Regarding other medications used for substance withdrawal among patients with COVID-19, non-steroidal anti-inflammatory drugs (NSAIDs) (41.0%) and acetaminophen (22.3%) were prescribed to alleviate the symptoms. 100% of the patients with MDMA use were prescribed both. Most patients with kratom and opioid use were prescribed NSAIDs (70.1% and 76.5%, respectively) and/or acetaminophen (38.2% and 38.8%, respectively). (Table 4).

Table 3 Withdrawal symptoms reported by the type of substance used

Withdrawal Symptom	Type of substance (%)							Total N=273 (%)
	Cigarettes (n=224)	Kratom (n=157)	Alcohol (n=122)	Opioid (n=85)	Amphetamine (n=33)	Cannabis (n=17)	MDMA (n=1)	
Insomnia	38.8	58	29.5	56.5	36.4	35.3	100	39.2
Muscle ache	37.1	61.8	21.3	63.5	36.4	29.4	100	36.3
Agitation/Irritable	8.5	9.6	5.7	5.9	18.2	17.6	100	7.7
Flu-like symptoms	4.9	5.7	1.6	7.1	6.1	0	0	4.4
ANS hyperactivity	3.1	1.9	6.6	3.5	3	11.8	0	3.7
Diarrhea	2.7	3.8	1.6	3.5	0	0	0	2.2
Nausea/ Vomiting	1.3	1.9	0.8	1.2	0	5.9	0	1.1
Increased appetite	0.9	0.6	0.8	0	6.1	0	0	0.7
Headache	0.9	1.3	0.8	1.2	0	0	0	0.7

n=the number of the sample size, N=the total number of cases in all groups, MDMA=3,4-Methylenedioxymethamphetamine

Table 4 Prescription of medications categorized by type of substance used

Drug prescribed	Type of substance (%)							Total N=273 (%)
	Cigarettes (n=224)	Kratom (n=157)	Alcohol (n=122)	Opioid (n=85)	Amphetamine (n=33)	Cannabis (n=17)	MDMA (n=1)	
Psychotropic agents								
Amitriptyline	22.8	34.4	10.7	41.2	42.4	29.4	0	22.7
Chlorpromazine	46.9	75.8	28.7	81.2	54.5	52.9	100	45.1
Haloperidol	6.7	4.5	9.8	2.4	15.2	17.6	100	7.3
Lorazepam	8.0	3.2	21.3	2.4	6.1	5.9	0	10.3
Diazepam	0.4	0	0.8	0	0	0	0	0.4
Others								
Ibuprofen/Naproxen	41.1	70.1	27.9	76.5	36.4	35.3	100	41.0
Acetaminophen	21.9	38.2	17.2	38.8	9.1	0	100	22.3
Tolperisone	0.4	1.9	0	1.2	0	0	0	1.1
Oral rehydration salt	0.4	0.6	0	1.2	0	0	0	0.4

n=the number of the sample size, N=the total number of cases in all groups, MDMA=3,4-Methylenedioxymethamphetamine

Discussion

This study on first-diagnosed substance use disorders among COVID-19 patients is the first one from southern Thailand, which has a unique socio-cultural context compared to other regions of the country. The PSU field hospital was located in Songkhla province, where some parts of the area and nearby provinces were in the conflict areas of the southern Thailand insurgency. The research aimed to investigate the prevalence of a first-diagnosed substance use disorder, withdrawal symptoms, and treatments provided to COVID-19 patients with SUDs, within the specific context and scrutiny of medical resources used during the pandemic year of 2021.

The study found that among the COVID-19 patients admitted to the field hospital, 12.9% had used alcohol and/or substances which met the criteria of SUDs and were found to have no prior confirmed diagnosis at the time of SUDs. Regarding kratom use, we found that twice as many individuals admitted to kratom use (7.41% of all patients with COVID-19) compared to prior studies which reported that the lifetime prevalence of kratom use in the entire Thai adult population was estimated to be between 2.5% and 3.0% before the pandemic^{13,14}. Although the prevalence rates of overall substance usage and SUDs were higher than in prior studies, the rates obtained in this study might still have been underestimated. This is because most individuals with severe and known SUDs who also had COVID-19 were identified and treated at governmental institutions for drug abuse rather than being treated for their COVID-19 infection at the field hospital, in accordance with the COVID-19 pandemic protocol management in 2021²⁰.

Even though kratom (72%) and opioids (71.8%) were the substances that caused the most common withdrawal symptoms of insomnia (39.2%) and muscle aches (36.3%), these symptoms were common in all SUDs patients. While our psychiatrists classified symptoms resembling those of a viral infection (flu-like symptoms in Table 3), to rule out the

possibility of COVID-19 infection symptoms, it is important to note that some symptoms, such as muscle aches, can be influenced by the infection and may be misunderstood by both patients and the healthcare team. Almost half of the patients with SUDs did not take any medications, and 31.5% of them needed only one psychotropic medication. Agitation and/or irritable mood were uncommon symptoms of withdrawal (7.7%), but they were symptoms that could disturb other patients and, in our study, were associated with aggressive behavior, especially among those who had a history of MDMA, amphetamine, and/or cannabis use. Therefore, not only COVID-19 patients with a history of substance use, including tobacco and alcohol but also other endemic diseases, such as dengue fever, should be closely monitored for withdrawal symptoms during their infection. Because of resource constraints during the pandemic, including human resources, the SBIRT model (screening, brief intervention and referral model) was not fully implemented for patients with SUDs at the PSU hospital at that time²¹.

For the treatment of substance withdrawal symptoms, chlorpromazine was prescribed for sedation and agitation, while amitriptyline was prescribed for sedation and as an additional painkiller. Additionally, NSAIDs and acetaminophen were prescribed for supportive treatment of muscle aches. These medications are drugs listed on the National List of Essential Medicines²¹, which were available at all general hospitals and field hospitals during the COVID-19 pandemic. They could be prescribed by Thai general practitioners nationwide for symptomatic treatment after the pandemic declined²¹. And it was found that they were effective in relieving substance withdrawal symptoms among patients with COVID-19 infection in this study. Only 3.7% of the patients with SUDs were transferred to a COVID-19 intensive care unit due to physical complications. Therefore, within the context of scrutiny of resources in low- and middle-income countries, these general medications may

be advised for the management of substance withdrawal. Regarding the results, we also suggest the establishment of a screening and comprehensive management of SUDs program for general practice across the country, based on the available medications and treatment protocols. Furthermore, the telemedicine we have implemented in clinical and community settings, including its use at field hospitals during the pandemic, should be continuously developed to address the treatment gap for SUDs and other mental illnesses, particularly in low- and middle-income countries²¹.

Limitations and suggestions

Although this was the first study of substance use disorder and COVID-19 infection at a specific medical service, such as the field hospital during the COVID-19 pandemic, it was limited by being conducted retrospectively and quantitatively, with a small patient sample size. The COVID-19 infection rate among all residents of southern Thailand during the same timeframe was 7.3%²². Thus, the sample size would have needed to exceed 2,116 as it was too small to be generalizable without any follow-up data on morbidity and mortality after the patients were discharged or referred to other medical institutions. Moreover, most of the patients were male and middle-aged.

Hence these results might not be generalizable to all patients with SUDs in Thailand. Therefore, further studies on substance and alcohol use following the COVID-19 pandemic should survey all genders, ages, ethnicities, and regions of Thailand. Further cohort studies should be conducted to examine the changes in substance use disorders (SUDs) following the decline of the pandemic in 2022, with the aim of understanding their implications for both policy and clinical practice.

Conclusion

12.9% of the COVID-19 patients admitted to a field hospital in southern Thailand had a confirmed diagnosis of

first-diagnosed substance use disorder by a psychiatrist. The most reported substances used among the patients with a COVID-19 infection were tobacco and kratom. Approximately half of the patients reported experiencing symptoms of substance withdrawal at the field hospital. Kratom and opioids were the substances most frequently associated with withdrawal symptoms. The most commonly reported withdrawal symptoms for all patients with SUDs were insomnia and muscle aches. The prescribed psychotropic medications for these symptoms were mostly chlorpromazine and amitriptyline. Most patients with SUDs did not report any complications related to their COVID-19 infection.

Declarations

We confirm that all methods were carried out in accordance with relevant guidelines and regulations.

Ethics approval and consent to participate

This study was approved by the Medical Ethics Committee of the Faculty of Medicine, Prince of Songkla University (REC. 65-449-3-4). All stages of the research were conducted in full compliance with the Declaration of Helsinki and the Ethical Statements of the Ethics Committee of the Faculty of Medicine, Prince of Songkla University. Throughout this process, individual patients could not be identified, thus the requirement for informed consent was waived by the Medical Ethics Committee of the Faculty of Medicine, Prince of Songkla University.

Availability of data and materials

The quantitative data used in and analyzed during the current study cannot be made publicly available for confidentiality reasons, but they can be made available on request from the corresponding author.

Authors' contributions

JP: conception and design of the study, analysis of data, drafting of the manuscript, and tables; SV: conception and design of the study, data collection, analysis of data. CJ: conception and design of the study, analysis of data, drafting of the manuscript, and tables. All authors approved the final manuscript.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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References

- Wei Y, Shah R. Substance use disorder in the COVID-19 pandemic: a systematic review of vulnerabilities and complications. *Pharmaceuticals* 2020;13.
- Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. A novel coronavirus from patients with pneumonia in China, 2019. *N Engl J Med* 2020;382:727-33.
- Liu J, Lewohl JM, Harris RA, Iyer VR, Dodd PR, Randall PK, et al. Patterns of gene expression in the frontal cortex discriminate alcoholic from nonalcoholic individuals. *Neuropsychopharmacology* 2006;31:1574-82.
- Lewis SM, Williams A, Eisenbarth SC. Structure and function of the immune system in the spleen. *Sci Immunol* 2019;4.
- Patanavanich R, Glantz SA. Smoking is associated with COVID-19 progression: a meta-analysis. *Nicotine Tob Res* 2020;22:1653-6.
- Alqahtani JS, Oyelade T, Aldhahir AM, Alghamdi SM, Almeahmadi M, Alqahtani AS, et al. Prevalence, severity and mortality associated with COPD and smoking in patients with COVID-19: a rapid systematic review and meta-analysis. *PLoS One* 2020;15:e0233147.
- Cadet JL, Krasnova IN. Interactions of HIV and methamphetamine: cellular and molecular mechanisms of toxicity potentiation. *Neurotox Res* 2007;12:181-204.
- Zhao SX, Kwong C, Swaminathan A, Gohil A, Crawford MH. Clinical characteristics and outcome of methamphetamine-associated pulmonary arterial hypertension and dilated cardiomyopathy. *JACC Heart Fail* 2018;6:209-18.
- Won S, Hong RA, Shohet RV, Seto TB, Parikh NI. Methamphetamine-associated cardiomyopathy. *Clin Cardiol* 2013;36:737-42.
- Pertwee RG. Pharmacological actions of cannabinoids. *Handb Exp Pharmacol* 2005:1-51.
- Miller AM, Stella N. CB2 receptor-mediated migration of immune cells: it can go either way. *Br J Pharmacol* 2008;153:299-308.
- Pacher P, Steffens S, Hasko G, Schindler TH, Kunos G. Cardiovascular effects of marijuana and synthetic cannabinoids: the good, the bad, and the ugly. *Nat Rev Cardiol* 2018;15:151-66.
- Angkurawaranon C, Jiraporncharoen W, Likhitsathian S, Thaikla K, Kanato M, Perngporn U, et al. Trends in the use of illicit substances in Thailand: results from national household surveys. *Drug Alcohol Rev* 2018;37:658-63.
- Likhitsathian S, Jiraporncharoen W, Aramrattana A, Angkurawaranon C, Srisurapanont M, Thaikla K, et al. Polydrug use among kratom users: findings from the 2011 Thailand National household survey. *J Subst Use* 2018;23:384-9.
- Xu KY, Mintz CM, Borodovsky JT, Glaser PEA, Bierut LJ, Grucza RA. Prevalence of kratom use and co-occurring

- substance use disorders in the United States. *Prim Care Companion CNS Disord* 2021;23.
16. Talek M, Cottler LB, Wichaidit W, Assanangkornchai S. Patterns of kratom use among male drug users in the Deep South of Thailand. *THJPH* 2021;51:16–24.
 17. Assanangkornchai S, Muekthong A, Sam-Angsri N, Pattanasattayawong U. The use of *Mitragynine speciosa* (“krathom”), an addictive plant, in Thailand. *Subst Use Misuse* 2007;42:2145–57.
 18. Saingam D, Assanangkornchai S, Geater AF, Balhithip Q. Pattern and consequences of kratom (*Mitragyna speciosa* Korth.) use among male villagers in southern Thailand: a qualitative study. *Int J Drug Policy* 2013;24:351–8.
 19. Tungtanuwat W, Lawanprasert S. Fatal 4x100; Home-made kratom juice cocktail. *J Health Res* 2010;24:43–7.
 20. Department of Disease Control. COVID-19 vaccination guideline 2021 in Thailand (Second Revision). [homepage on the Internet] Nonthaburi: Department of Disease Control, Ministry of Public Health; 2021 [cited 2024 Feb 5]. Available from: <https://ddc.moph.go.th/vaccine-covid19/getFiles/11/1628849610213.pdf>
 21. ndi.fda.moph.go.th/drug_national [homepage on the Internet]. Nonthaburi: National Drug Information; 2022 [cited 2024 Feb 5]. Available from: https://ndi.fda.moph.go.th/drug_national
 22. Onderdonk M, Goldstein N. Substance use disorder treatment through telemedicine in the age of COVID-19. *J Addict Nurs* 2023;34:96–7.
 23. Kaewkrajang P, Jatchavala C, Sangsuwan T. Anxiety, optimism, and COVID-19 vaccine hesitancy among students in a University in Southern Thailand during the 2021 academic year. *Vaccines* 2023;11:1157.