Original Article

JHSMR Journal of Health Science and Medical Research

Cannabis Use Behaviors and Related Harms among Adults in Thailand by Sex Assigned at Birth and Age Groups

Jirawan Jayuphan, M.Sc.[1], Sawitri Assanangkornchai, M.D., Ph.D.[1,2], Wit Wichaidit, Ph.D.[1,2]

[1]Department of Epidemiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.

[2]Centre for Alcohol Studies, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.

Received 18 October 2023 ● Revised 11 December 2023 ● Accepted 8 January 2024 ● Published online 3 April 2024

Abstract:

Objective: The objectives of this study were to describe: 1) cannabis use behaviors; 2) self-reported cannabis-related harms and harmful behaviors among adults in Thailand, stratified by sex (assigned at birth) and age groups.

Material and Methods: A nationally-representative survey among adults in Thailand in May 2023 was conducted. Data using descriptive statistics with sampling weight adjustment was analyzed.

Results: Among the study participants (n=2,191 participants), approximately 15% of the participants were current cannabis users (estimated number: 7.5 million people aged 20 or over nationwide). Former and current users reported recreation or other non-medical purposes as the primary purposes of use (93% combined). Ingestion was the most common method of cannabis use. Male participants were more likely than female participants in all age groups to report using smoked cannabis. The most common harmful was riding a motorcycle after having used cannabis, although virtually no participants reported road accidents after same-day cannabis use.

Conclusion: This study's data provided basic information for relevant stakeholders. However, the lack of detailed information, the potential influence of social desirability, and the limited temporal generalizability should be considered in the interpretation of this study's findings.

Keywords: adults, cannabis, harms, thailand, use

Contact: Wit Wichaidit, Ph.D.
Department of Epidemiology, Faculty of Medicine, Prince of Songkla University,
Hat Yai, Songkhla 90110, Thailand.
E-mail: wit.w@psu.ac.th

J Health Sci Med Res .....
doi: 10.31584/jhsmr.20241052
www.jhsmr.org

Introduction

Cannabis is one of the most commonly used drugs in the world, along with alcohol and tobacco, with over 200 million users[1]. Additionally, its prevalence is projected to rise with changes in cannabis-related legislation in various countries. In Thailand, a middle-income country in Southeast Asia, the government issued the Notification of Ministry of Public Health, RE: Narcotics under Category 5 of the Narcotics Act B.E. 2565 (2022), which removed cannabis from the list of narcotics[2]. This allowed legalized and relatively unrestricted sales of cannabis to any person aged 20 years or older[3].

The context of cannabis consumption in the Kingdom has changed from illicit drug use to that of a legal substance with potential harm; similar to that of alcohol or tobacco. What differs between cannabis and other legal substances is the volatility in consumption and the introduction of both new products and methods of use. Furthermore, given the long history of cannabis use in Thailand and the suppression in recent decades[4], cannabis use may be found not only in adolescents and youths, but also in working-aged and older adults, with variations between age groups.

However, previous assessments of cannabis use behaviors have focused among adolescents, youths, and young adults[5–8]. Furthermore, the description of health disparities might have focused on variations in cannabis use behaviors and harms by sex and LGBTQA+ status, but not by age groups[5,6,8–12]. A number of population-level assessments of cannabis use behaviors have been conducted in Thailand, but these were made before the *de facto* legalization[13,14]. Population-level description of context-relevant cannabis use behaviors and cannabis-related harms can provide stakeholders in behavioral health and public safety with empirical data for future resource prioritization and program planning. The objective of this study was to describe variations by sex (assigned at birth) and age groups in the general population of adults in Thailand aged 20 years or older with regards to: 1) cannabis use behaviors and; 2) cannabis-related harms and harmful behaviors.

Material and Methods

Study design and setting

A community-based cross-sectional study in randomly selected provinces and sub-districts in Thailand was conducted.

Study participants and sample size calculation

The target population for this study included the general population of adults in Thailand. Inclusion criteria were: 1) being a member of the sampled households (having resided in the sampled household for at least 90 nights per year; 2) aged 20 years or older; 3) having lived in the sampled household for at least 3 months; 4) able to communicate in the Thai language. Exclusion criteria were: 1) employees of the household; 2) tenants of the household; 3) institutionalized individuals (e.g., clergy, prisoners, detained juveniles, hospital patients, boarding school students, members of the military and police living in garrisons).

The sample size for the study was calculated to address the primary objective of estimating the prevalence of cannabis consumption in Thailand, based on the assumed prevalence of 2.5% (p-value=0.025)[15] at a 95% level of confidence, with a 1% margin of error (delta=0.01). With an assumed design effect of 2, as well as assuming that 85% of sampled residents agreed to participate in the study, subsequently a sample size of 2,158 individuals was obtained. Then, 11 provinces plus Bangkok were randomly sampled (the capital), and assigned a number of samples in each region according to probability proportional to size.

Outcome measurement: cannabis use behaviors

Cannabis use was measured by adapting a questionnaire previously used in another study in Thailand[13] in combination with the Daily Sessions, Frequency, Age of

Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU)[16]. An investigator (WW) translated the English-language questionnaire to Thai and then used Google Translate to back-translate into English. Google Translate was used in lieu of a human translator due to a lack of time and budget to hire external human input. Points of discrepancies between the original English and back-translated English versions were identified and the Thai translation was further revised and finalized.

Cannabis use behaviors were assessed via two questions: 1) "B1_1. In this lifetime, have you ever used cannabis?", and; 2) "B1_5. When was the most recent occasion that you used cannabis?". Those who had used cannabis in their lifetime, but not in the past 12 months were considered to be former users; whereas, those who had used cannabis within the past 12 months were classed as current users. Those whom refused to answer either of the two questions, and those who answered: "Don't know," were treated as having missing data.

Outcome measurement: self-reported harm and harmful behaviors associated with cannabis use

Cannabis-related harm measurement questions were used, based on instruments used to measure alcohol-related harm to others in a national survey[17], with further modifications to fit the context of cannabis-related harm. The final inventory of cannabis-related harm questions thus included: 1) whether the participant had visited a healthcare provider and received a diagnosis that the condition was caused by cannabis, or its derivative in the past 12 months; 2) whether the participant had operated a motorcycle after having used cannabis in the past 12 months; 3) whether the participant had operated a car after having used cannabis in the past 12 months; 4) whether the participant had experienced any type of accident resulting in bodily injury after having used cannabis in the past 12 months, and; 5) whether the participant had experienced work-related problems (being absent/being late/being inefficient/loss of employment). The first four issues were deemed to be relevant to the current study and they were included in the study analyses.

Exposure measurement: age and sex of the study participants

The same set of questions as those used in previous rapid community-based surveys on alcohol consumption to measure the demographics of the study participants were used[18,19] Thailand. Among 804 participants, there were 183 current drinkers with 412 drinking events (215 low-, 79 medium-, and 118 high-intensity. However, questions regarding the number of household members, gender identity, and personal / household income were modified to suit the context of this study. For the measurement of sex, we used the question "A1. Birth gender" with the possible answer choices: 1) Male; 2) Female; 3) Others; 99) Refuse to answer. Those who answered "Others" and "Refuse to answer" were excluded from the analyses. Participants were asked to self-report their age in years, and those who indicated 88 (the proxy for "don't know") and 99 (the proxy for "refuse to answer") and an age of over 120 years (probable data entry errors) were excluded as missing values. The participants were then categorized into six groups: 1) Male youths aged 20-24 years; 2) Female youths aged 20-24 years; 3) Male adults aged 25-59 years ("Working age"); 4) Female adults aged 25-59 years); 5) Male adults aged 60 years or older ("Elderly"); 6) Female adults aged 60 years or older. The cut-off point of 24 years was chosen based on the United Nations definition of youths[20] and the age of 60 years was chosen as the cut-off point for elderly people based on the mandatory retirement age for civil servants in the Royal Thai Government.

Study instrument

The study instrument was a questionnaire that included 4 sections; namely: A) Characteristics of the study participants; B) Patterns of cannabis use (cannabis use,

impacts of cannabis use, cannabis use disorder screening questionnaire / CUDIT-R, kratom use, alcohol use, tobacco use excluding electronic cigarettes); C) Access to cannabis and exposure to cannabis, exposure to secondhand cannabis smoke, opinions regarding cannabis control policies, and attitude and norms regarding cannabis use; and D) Other health behaviors. Data from Sections A and B were used for the analyses.

Data collection

A survey research firm (SAB Co., Ltd.) was contracted to conduct data collection based on the protocols, supporting documents, and the study instrument that had received ethical approval. The survey research firm was asked to use a stratified multi-stage cluster sampling technique to select study participants. In Stage 1, 2 provinces from each region of Thailand were selected (except for the Bangkok Metropolitan Area: in which we selected Bangkok and one neighboring province). In Stage 2, the survey research firm sampled the main sub-district of the Mueang (Capital) District of each selected province to represent the urban area population and selected a sub-district in another district to represent the rural population (except for Bangkok, in which 2 urban districts were selected). In Stage 3, the survey research firm performed clustered sampling by contacting the health promotion hospital (primary care facility) responsible for the selected municipality area or sub-district, then randomly sampled village health volunteers who worked under each health promotion hospital using simple random sampling. The survey research firm then asked the village health volunteers to escort the data collectors to all households under the volunteer's care.

Upon arriving at each household, data collectors introduced themselves and informed all adults in the household that met the study criteria as too the study and asked for verbal informed consent. Data collectors also inquired of each participant about their ability to read. Among participants that were able to read, data collectors would then give either a tablet or smartphone containing the questionnaire to the participant to self-administer. Among participants who were not able to read, data collectors would collect the data using face-to-face interviews. Before data collection began, data collectors would ensure that the health volunteer was not in the vicinity.

Data management

The survey research firm's data management team oversaw the data collection process by collaborating with the team's supervisors to check the quality of the collected data each working day. The data management team also used a software package to prevent errors, e.g., incorrect entry of numbers or data inconsistency. The data management team then performed additional data processing before sending the final data to the investigators for further analyses.

Data analyses

Descriptive statistics was used to report the study findings. The calculated sampling weight for participants in each geographic region was based on the proportion between the population of Thai adults residing in a given region and the number of participants from the same region. This sampling weight was then used to perform weighted analyses with margin of errors using the Survey package in R[21]. The main findings are reported as weighted percent±standard errors (as margin of error).

Ethical considerations

This study received ethical approval from the Human Research Ethics Unit, Faculty of Medicine, Prince of Songkla University (REC. 65-434-19-2). Investigators received waiver of written informed consent, which included a waiver of the requirement to record the participant's name. This

was based on the controversial and politicized nature of cannabis use and trade in Thailand.

Results

A total of 2,191 participants answered the survey questions (Table 1). Most participants were predominantly female, Buddhist, with a high school education or less, and a median income of between 10,000 to 14,999 Thai Baht. Altogether, over 70% of our participants were working-aged adults.

Lifetime users of cannabis were most likely to be male youths, male elderly adults, and male working-aged adults (Table 2). The prevalence of current cannabis use varied from 8.7% among female youths to 21.2% among male youths. However, all female counterparts within each age group had a lower prevalence of use. The differences between age groups within each sex were relatively modest. Similar patterns also existed with regard to the current use of cannabis. Past-year initiation of cannabis use among current users also varied by age group, with female youths being the most likely group to have initiated use within 12 months prior to the survey. Youths and working-aged adult males were more likely to report recreation as the main purpose of cannabis use. Ingestion was the most common method of use (80% or more in all sexes and age groups); although the extent that this was reported in each group varied. Male participants in all age groups were more likely to report using smoked cannabis than their female counterparts.

With regard to self-reported harms from cannabis use in the past 12 months (Table 3), it was found that the number of visits to a doctor or medical professional in the past 12 months, the number of riding a motorcycle outside the home in the past 12 months and the number of driving a car outside the home in the past 12 months were significantly different between groups. Elderly female participants were most likely to visit healthcare workers and were diagnosed with cannabis-related symptoms, followed by elderly male participants. Male youths were most likely to report using cannabis before riding a motorcycle; whereas, working-aged males were most likely to report using cannabis prior to driving a car.

Based on the size of the Thai population and the sampling weights, it was estimated that there were approximately 7.5 million former cannabis users and 7.6 million current cannabis users in the general population of adults in Thailand, aged 20 years or older (Table 4). Among these 15 million current and former users, nearly 9 million had used cannabis recreationally. Among the 7.6 million current users, 3.3 million had visited a healthcare provider and were diagnosed with a cannabis-related symptom (Table 5). Furthermore, nearly 1 million reported having ridden a motorcycle after using cannabis on the same day, and over 626,000 reported having driven a car after using cannabis on the same day; although the history of accidents after using cannabis on the same day was relatively uncommon.

Discussion

In this cross-sectional study, cannabis use patterns and self-reported harm were characterized among representative samples of community-residing adults in Thailand. There were substantial differences in cannabis use behaviors between men and women within each age group, while differences between age groups within each sex were modest. Male participants were also more likely than female participants to report using cannabis prior to operating a vehicle. The findings of this study have implications for stakeholders in substance use as well as public safety. However, a number of considerations should be made in the interpretation of this study's findings.

Approximately 30 percent of the participants in this study had used cannabis in their lifetime, half of whom had stopped using before the *de facto* legalization. This contrasted sharply with the survey findings during the 2000s and 2010s, where self-reported cannabis use prevalence

Table 1 General characteristics of the study participants (n=2,191 adults in Thailand aged 20 years or older)

Characteristic	Percent±standard error or mean±standard error (%)
Gender	
Male	47.4±1.1
Female	52.6±1.1
Age in years (mean±SE)	45.8±0.3
Region	
Bangkok and Metropolitan Area	14.5±0.0
Central and Eastern Region	24.0±0.0
Northern Region	9.5±0.0
Western Region	4.9±0.0
Northeastern Region	33.4±0.0
Southern Region	13.7±0.0
Highest level of education completed	
Junior High School or Lower	32.4±1.0
High School or Equivalent	38.8±1.0
Some college (did not graduate) or currently studying	2.8±0.4
Associate's degree	11.8±0.7
Bachelor's Degree	13.6±0.7
Graduate Degree	0.6±0.2
Personal monthly income	
No more than 5,000 THB	12.1±0.7
5,001 to 9,999 THB	19.4±0.8
10,000 to 14,999 THB	30.0±1.0
15,000 to 19,999 THB	17.0±0.8
20,000 to 24,999 THB	11.5±0.7
25,000 to 29,999 THB	5.4±0.5
30,000 to 34,999 THB	2.1±0.3
35,000 to 39,999 THB	1.3±0.2
40,000 to 44,999 THB	0.5±0.1
45,000 to 49,999 THB	0.0±0.0
50,000 THB or more	0.7±0.2
Religion	
Islam	1.3±0.2
Buddhism	97.8±0.3
Christianity	0.9±0.2
Sex and age group	
Youths (20–24 years), male	4.7±0.5
Youths (20–24 years), female	3.7±0.4
Working Age Adults (25–59 years), male	34.5±1.0
Working Age Adults (25–59 years), female	37.4±1.0
Elderly Adults (60 years or older), male	8.3±0.6
Elderly Adults (60 years or older), female	11.5±0.7
Cannabis use status	
Never users	70.3±0.9
Former users (used but not in the past 12 months)	14.7±0.7
Current users (used within the past 12 months)	15.0±0.8
Age (in years) at initiation of cannabis use (among former and current users)	29.1±0.5
Initiated cannabis use within the past year (among current users)	22.5±2.3

Table 1 (continued)

Characteristic	Percent±standard error or mean±standard error
Main purpose of cannabis use (among former and current users only)	
Recreation (for enjoyment/relaxation/socialization)	59.5±1.9
Other non-medical purposes (appetite, sleep, others such as cooking or experimentation)	34.2±1.9
Medical purpose (pain relief, cancer, seizures)	6.3±1.0
Method of cannabis use (among former and current users only)	
Ingestion (eaten or drank)	60.1±1.9
Mixed with cigarette	16.8±1.4
Rolled in a joint	9.2±1.1
Smoked with water pipes	5.2±0.9
Smoked in pipes or dried bong	2.5±0.6
Others (infusion drop, capsules, spray, inhalants)	6.2%±0.9

was below 1 percent[22]. This study's findings suggested that social desirability might have heavily influenced the findings of previous studies, and that cannabis use was more common than reported: particularly in the 2000s. In this current survey, male participants were more likely to report recreation as the main purpose of cannabis use than female participants in the same age group. Working-aged and elderly female participants were more likely to report using cannabis for other non-medical purposes than the other groups. Recreational use of cannabis is known to be a negative coping mechanism against stress[23–25]; however, it can also be social and not stress-related26. In this study, the "other purposes" category was meant to be inclusive and non-specific; thus, caveats are required with regard to this non-specificity. Cannabis is known to be used in Thai cuisine as a form of herb or spice in soups[4], meant to enhance flavors and induce a euphoric effect[27]. Thus, the "other purposes" of cannabis use in this study's findings could have reflected a motive that was more closely aligned with cuisine, recreation, medical use, or a combination thereof. Future studies should consider qualitative data collection to further contextualize cannabis use in the general population of adults in Thailand. Furthermore, cannabis users in Thailand do engage in polydrug use[28,29]. Although, information was collected on use of other substances, it is not present here due to length limitation and the preference to present variations in cannabis use behaviors to the fullest possible extent. Future analyses should include patterns of polydrug use involving cannabis in order to contextualize cannabis use

Edibles/infusion were the most common, primary form of cannabis used by participants. However, these findings lacked details with regard to the type of food or drink consumed. Additionally, information regarding frequency, amount of psychoactive ingredient present, or duration of use was not collected. The original version of the DFAQ-CU that was adapted for the measurement of cannabis use behaviors in this study contained the question: "*When you eat edibles, how many milligrams of THC do you personally ingest in a typical session?*"[16]. Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU. This question was not included on the study instrument after considering the lack of standardization in cannabis cultivation and processing as well as the unknown level of awareness regarding the existence and quantification of THC within the Thai population. This measurement

Table 2 Cannabis use status and patterns among the study participants, with disaggregation by sex assigned at birth and age groups (n=2191 adults in Thailand aged 20 years or older) (column percent; percent±standard error or mean±standard error)

Characteristic	Youth (20–24 years), Male	Youth (20–24 years), Female	Working Age Adults (25–59 years), Male	Working Age Adults (25–59 years), Female	Elderly Adults (60 years or older), Male	Elderly Adults (60 years or older), Female	P-value*
	(n=102 Persons)	**(n=81 Persons)**	**(n=755 Persons)**	**(n=819 Persons)**	**(n=181 Persons)**	**(n=253 Persons)**	
Cannabis Use Status	(n=99)	(n=81)	(n=752)	(n=819)	(n=181)	(n=253)	
Never Users	58.8%±4.9%	76.6%±4.7%	62.0%±1.8%	78.6%±1.4%	59.2%±3.6%	78.3%±2.6%	**<0.001**
Former Users (used but not in the past 12 months)	20.1%±4.0%	14.8%±3.9%	18.8%±1.4%	8.7%±1.0%	26.5%±3.3%	11.8%±2.0%	
Current Users (used within the past 12 months)	21.2%±4.1%	8.7%±3.1%	19.2%±1.4%	12.8%±1.2%	14.4%±2.6%	9.9%±1.9%	
Age (in years) at initiation of cannabis use (n=651 former and current users)	19.5±0.3	19.8±0.3	27.1±0.6	30.8±0.8	31.4±1.9	41.7±2.4	**<0.001**
Initiated cannabis use within the past year (n=328 current users)	42.9%±10.8%	85.8% ± 13.2%	16.0% ± 3.1%	26.5%±4.3%	7.6%±5.2%	23.9%±8.5%	**<0.001**
Main purpose of cannabis use (among former and current users only)	**(n=43)**	**(n=19)**	**(n=288)**	**(n=172)**	**(n=74)**	**(n=55)**	
Recreation (for enjoyment/relaxation/ socialization)	90.7%±4.5%	79.0%±9.4%	70.4%±2.7%	45.3%±3.8%	55.2% ± 5.7%	21.8%±5.6%	**<0.001**
Other non-medical purposes (appetite, sleep, others such as cooking or experimentation)	9.4%±4.5%	15.8%±8.4%	26.9%±2.6%	47.1%±3.9%	33.9% ± 5.5%	58.2%±6.7%	
Medical purpose (pain relief, cancer, seizures)	0.0%±0.0%	5.2%±5.1%	2.8%±1.0%	7.6%±2.0%	10.9% ± 3.6%	20.0%±5.4%	

Table 3 Self-reported history of cannabis-related harms and harmful behaviors (health effects, operating vehicles under the influence of cannabis, and unintentional injury) in the past 12 months (n=324 current cannabis users)

Item*	Youth (20-24 years), Male	Youth (20-24 years), Female	Working Age Adults (25-59 years), Male	Working Age Adults (25-59 years), Female	Elderly Adults (60 years or older), Male	Elderly Adults (60 years or older), Female	P-value*
	(n=102 Persons)	(n=81 Persons)	(n=755 Persons)	(n=819 Persons)	(n=181 Persons)	(n=253 Persons)	
Visited a doctor or medical professional in the past 12 months	(n=21)	(n=7)	(n=143)	(n=105)	(n=26)	(n=25)	
Never visited	76.0%±9.3%	42.6%±18.7%	62.3%±4.0%	55.3% ± 4.8%	30.9%±9.1%	20.1%±8.0%	**<0.001**
Visit – not diagnosed with a cannabis-related symptom	0.0%±0.0%	0.0%±0.0%	2.1%±1.2%	0.0% ± 0.0%	0.0%±0.0%	4.0%±3.9%	
Visit – diagnosed with a cannabis-related symptom	24.0%±9.3%	57.4%±18.7%	35.6%±4.0%	44.7% ± 4.8%	69.1%±9.1%	75.9%±8.6%	
Riding a motorcycle outside the home in the past 12 months	(n=19)	(n=7)	(n=144)	(n=105)	(n=26)	(n=25)	
Never rode motorcycle	0.0%±0.0%	28.4%±17.0%	4.2%±1.7%	8.6%±2.7%	3.8%±3.8%	36.0%±9.6%	**0.008**
Rode a motorcycle – never used cannabis on the same day	68.7%±10.6%	71.6%±17.0%	83.5%±3.1%	78.2%±4.0%	88.5%±6.3%	56.0%±9.9%	
Rode a motorcycle – used cannabis before riding	31.3%±10.6%	0.0%±0.0%	12.4%±2.7%	13.3%±3.3%	7.7%±5.2%	8.0%±5.4%	
Driving a car outside the home in the past 12 months	(n=21)	(n=7)	(n=142)	(n=105)	(n=26)	(n=25)	
Never drove a car	57.1%±10.81%	85.5%±13.4%	30.3%±3.9%	52.3%±4.9%	54.0%±9.8%	87.9%±6.6%	**<0.001**
Drove a car – never used cannabis on the same day	33.3%±10.3%	14.5%±13.4%	55.0%±4.2%	43.9%±4.8%	46.0%±9.8%	12.1%±6.6%	
Drove a car – used cannabis before driving	9.6%±6.5%	0.0%±0.0%	14.8%±3.0%	3.8%±1.9%	0.0%±0.0%	0.0%±0.0%	
Accident (any type) resulting in physical injury in past 12 months	(n=21)	(n=7)	(n=140)	(n=105)	(n=26)	(n=25)	
Never had an accident	80.9%±8.6%	85.8%±13.2%	84.3%±3.1%	90.5%±2.9%	96.1%±3.8%	88.0%±6.5%	0.700
Had an accident – did not use cannabis on the same day	19.1%±8.6%	14.2%±13.2%	15.0%±3.0%	9.6%±2.9%	3.9%±3.8%	12.0%±6.5%	
Had an accident – used cannabis before the accident	0.0%±0.0%	0.0%±0.0%	0.7%±0.7%	0.0%±0.0%	0.0%±0.0%	0.0%±0.0%	

Excluded those who said "don't know" or "refuse to answer."

*By chi-square test of independence with Rao-Scott Adjustment or one-way ANOVA. Bold texts denote statistical significance at 95% level of confidence

Table 4 Estimated number of adults in Thailand by cannabis use behaviors

Characteristic	Youth (20–24 years), Male	Youth(20–24 years), Female	Working Age Adults (25–59 years), Male	Working Age Adults (25–59 years), Female	Elderly Adults (60 years or older), Male	Elderly Adults (60 years or older), Female
Cannabis Use Status						
Never Users	1,347,615	1,437,414	10,794,466	14,898,366	2,475,965	4,582,767
Former Users (used but not in the past 12 months)	460,095	277,751	3,280,764	1,640,735	1,106,466	690,779
Current Users (used within the past 12 months)	485,253	161,753	3,340,246	2,428,629	600,718	576,140
Initiated cannabis use within the past year (among current users)	323,009	208,413	581,336	829,738	69,282	183,905
Main purpose of cannabis use (among former and current users only)						
Recreation (for enjoyment/relaxation/ socialization)	898,828	347,149	4,692,400	1,801,987	942,607	275,959
Other non-medical purposes (appetite, sleep, others such as cooking or experimentation)	92,754	69,309	1,790,138	1,874,164	579,135	736,946
Medical purpose (pain relief, cancer, seizures)	0	23,046	185,272	301,805	185,442	254,014

Table 5 Estimated number of current cannabis users with history of cannabis-related harms and harmful behavior in the past 12 months

Characteristic	Youth (20–24 years), Male	Youth (20–24 years), Female	Working Age Adults (25–59 years), Male	Working Age Adults (25–59 years), Female	Elderly Adults (60 years or older), Male	Elderly Adults (60 years or older), Female
Visited a doctor or medical professional in the past 12 months						
Never visited	368,820	68,904	2,065,516	1,344,168	185,697	115,917
Visit – not diagnosed with a cannabis-related symptom	0	0	69,354	0	0	23,024
Visit – diagnosed with a cannabis-related symptom	116,434	92,849	1,182,352	1,084,462	415,021	437,198
Riding a motorcycle outside the home in the past 12 months						
Never rode motorcycle	0	45,880	139,037	207,889	23,046	207,305
Rode a motorcycle – never used cannabis on the same day	302,436	115,873	2,787,301	1,898,398	531,623	322,786
Rode a motorcycle – used cannabis before riding	137,854	0	413,909	322,342	46,049	46,049
Driving a car outside the home in the past 12 months						
Never drove a car	276,844	138,353	996,136	1,270,485	324,338	506,315
Drove a car – never used cannabis on the same day	161,609	23,400	1,810,371	1,065,790	276,380	69,825
Drove a car – used cannabis before driving	46,800	0	486,938	92,355	0	0
Accident (any type) resulting in physical injury in past 12 months						
Never had an accident	392,360	138,729	2,736,117	2,196,647	577,318	507,233
Had an accident – did not use cannabis on the same day	92,894	23,024	488,492	231,982	23,400	68,906
Had an accident – used cannabis before the accident	0	0	23,024	0	0	0

instrument may need further modification before use in other settings.

It was found that more than four-fifths of youths that were former and current users of cannabis had initiated cannabis use within the prior 12 months. The prevalence was particularly high among female youths. These findings echo existing concerns regarding the implications of cannabis legalization30. However, the extent that cannabis legislation is associated with changes in prevalence of cannabis use varies widely[31–33]. The findings of this study contribute to the existing body of empirical data on such changes. Considering that cannabis is a potential gateway drug to harder substances[34], stakeholders in narcotics control should also take the findings of this study into account when making plans for future programs.

Male participants in all age groups were more likely than female participants to report smoking as the primary method of use, similar to the findings of another recent study[8]. The difference might be influenced by traditional gender roles[35,36]; not unlike alcohol or tobacco use. In this study, we disaggregated the distribution of study outcomes by sex assigned at birth and not gender. It was decided to use sex assigned at birth instead of gender identity for disaggregation due to concerns regarding lack of statistical power. Approximately 2 percent of Thai youths identify as transgenders[37,38], which would have equaled to approximately 40 participants in this study, and any estimates made in this sub-population would have had a very large margin of error. Furthermore, considering the generational variations in LGBTQA+ self-identification[39,40], such categorization would be subjected to cohort effects; potentially leading to misclassification and information bias. Nonetheless, in consideration that disparities exist between cisgender-heterosexual and LGBTQA+ youths with regard to cannabis use[6,8,12,37], and that one-fourth of Thai adolescents identify as LGBTQA+37, larger national surveys should consider incorporating questions regarding cannabis use and LGBTQA+ identities to describe health disparities with adequate statistical power.

Self-reported motor vehicle accidents with prior cannabis use were virtually nonexistent among the study participants, which differed greatly from the findings in other studies[41–45]. This study findings were inconsistent with Thailand's high burden of road traffic injuries[46]. Despite the assurance of anonymity to the study participants, social desirability bias might have contributed to the observed discrepancies. Cannabis use is associated with physical health problems[47,48] and mental health problems[49]. However, we did not probe for details regarding health issues among the study participants, as it was not deemed that the use of clinical terminology was suitable for a community-based survey in the general population of adults. Although, initially, there was a plan to include questions pertaining to the perpetration and victimization of interpersonal violence, these were eventually removed after receiving comments from our institutional review board. Future studies should consider data collection from more clinically informed people (e.g., healthcare professionals and students), and include questions pertaining to violence to provide a more complete perspective regarding cannabis-related harms.

The primary strength of this study is the representativeness of the study participants in addition to the ability to make population-level inferences with adjustments to the sampling weight. However, a number of limitations should be considered in the interpretation of this study's findings. Firstly, there was no method to accurately quantify the dosage of cannabis used; particularly for edibles. Therefore, it could only assess disparities in cannabis use by categories. Secondly, although Thailand has legalized cannabis *de facto*, the issue of cannabis was politicized and we could not rule out the possibility that residual social desirability influenced the study's findings. Thirdly, as the status of cannabis in Thailand remains a dynamic social issue, the findings of this study may have limited generalizability beyond the study's contemporary context.

Conclusion

In this nationallyrepresentative survey, the prevalence of self-reported cannabis use behaviors and cannabis-related harm among adults aged 20 years and older living in Thailand, stratified by sex (gender assigned at birth) and age groups, is described. It was found that approximately 9% to 21% of the population are current cannabis users, that the primary purposes of cannabis use were either recreation or non-medical purposes, and that ingestion was the most common method of cannabis use. Male participants were more likely to report recreational use and smoking as the method of use than female participants, and younger users were more likely to report cannabis-related harmful behaviors than older users. The results of this survey have implications for relevant stakeholders. However, the lack of detailed information regarding dosage and context of cannabis use, the influence of social desirability in self-reported data, and the limited generalizability of the survey should be considered as caveats in the interpretation of the study findings.

Acknowledgement

The authors would like to thank all study participants for their valuable time and all data collectors for their tireless efforts.

Funding sources

Funding support for the study was provided by the Thai Health Promotion Foundation. The funder played no role in the study design nor interpretation/presentation of the study findings.

Data availability statement

The anonymized dataset and supporting file necessary to replicate the findings of this study is available at the following URL: https://www.kaggle.com/datasets/wichaiditwit/jhsmr-2023-0589-supplementary

References

1. Elflein J. Number of cannabis users worldwide by region 2011-2021 [homepage on the Internet]. Hamburg: Statista; 2023 [cited 2023 Aug 27]. Available from: https://www.statista.com/statistics/264734/number-of-cannabis-users-worldwide-by-region/
2. Royal Thai Government. Notification of Ministry of Public Health, RE: Narcotics under Category 5 of the Narcotics Act B.E. 2565 (2022) [homepage on the Internet]. 2022 [cited 2023 Aug 27]. Available from: https://mnfda.fda.moph.go.th/narcotic/?p=12061
3. Tang Y. High times in Thailand: New weed laws draw tourists from across Asia [homepage on the Internet]. New York: Associated Press; 2023 [cited 2023 Aug 27]. Available from: https://apnews.com/article/thailand-cannabis-tourism-asia-ad54d1ff0ba57ecaadf75aa48072f8db
4. Blair E. History of Cannabis Use and Anti-Marijuana Laws in Thailand [homepage on the Internet]. Thailand Law Forum. 2011 [cited 2023 Sep 30]. Available from: http://www.thailawforum.com/history-of-marijuana-cannabis-thailand.html
5. Chen LY, Martins SS, Strain EC, Mojtabai R, Storr CL. Sex and age differences in risk factors of marijuana involvement during adolescence. Addict Disord Their Treat 2018;17:29–39.
6. Dunbar MS, Siconolfi D, Rodriguez A, Seelam R, Davis JP, Tucker JS, et al. Alcohol use and cannabis use trajectories and sexual/gender minority disparities in young adulthood. Psychol Addict Behav 2022;36:477–90.
7. Harris-Lane LM, Drakes DH, Donnan JR, Rowe EC, Bishop LD, Harris N. Emerging adult perceptions of cannabis consumption post-legalization: considering age and sex differences. J Adolesc Health 2023;72:404–11.
8. Struble CA, Borodovsky JT, Habib MI, Hasin DS, Shmulewitz D, Livne O, et al. Extending gender- and sex-based analyses in cannabis research: findings from an online sample of gender diverse young adult consumers. Cannabis Cannabinoid Res 2023;
9. Gutkind S, Shmulewitz D, Hasin D. Sex differences in Cannabis use disorder and associated psychosocial problems among US adults, 2012-2013. Prev Med 2023;168:107422.
10. Halladay JE, Boyle MH, Munn C, Jack SM, Georgiades K. Sex differences in the association between Cannabis use and suicidal ideation and attempts, depression, and psychological distress among canadians. Can J Psychiatry 2019;64:345–50.

11. Pasquier B, Yaffe K, Levine DA, Rana JS, Pletcher MJ, Tal K, et al. Sex differences in the association between cumulative use of cannabis and cognitive function in middle age: the coronary artery risk development in young adults study. Cannabis Cannabinoid Res 2023;
12. Schuler MS, Rice CE, Evans-Polce RJ, Collins RL. Disparities in substance use behaviors and disorders among adult sexual minorities by age, gender, and sexual identity. Drug Alcohol Depend 2018;189:139–46.
13. Assanangkornchai S, Thaikla K, Talek M, Saingam D. Medical cannabis use in Thailand after its legalization: a respondent-driven sample survey. Peer J 2022;10:e12809.
14. Kalayasiri R, Boonthae S. Trends of cannabis use and related harms before and after legalization for recreational purpose in a developing country in Asia. BMC Public Health 2023 19;23:911.
15. WHO. Cannabis [homepage on the Internet]. Geneva: Alcohol, Drugs and Addictive Behaviours; 2022 [cited 2022 Oct 9]. Available from: https://www.who.int/teams/mental-health-and-substance-use/alcohol-drugs-and-addictive-behaviours/drugs-psychoactive/cannabis
16. Cuttler C, Spradlin A. Measuring cannabis consumption: psychometric properties of the daily sessions, frequency, age of onset, and quantity of Cannabis use inventory (DFAQ-CU). PLoS One 2017;12:e0178194.
17. Wichaidit W, McNeil E, Saingam D, Assanangkornchai S. Alcohol consumption in Thai society report 2017. songkhla Thailand: Center for Alcohol Studies; 2019; p.150.
18. Vichitkunakorn P, Conigrave KM, Geater AF, Assanangkornchai S. A context-specific instrument to record drinking behaviour: a pilot study on implications of identifying the context of risky drinking. Community Ment Health J 2021;57:167-77. doi: org/10.1007/s10597-020-00629-0.
19. Wichaidit W, Prommanee C, Choocham S, Chotipanvithayakul R, Assanangkornchai S. Modification of the association between experience of economic distress during the COVID-19 pandemic and behavioral health outcomes by availability of emergency cash reserves: findings from a nationally-representative survey in Thailand. Peer J 2022;10:e13307.
20. United Nations. Youth | United Nations [homepage on the Internet]. New York: United Nations; 2023 [cited 2023 Oct 1]. Available from: https://www.un.org/en/global-issues/youth
21. Lumley T. Complex surveys: a guide to analysis using R. Hoboken. New Jersey: John Wiley & Sons, Inc; 2010.
22. Angkurawaranon C, Jiraporncharoen W, Likhitsathian S, Thaikla K, Kanato M, Perngparn U, et al. Trends in the use of illicit substances in Thailand: results from national household surveys. Drug Alcohol Rev 2018;37:658–63.
23. Ahsan S, Kiani FS, Hanif R, Andleeb SN. Negative coping styles among individuals with cannabis use disorder and non-users – a cross sectional study. J Pak Med Assoc 2021;71:1757–60.
24. Foster DW, Jeffries ER, Zvolensky MJ, Buckner JD. The interactive influence of cannabis-related negative expectancies and coping motives on cannabis use behavior and problems. Subst Use Misuse 2016;51:1504–11.
25. Hyman SM, Sinha R. Stress-related factors in cannabis use and misuse: implications for prevention and treatment. J Subst Abuse Treat 2009;36:400–13.
26. DiGuiseppi GT, Fedorova EV, Conn B, Lankenau SE, Davis JP, Ataiants J, et al. Understanding changes in social cannabis use among young adults during the covid-19 pandemic: a social network analysis. Cannabis 2023;6:20–33.
27. Daily News Writers. "Happy Noodles" with "Ganja" to enhance flavors and generate income. Daily News Newspaper [homepage on the Internet]. Bangkok: Daily News Newspaper; 2021 [cited 2023 Sep 30]. Available from: https://d.dailynews.co.th/article/843221/
28. 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. Null 2018;23:384–9.
29. 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.
30. Bahji A, Stephenson C. International perspectives on the implications of cannabis legalization: a systematic review & thematic analysis. Int J Environ Res Public Health 2019;16.
31. Chiu V, Leung J, Hall W, Stjepanović D, Degenhardt L. Public health impacts to date of the legalisation of medical and recreational cannabis use in the USA. Neuropharmacology 2021;193:108610.
32. Scheim AI, Maghsoudi N, Marshall Z, Churchill S, Ziegler C, Werb D. Impact evaluations of drug decriminalisation and legal

regulation on drug use, health and social harms: a systematic review. BMJ Open 2020;10:e035148.

33. Wilkinson ST, Yarnell S, Radhakrishnan R, Ball SA, D'Souza DC. Marijuana Legalization: impact on physicians and public health. Annu Rev Med 2016;67:453–66.
34. Wilson J, Mills K, Freeman TP, Sunderland M, Visontay R, Marel C. Weeding out the truth: a systematic review and meta-analysis on the transition from cannabis use to opioid use and opioid use disorders, abuse or dependence. Addiction 2022;117:284–98.
35. Sarakadee Lite Editors. Cannabis was the trend in Thai mural arts for more than 100 years [homepage on the Internet]. Bangkok: Sarakadee Lite Editors; 2023 [cited 2023 Aug 27]. Available from: https://www.sarakadeelite.com/arts_and_culture/cannabis-art/
36. Silpa Magazine Editors. Observing the golden age of "cannabis": from the Chinese in Petchburi to the literature - Did Thai soldiers pack cannabis into battles? [homepage on the Internet]. Bangkok: Silpa Magazine; 2023 [cited 2023 Aug 27]. Available from: https://www.silpa-mag.com/culture/article_26155
37. Wichaidit W, Mattawanon N, Somboonmark W, Prodtongsom N, Chongsuvivatwong V, Assanangkornchai S. Behavioral health and experience of violence among cisgender heterosexual and lesbian, gay, bisexual, transgender, queer and questioning, and asexual (LGBTQA+) adolescents in Thailand. PLoS One 2023;18:e0287130.
38. Wichaidit W, Assanangkornchai S, Chongsuvivatwong V. Disparities in behavioral health and experience of violence between cisgender and transgender thai adolescents. PLoS One 2021;16:e0252520
39. Goldman J. Gen Z consumers increasingly identify as LGBTQ+ [homepage on the Internet]. New York: Insider Intelligence; 2023 [cited 2023 Dec 4]. Available from: https://www.insiderintelligence.com/content/gen-z-consumers-increasingly-identify-lgbt
40. IPSOS. LGBT+ PRIDE 2021 Global Survey: a 27-country Ipsos survey [homepage on the Internet]. New York: Ipsos; 2021 [cited 2022 Oct 27]. Available from: https://www.ipsos.com/sites/default/files/ct/news/documents/2021-06/LGBT%20Pride%202021%20Global%20Survey%20Report_3.pdf
41. Choo EK, Nishijima D, Trent S, Eichelberger A, Ye Y, Audett A, et al. Cannabis presentations to the emergency department after MVC in the era of legalization for recreational use. J Safety Res 2022;80:341–8.
42. Gunadi C. Does expanding access to cannabis affect traffic crashes? County-level evidence from recreational marijuana dispensary sales in Colorado. Health Econ 2022;31:2244–68.
43. Kilmer B, Rivera-Aguirre A, Queirolo R, Ramirez J, Cerdá M. Cannabis legalization and traffic injuries: exploring the role of supply mechanisms. Addiction 2022;117:2325–30.
44. Nazif-Munoz JI, Oulhote Y, Ouimet MC. The association between legalization of cannabis use and traffic deaths in uruguay. Addiction 2020;115:1697–706.
45. Windle SB, Socha P, Nazif-Munoz JI, Harper S, Nandi A. The impact of cannabis decriminalization and legalization on road safety outcomes: a systematic review. Am J Prev Med 2022;63:1037–52.
46. Murray CJL, Barber RM, Foreman KJ, Ozgoren AA, Abd-Allah F, Abera SF, et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries. Lancet 2015;386:2145-91.
47. Karila L, Roux P, Rolland B, Benyamina A, Reynaud M, Aubin HJ, et al. Acute and long-term effects of cannabis use: a review. Curr Pharm Des 2014;20:4112–8.
48. Richards JR, Blohm E, Toles KA, Jarman AF, Ely DF, Elder JW. The association of cannabis use and cardiac dysrhythmias: a systematic review. Clin Toxicol (Phila) 2020;58:861–9.
49. Urits I, Gress K, Charipova K, Li N, Berger AA, Cornett EM, et al. Cannabis use and its association with psychological disorders. Psychopharmacol Bull 2020;5:56–67.