Spatial Distribution Analysis of Cannabis-Infused Food and Drink Establishments in Pathum Thani Province, Thailand Through Geographic Information Systems

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Abstract
The liberal cannabis policy in Thailand has been made to reach cannabis-infused food and drink. It is becoming popular in the population and easy to assess. This study was survey research to investigate the consumption of cannabis-infused food and drink among undergraduate students, explored and visualized the spatial distribution analysis of cannabis-infused food and drink establishments in Pathum Thani Province, Thailand through geographic information systems (GIS). The process was separated into 2 parts: survey and GIS parts. The 240 undergraduate students were recruited in the survey using purposive sampling with the questionnaire and analyzed by descriptive statistics. Therefore, cannabis-infused food and drink establishments were explored and delineated using GIS to visualize the location, bubble, and buffer maps. The locations of both the establishments and universities were acquired from Google Maps. The finding indicated that the majority of the samples were female (72.1%) with an average age of 20.12 years. They mostly experienced consumption of cannabis-infused food and drink (68.7%) with less than 1 time/month (61.2%). The spatial distribution discovered the coordinates distribution of 14 cannabis-infused food and drink establishments shown in the location map and visualized the population density per square kilometer with 7 levels dividing 7 districts of Pathum Thani province. Moreover, the spatial analysis utilized a bubble map separated by weekly sales, number of customers, and monthly income with 4 levels, and reporting in weekly sales was directly related to the number of customers and monthly income. This research presented buffer maps that show the 10-kilometer radius around the five universities to demonstrate the accessibility of obtaining cannabis-infused food and drink around the university and residential areas. The findings can be used to expose the policy to control cannabis-infused food and drink around the university and develop an intervention program to change behavior.

Keywords: Cannabis, Food and Drink, GIS, Spatial Analysis, Undergraduate Students

1. Introduction

Cannabis, also referred to as marijuana, is a group of three plants with psychoactive properties: Cannabis Sativa, Cannabis Indica, and Cannabis Ruderalis. It is made up of more than 120 components, also known as cannabinoids, among which we can find cannabidiol (CBD) and tetrahydrocannabinol (Δ9-THC). While Δ9-THC is psychoactive, CBD is not, and everyone can find cannabis products that contain just CBD, Δ9-THC, or a combination of both. Cannabis's social acceptance in many nations is a big motivator for its incorporation into food and drinks. This acceptance has cleared the road for recreational cannabis legalization, increasing the demand for cannabis-infused food and drinks [1]. By region, North America was the most prominent regional cannabis food and beverage market in 2018 [2]. This can be attributed to the lifting of a ban on the addition of cannabis in the production of food and drink in the U.S. Asia-Pacific is expected to witness the highest of 31.4% during the forecast period. Moreover, the information from the Center for Addiction Studies' ninth academic conference recently held in February 2022 found that the use of cannabis in Thailand has doubled from the previous years.

Research shows around 1.89 million Thai over the age of 18 or approximately 4.3% are using cannabis compared to around 1 million users in 2020 [3].

Food and beverage products containing cannabis extract (edibles) have emerged as a popular and lucrative facet of the legalized market for both recreational and medicinal cannabis [4]. Towards the end of July 2021, Thailand's Ministry of Public Health (MOPH) issued a notification under the Food Act regarding food products that contain cannabis as a publication in the country's Government Gazette. The notification, among other things, sets forth the classification of food products containing cannabis and the related requirements concerning food quality, standards, and labeling requirements [5]. In addition, following the removal of cannabis from the list of controlled narcotics paving the way for their commercial and economic benefits, the market for cannabis-flavored drinks has seen a rigorous expansion. There are now such products as cannabis tea and cannabis coffee some of which may be found in café & restaurants or vending machines making them very easily accessible to different groups of consumers including vulnerable groups, namely children and adolescents have access to cannabis, and products containing cannabis are illegal. If cannabis as a food ingredient or various processing is allowed free use without regulated laws [6]. It may affect the brains of children and adolescents, such as developmental delays, behavior problems, and decreased intelligence, and affects the mood and risk of depression or anxiety, including negative effects on physical health both short term and long term. Adolescents will get negative results or more obvious adverse effects than adults because adolescent brains are not yet fully mature, they are vulnerable to addictive substances [7].

The trend has caused some concern for medical doctors and addiction researchers who warn that the impact of Δ9-THC found in cannabis may affect those consuming large amounts of the substance continuously [8]. This might have an impact on how the brain develops. With a clear label indicating the contents and the amount of Δ9-THC per 100 milliliters or serving size, the ready-made drinks need FDA approval. Contrarily, beverages served in cafes are typically created on-site, and even the same drink may contain a different combination, which could affect how much Δ9-THC is present in it. This is where it can become dangerous [9]. There should be, for instance, a number proportionate to 1 kilogram of a person's weight and how many micrograms one must not exceed since it could cause side effects [10]. Even the shops or the business operators probably aren't yet aware of the maximum level of Δ9-THC per glass and even if they do there can be no real regulation since there hasn't been any inspection taking place. Another thing is that the drinks are all made differently [11]. The report of the Drug Research Center found that Savory and sweet foods did not meet the threshold for Δ9-THC more than 0.2% by weight [12]. Royal College of Pediatricians of Thailand is recommending to prevent the effects of cannabis use on children and adolescents as follows; Children under 20 years old should not access and consume cannabis because the brain is not fully developed [12]. Several doctors have warned that children refrain from consuming the substance since it can affect their physical, mental, and even emotional development [13] and [14].

This study aimed to investigate the characteristics of consumption of cannabis-containing food and drink among undergraduate students in Pathum Thani province, explored the cannabis-infused food and drink establishments in the study area, and anatomized the spatial distribution analysis of cannabis-infused food and drink establishments in Pathum Thani province, Thailand through GIS. Undergraduate students are the age group who are in the process of learning with their lives. It is an age when they have the freedom to make decisions and have health behaviors that match their own needs [15]. They can easily assess the cannabis-infused in food and drink in café shops, restaurants, or online products [16]. Additionally, this study explored the location of cannabis-infused food and drink establishments in Pathum Thani Province and analyzed the spatial distribution by focusing on weekly sales, monthly income, and number of customers per day using the geographic information systems. This process can describe the distribution of cannabis-infused food and drink establishments which may promote consumption from nearly all residences and universities of undergraduate students [17] and [18].

The gap in the study is a few studies of cannabis-infused food and drink. Prior research endeavors have concentrated on investigating the attributes of intentions, viewpoints, and personal encounters linked to the consumption of cannabis-infused food and drink [19] and [20]. Also, some research was conducted to find out what factors affect young adults' happiness, well-being, and product-choice behavior when it comes to cannabis-infused products [21]. Furthermore, vaping cannabis was the subject of most research rather than consuming it through food or drink [22] and [23].

It was evident from the foregoing that this study was different from the others in that it examined and analyzed environmental aspects using GIS, such as the availability of cannabis-infused food and drink establishments near universities and residential dorms and the consumption of cannabis-infused food and drink was the study's main focus. Importantly, following the recent removal of cannabis from Thailand's list of controlled narcotics food and drink stores can buy the infused cannabis menu legally. The recommended daily intake for Δ9-THC in Thailand has not yet been established. With cannabis now being freely used as an ingredient in food and drink, this allows easy access to the general public which includes children and the youth as well. The results of this study can be applied to developing the intervention program to change the consumption behavior of cannabis-infused food and drink. The healthcare providers and university administration can use this distribution data to impose the policy for controlling the sales of cannabis-infused food and drink in the university and around the university.

2. Material and Methods

2.1 Study Design

This study was survey research separated into 2 parts: 1.) Survey the cannabis-infused food and drink among undergraduate students in Pathum Thani province. This part was to examine the consumption of cannabis-infused food and drink using a questionnaire among undergraduate students. The questions consisted of experience of consuming cannabis-infused food and drink, frequency of consumption of cannabis-infused food and drink, reasons to consume, and factors related to the cannabis-infused food and drink. 2.) Explore the cannabis-infused food and drink establishments in Pathum Thani province and apply the GIS for the present location map, bubble map to describe the distribution divided by location, weekly sales, number of customers, and monthly income, and buffer map to visualize the radius of cannabis-infused food and drink establishments around the five universities same as the survey part. The data collection was conducted by the researchers between April to May 2023 through a questionnaire and interview form shown in the methodology flowchart in Figure 1.

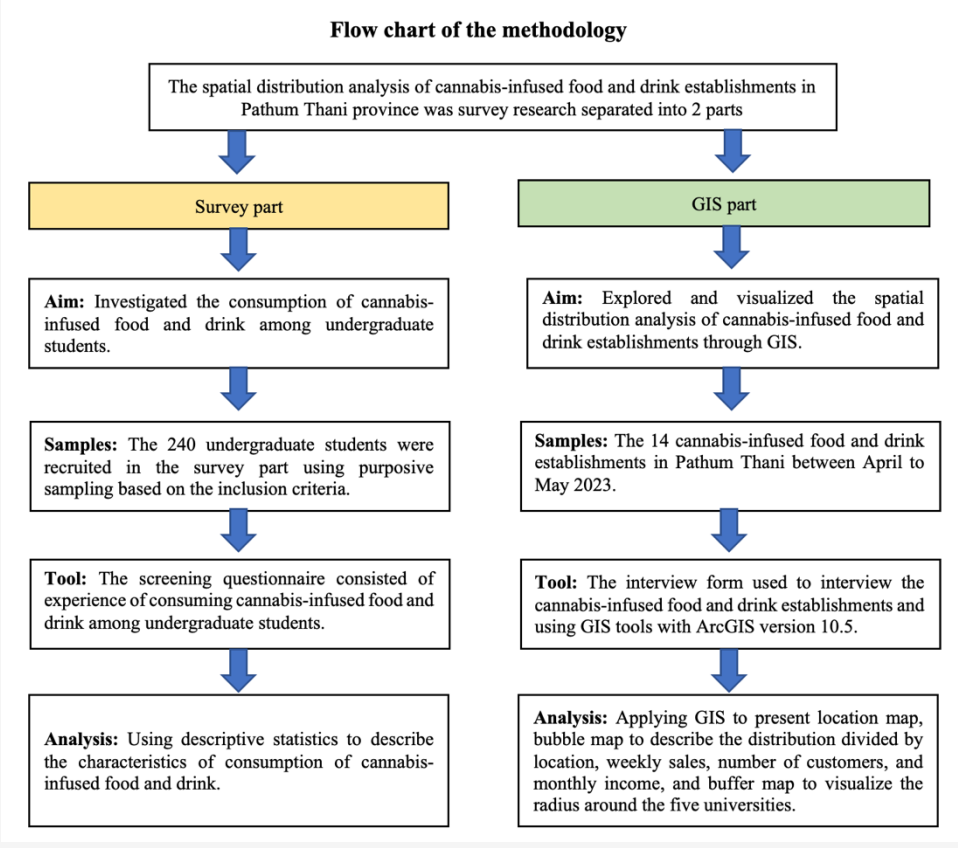

Figure 1: Flow chart of the methodology in this study

2.2 Participants and Mapping Data

This study area was selected in Pathum Thani province, Thailand. This is the central part of the province in Thailand and is considered a part of the Bangkok Metropolitan Area. This area has many universities and most of them are located in urban areas [24]. The population of this study lived in urban areas and they had various population characteristics, that related to health behavior and can lead to the intake of cannabis-infused food and drink among undergraduate students [25].

2.2.1 Participants in Survey Process

This part survey of the consumption of cannabis-infused food and drink among undergraduate students. The participants were representatives of undergraduate students in Pathum Thani province. The participants of this part calculated the sample size by using the equation with the finite population of Cochran [26]. Thus, the sample size of this part was 240 participants. To increase the diversity of undergraduate students, each university was given 48 participants. This survey used purposive random sampling to recruit the participants into the study based on the inclusion criteria. The inclusion was selected by the participants who were undergraduate students and registered in Pathum Thani province in the academic year of 2023. They voluntarily participate in the survey can communicate in Thai, and can be contacted by telephone and social networks. Using purposive random sampling, the researchers chose five universities from the total number of participants in the survey: Thammasat University **(**TU**)**, Pathum Thani University **(**PTU**)**, Valaya Alongkorn Rajabhat University **(**VRU**)**, Rajamangala University of Technology Thanyaburi **(**RMUTT**)**, and Rangsit University **(**RSU**)**.

2.2.2 Data and Mapping

The researchers gathered data to assess the accessibility of cannabis-infused food and drinks among undergraduate students and explored food and drink establishments in the province of Pathum Thani using an interview form. The locations of both the establishments and universities were acquired from Google Maps. The study area for this research was Pathum Thani province, which is divided into seven districts, as shown in the map of the study area in Figure 2. Pathum Thani, Thailand shapefiles were obtained from http://www.DIVA-GIS.org [27]. The coordinate system UTM Zone 47P was used and constructed the map with Latitude: 13° 50′0″ N to 14° 20′0″ N and Longitude: 100° 20′0″ E to 101° 0′0″ E.

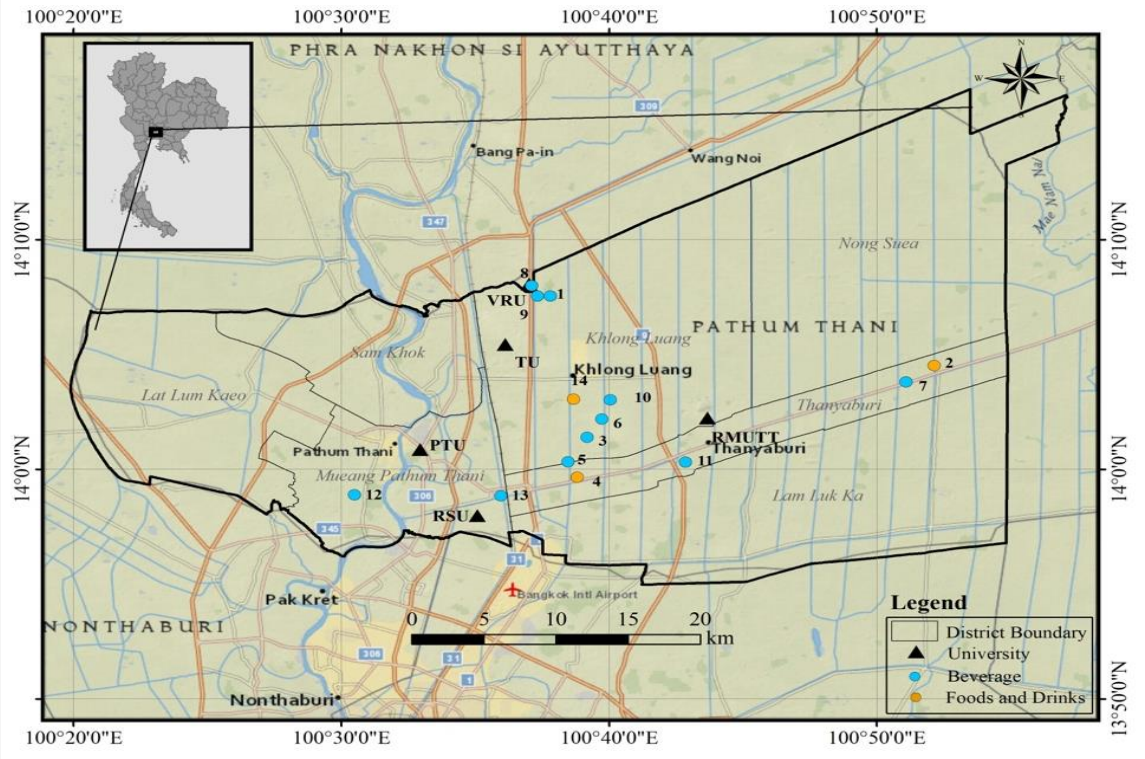

Figure 2: The study area in Pathum Thani province, Thailand

2.3 Ethical Consideration

This research was approved the ethical consideration by the ethics review committee for research involving human research participants, Group I, Chulalongkorn University. Approval for the study was granted on February 28, 2023, with study number 650163 and COA number 041/66. The researchers provided a concise verbal overview of the research study's objectives and procedures, outlined the advantages of participating, and assured confidentiality in the data collection process via questionnaires and interviews. Each participant was also informed that participation in this study was entirely voluntary, and they could withdraw at any time without any adverse effects. The results of this study were presented as a complete overview; no identifying information was collected and was excluded from the report. Participant anonymity was maintained using codes instead.

2.4 Instrument of the Study

The tool consisted of 2 parts of the form to collect the consumption of cannabis-infused food and drink and to explore the cannabis-infused food and drink establishments in Pathum Thani province. The details of this part can be described as follows:

Part I Screening Questionnaire; Open-ended and closed-ended questions were used to survey consumption of cannabis-infused food and drink among undergraduate students in Pathum Thani Province, Thailand. Answering the questionnaire took approximately 5 minutes. The questions were assessed with a 6-item consisting of age, gender, experience of consuming cannabis-infused food and drink, frequency of consumption, reason to consume, and factors related to the consumption.

Part 2 Interview form; This form was used to interview the cannabis-infused food and drink establishments. This part was applied to explore the cannabis-infused food and drink establishments in the study area and interviewed with open-ended and closed-ended questions with 7-item including namely of café& restaurant, location, weekly sales, type of product, number of customers per day, a monthly income, and period of opening the store.

The measurement tools tested the validity by the peer form 3 expert in this field. The experts consider and inspect the questionnaire and give an IOC score for each question [28]. A cut-off score of 0.5 was used to determine the validity of the question. The IOC score in the tool was 0.91 and 0.92 in part 1 and part 2. The reliability was tested by trying out 30 cases of which it was not the participants. After finalizing the questionnaire, the coefficient for reliability (Cronbach's alpha) was more than 0.90.

2.5 Data Collection

2.5.1 Survey part

The researchers had an agreement with the university's administrators asking permission to collect data at the university in Pathum Thani province. The data were gathered from five universities. After that, the researchers were contracted with the gate personnel who were either classroom leaders or educational officers of each university. After the gate personnel were pleased to collect the data, they announced the data collection details to students in advance and made an appointment to collect the data. The researchers have explored the participants and selected them based on inclusion criteria. The data collection was conducted in a private room in the university to protect the rights of the sample according to ethical principles for human research and can keep the confidentiality of the participants in the research related to cannabis. After obtaining the consent of the participants, the researchers asked the participants about their willingness and collected the data using a questionnaire. They were assessed with a 6-item questionnaire and took 5 minutes to answer.

2.*5.2 Geographic Information Systems part*

The details of cannabis-infused food and drink establishments in Pathum Thani province, Thailand were collected from the researchers with interview forms and explored cannabis-infused food and drink in café& restaurants between April to May 2023. These specifics were imported into SPSS version 29.0 for analysis with ArcGIS version 10.5. The addresses provided in the researcher's data collection were used to generate the coordinates on Google Maps. Our first step was to combine several data sources, including interview data, information about cannabis-infused food and drink establishments, and Google Maps location information, into a single GIS database. Each data point was mapped to its actual position in Pathum Thani, Thailand, using geographic coordinates to ensure spatial accuracy. Spatial visualization: The researchers utilized thematic mapping to visualize the spatial distribution of cannabis-infused food and drink establishments across different districts of Pathum Thani. This section demonstrated spatial visualization utilizing the location map to indicate cannabis-infused food and drink enterprises and a bubble map to depict the distribution separated by location, weekly sales, number of customers, and monthly income. Additionally, this spatial analysis visualized the buffer map to provide a 10-kilometer radius centered on the five universities.

Importantly, the locations of the five universities were incorporated into the location map, bubble map, and buffer map, similar to the universities in the survey, including Thammasat University (TU), Pathum Thani University (PTU), Valaya Alongkorn Rajabhat University (VRU), Rajamangala University of Technology Thanyaburi (RMUTT), and Rangsit University (RSU). These five universities were selected through purposive sampling, focusing on a pilot study that found a high proportion of cannabis-infused food and drink consumption in the study area. These universities share similar characteristics, such as age structure, study environments, location in urban areas, and student lifestyle, all of which may influence the consumption of cannabis-infused food and drink. This process assesses the availability of cannabis-infused food and drinks for undergraduates around the five universities and residential areas.

2.6 Statistical Analysis

The data analysis was performed using SPSS 29.0 for Windows. The part described the characteristics of consumption of cannabis-infused food and drink among undergraduate students by descriptive statistics such as number, percentage, mean, standard division, and max-min. Additionally, a descriptive statistic was used to determine the data variables of cannabis-infused food and drink establishments divided by location, weekly sales, customers, and monthly income. Spatial distribution analysis was conducted using GIS tools with ArcGIS version 10.5. This part of the analysis visualized the location map, bubble map, and buffer map located cannabis-infused food and drink establishments in Pathum Thani province, Thailand.

3. Results

3.1 Result of the Survey

In this study, a total of 240 participants took part in measurements to survey the consumption of cannabis-infused food and drink. As indicated in Table 1, the findings revealed that the 240 individuals had an average age of 20.12 (SD.= 0.84) with 72.9% belonging to the 19-20 years age group. Additionally, 165 participants responded with a "Yes". Consequently, these 165 samples were included for questions 4 to 6, allowing them to continue answering the subsequent questions. Most participants reported consuming cannabis-infused food (68.7%) and consuming less than once a month (61.2%). The majority of consumers with the intention of consuming cannabis-infused food and drinks wanted to try them (47.9%), followed by those who had discovered them through social media and believed they would have no effects (32.7% and 31.5%, respectively). The results of the assessment of the top three factors influencing the consumption of cannabis-infused food and drink showed that the majority of participants responded to the factors of curiosity (55.8%), peer pressure from friends (46.1%), and accessibility (43.6%).

3.2 Result of Exploring Cannabis-Infused Food and Drink Establishments

Between April and May 2023, the results from exploring the distribution of establishments selling cannabis-infused food and drink in Pathum Thani province, using the interview form, indicated that 14 establishments were engaged in such sales in the study area. As shown in Table 2, which presents data on cannabis-infused food and drink establishments, it was found that the number of weekly sales ranged from 100 to 450 glasses, with a mean of 259.21 glasses (SD. = 95.60). The establishments rated the number of customers per day to range from 20 to 82 people, with a mean of 45.64 people (SD. = 17.56). Monthly income varied from 16,000 to 90,000 baht, with a mean of 43,271.43 baht (SD. = 19,638.52). The duration to open the store was rated from 4 to 25 months, with a mean of 12.71 months (SD. = 6.50).

Spatial distribution analysis was conducted using GIS to visualize the location map of cannabis-infused food and drink establishments. This analysis revealed the coordinated distribution of 14 cannabis-infused food and drink establishments in Pathum Thani Province (Figure 3), identified the locations of five universities (TU, PTU, VRU, RMUTT, and RSU), and visualized population density per square kilometer (ppl/sq.km) across seven levels, divided among the seven districts of Pathum Thani province. This data was divided into 11 establishments (78.6%) that offered drinks and 3 establishments (21.4%) that sold food and drinks.

Additionally, significant results were presented, demonstrating the need to elaborate on the relationship between the locations of the establishments and the population density in the study area. This analysis indicated how the distribution of cannabis-infused food and drink establishments correlates with the varying levels of population density in different regions. This analysis involves examining whether certain districts with higher population density tend to have a greater concentration of these establishments. Figure 3 shows that seven cannabis-infused food and drink establishments were located in the Klong Luang district (50.0%) with the second-highest population density of 567 ppl/sq.km.

Table 1: The descriptive of subjects by survey consumption of cannabis-infused food and drink (n= 240)

Variables	Number (%)
Age (Years); Mean± SD.= 20.12 ± 0.84, Range = 19-22	
19-20	175 (72.9%)
21-22	65 (27.1%)
Gender	
Female	173 (72.1%)
Male	67 (27.9%)
Experienced to consume cannabis in food and beverage	
Yes	165 (68.7%)
No	75 (31.3%)
Frequency of consumption (n=165)	
Less than 1 time per month	101 (61.2%)
More than 3 times per month	52 (31.5%)
1-2 times per week	8 (2.9%)
More than 3 times per month	4 (2.4%)
Every day	0 (0.0%)
Reasons to consume* (n=165)	
Wanted to try	79 (47.9%)
Seen on social media	54 (32.7%)
Thought that would be no effect	52 (31.5%)
Easy to buy and access, popular	44 (26.7%)
No offense and legal support	43 (26.0%)
Lack of cannabis knowledge	32 (19.4%)
Persuaded from friend	32 (19.4%)
Seen on TV advertising	19 (11.5%)
Persuaded by family members	2 (1.2%)
Factors related to cannabis consumption* (n=165)	
Curiosity	92 (55.8%)
Peer pressure from friends	76 (46.1%)
Easy to assess	72 (43.6%)
Environment conducive to consume	66 (40.0%)
Modernity, trend	55 (33.3%)
Laws of cannabis	45 (27.3%)
Access to advertisement of cannabis	45 (27.3%)
Lack of knowledge about cannabis	28 (17.0%)
Family support and influence	12 (7.3%)

** Several choices below can be selected.*

Table 2: The cannabis-infused food and drink establishments data by descriptive statistics (n= 14)

Variables	Mean	SD.	Range
Weekly sales **(**Glasses)	259.21	95.60	100-450
Number of customers per day (Person)	45.64	17.56	20-82
Monthly income (Baht)	43,271.43	19,638.52	16,000-90,000
Period of opening the store (Month)	12.71	6.50	4-25

Moreover, five establishments were located in Thanya Buri district (35.7%) and two in Muang district (14.3%) with the highest population n density recorded as 926 ppl/sq.km. In conclusion, establishments are strategically located in areas with higher population density, potentially due to increased consumer demand or other factors. By studying this relationship, one can gain insights into market dynamics and consumer behavior, as well as potential correlations between the prevalence of cannabis-infused food and drink establishments and the density of residents in the surrounding areas.

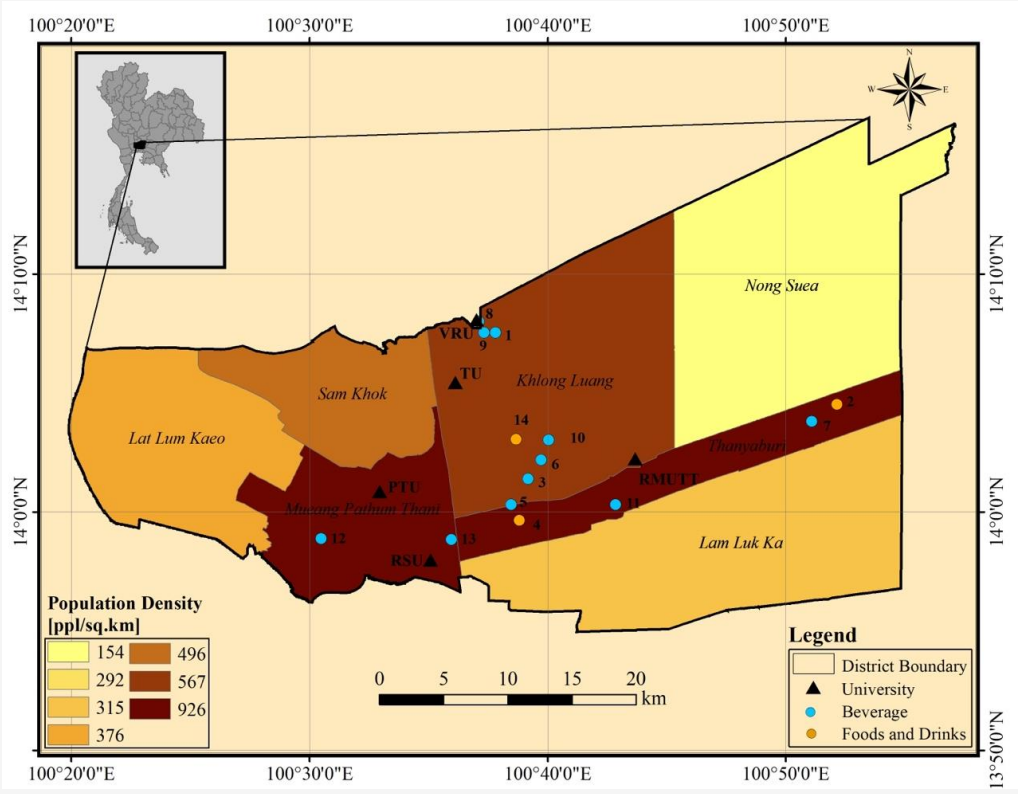

Figure 3: Locations of cannabis-infused food and drink establishments and population density

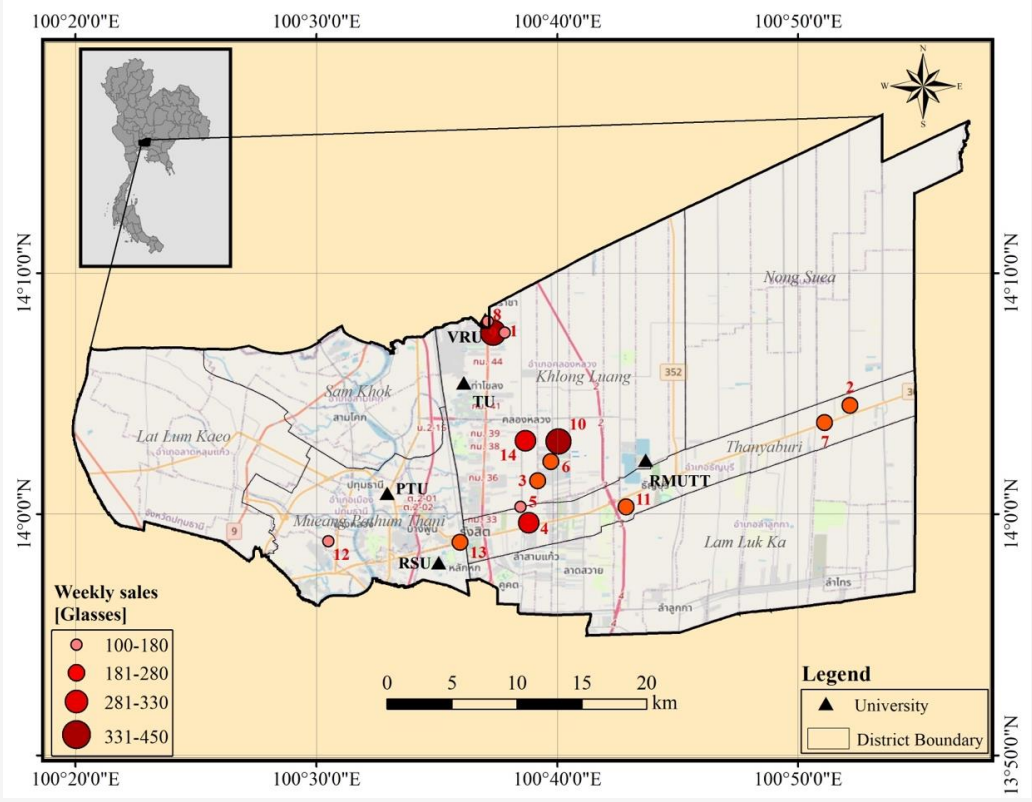

Figure 4: Cannabis-infused food and drink establishments' weekly sales

The geographic information systems demonstrated spatial visualization using a bubble map. Figure 4 illustrates the distribution of cannabis-infused food and drink establishments categorized by weekly sales into four levels. Additionally, the findings indicated that two establishments sell cannabis-infused food and drink, with weekly sales ranging from 331 to 450 glasses, located in Klong Luang district. Most of them are brought 181-280 glasses per week. We also investigated the distribution of cannabis-infused food and drink establishments concerning monthly income (Figure 5) and customers per day (Figure 6), demonstrating direct consistency with weekly sales. The majority of establishments reported a monthly income of 28,821 to 43,200 baht and attracted 36-35 customers per day. Establishments with higher weekly sales of cannabis-infused food and drink tended to have a larger number of customers per day and a higher monthly income. Furthermore, this study presented buffer maps illustrating a 10-kilometer radius around the five universities to demonstrate the accessibility of obtaining cannabis-infused food and drink in university and residential areas for undergraduate students (Figure 7).

4. Discussion

From survey method demonstrated that 68.7% of undergraduate students had experienced consuming cannabis-infused food and drink. Undergraduate students are curious and want to try new things; friends' influence affects daily life. They can easily assess the cannabis-infused food and drink in café shops or restaurants or online products and it affects their health condition from large and continuous amounts of consumption. The summary of the survey revealed they mostly consumed cannabis-infused food and drink with wanted to try them (47.9%), followed by those who had seen them on social media (32.7%), believed they would have no effects (31.5%) and factors related to their consumed were curiosity (55.8%), peer pressure from friends (46.1%) and accessibility (43.6%). These results were consistent with Meeprom, et al., [21] who studied cannabis-infused food among young adult consumers. It was found that young adults must have taste value, relative advantage, and interaction value to enjoy and feel good after consuming cannabis-infused food. Furthermore, some social and functional value dimensions provide sufficient conditions for perceived well-being, which in turn influences consumer choice behavior.

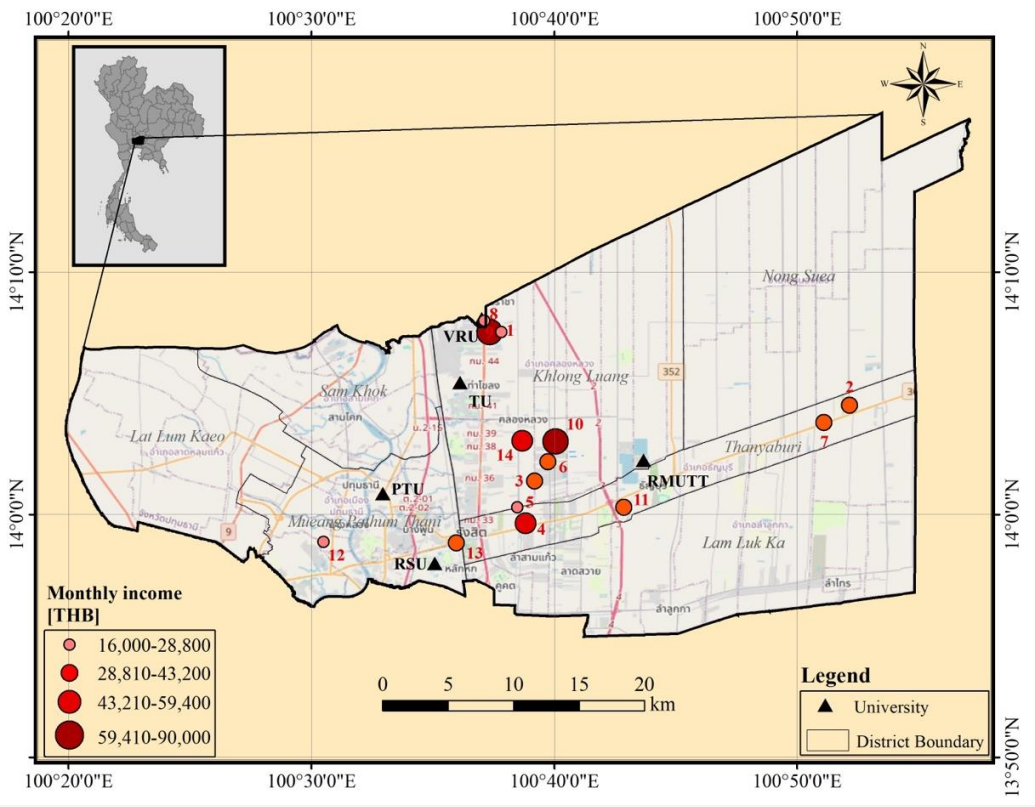

Figure 5: Cannabis-infused food and drink establishments' monthly income

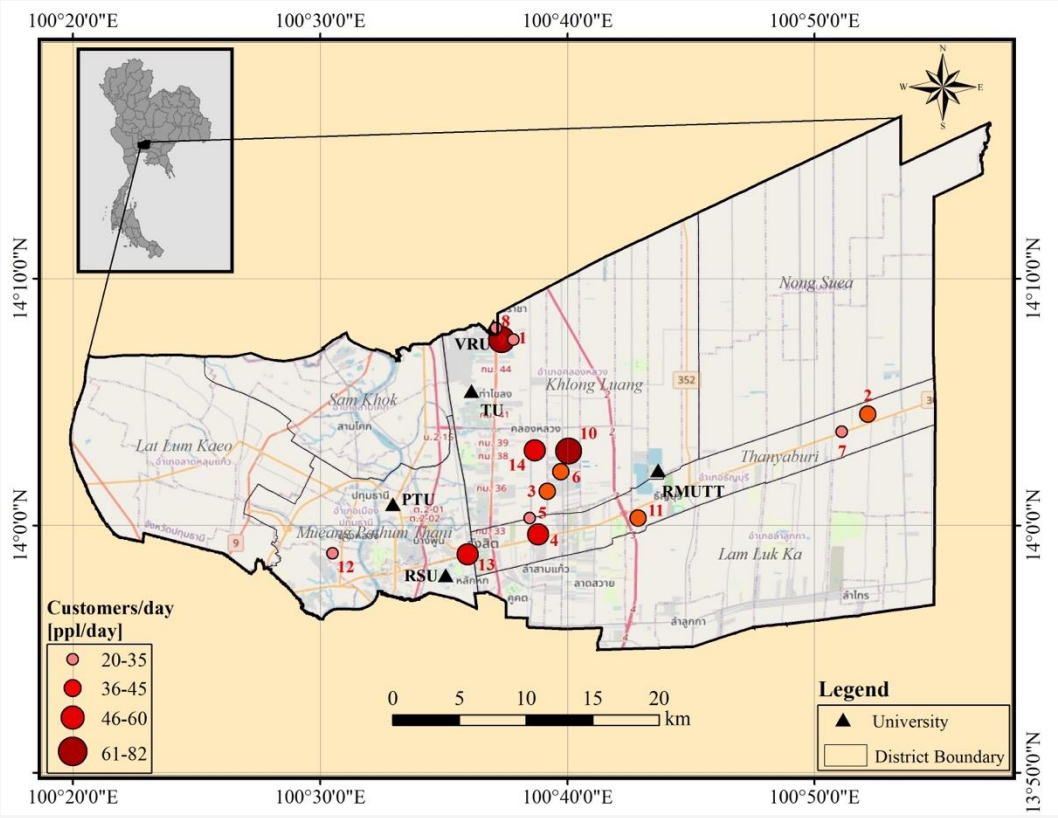

Figure 6: Cannabis-infused food and drink establishments' customers per day

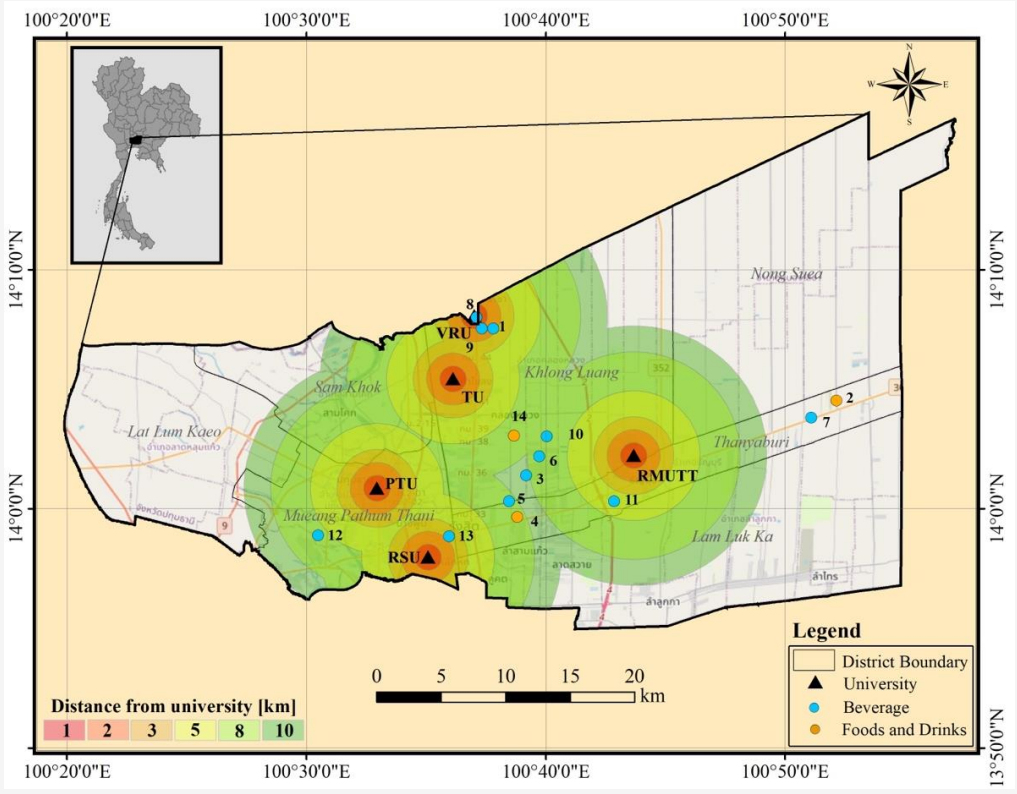

Figure 7: Distances radiating from universities

Δ9-THC, or delta-9-tetrahydrocannabinol, is a naturally occurring compound found in the cannabis plant. It is one of the many cannabinoids present in cannabis, and it is particularly notable for its psychoactive effects. Δ9-THC is the primary chemical responsible for the "High" or euphoric sensations associated with cannabis use. Additionally, Δ9-THC interacts with the endocannabinoid system in the human body, particularly with the CB1 receptors in the brain and central nervous system [8]. This interaction leads to various physiological and psychological effects, including altered perception, mood changes, and an increased sense of relaxation [9]. Royal College of Pediatricians of Thailand [12] recommends children under 20 years old should not access and consume cannabis because the brain is not fully developed. Cannabis contains Δ9-THC which has long-term effects on the brain of children. Therefore, children should not receive Δ9-THC unless there is a doctor's order.

The cannabis-infused food and drink establishments are located in the area of universities in Pathum Thani province which can lead to easy accessibility for undergraduate students. The GIS is a type of information technology that makes it possible to use geographic information systems effectively for work-related purposes. It can gather geographic data that can be examined and displayed [29]. To understand this issue, it is necessary to map out where cannabis-infused food and drink establishments are distributed. Determining the distribution of cannabis-infused food and drink establishments offers several specific advantages to assess the cannabis-infused food and drink, especially when operated within the context of GIS [30]. The location map of the spatial distribution analysis shows the distribution of cannabis-infused food and drink establishments in Pathum Thani province, Thailand, around five universities. The same five universities from the survey have been integrated into the GIS map. Our pilot study results revealed that these five universities had a high proportion of consumption of cannabis-infused food and drink in the study area. Interestingly, several food and drink establishments offer cannabis-infused products in the Klong Luang, Thanya Buri districts, and Muang districts. Seven of these establishments (50.0%) are located in Klong Luang, which is the location of TU and VRU, while the remaining five establishments are located in Thanya Buri (35.7%), which is near RMUTT, and two establishments are located in Muang districts (14.3%), which is the location of RSU and PTU. Consequently, the cannabis-infused food and drink establishment's locations make it easier for undergraduate students from five nearby universities and residents in the surrounding areas to access these establishments.

The bubble map, which means they show spatial patterns of a specific theme or variable. A bubble map is used as a bubble to indicate data values or categories related to specific geographic regions. Different parameters of the data, such as the magnitude of cannabis-infused food and drink at various establishments, may be encoded using the size and color of the bubbles [31]. This spatial distribution is appropriate for visual geospatial data. The bubble map can show the spatial distribution and variation of the data across a geographic area, such as a province, or a district/city of cannabis-infused food and drink establishments. The circumference of the circle depicts a geographic area's numerical value [32]. It is consistent with the study of Ivan Franch-Pardo, et al. [33] described that spatial distribution analysis by GIS can be used to determine the distribution of Covid-19. Similarly, Jia, et al. [34] showed that policymakers and stakeholders can better protect and promote these priceless cultural treasures while resolving regional imbalances by using spatial distribution to define the influencing variables of traditional villages. And, Solihah, et al. [35] have shown that spatial distribution mapping is essential for understanding the distribution of contaminants in a given area, particularly in urban settings. Using a spatial distribution map of PM2.5, the best course of action for reducing air pollution by PM2.5 concentrations can be identified. Moreover, according to Agyemang-Duah and Rosenberg [36], the spatial distribution can be used to characterize medical facilities and how they affect people's ability to receive primary healthcare. The hospital bubble analysis map makes it clear that 90% of the communities are not included in Ghana Health's and the WHO's database.

A buffer is a spatial analysis technique that involves creating a zone or area around a geographic feature. This zone is defined by a specified distance from the feature and is represented as a polygon [32]. Buffer maps can assess the spatial relationship between the university and cannabis-infused food and drink establishments, specifically those within the defined radius. The buffer maps identify and analyze the cannabis-infused food and drink establishments around five universities based on the distances from universities to establishments. It became evident that five universities are situated within an area with a diverse concentration of establishments within a 10-kilometer radius.

The buffer map revealed a varied distribution of cannabis-infused food and drink establishments, indicating that VRU, RMUTT, TU, PTU, and RSU are located within a region where these establishments are present, promoting ease of access for undergraduate students [37]. This spatial analysis provides valuable insights into the proximity of these establishments to the universities and serves as a foundation for further studies or public health initiatives.

Undergraduate students are curious and drawn to try the places after seeing social media advertisements for them, and the places' convenient location and reasonable prices make them accessible and affordable for them. Additionally, the menu's variety and interest can increase consumption. Because undergraduate students are required to live in a society of friends, the influence of a group of friends or influencers has an impact on access. This may make it difficult for them to decline, or they may decide to consume with influence from social media influencers [19]. Nowadays in Thailand, there has yet to be a recommended level of safe consumption for Δ9-THC per day in Thailand [11]. Even the establishments probably aren't yet aware of the maximum level of Δ9-THC per glass. Moreover, the Royal College of Pediatricians of Thailand [12] recommends preventing the effects of cannabis use on adolescents particularized that should measuring the place to control the production and sale of food and drinks containing cannabis and mark/warning messages to prevent the use in children and adolescents, stating "Children and youth under the age of 20 are not allowed to consume". In addition, the relevant departments should control product advertising such as cartoon images, or the use of words in the media to mislead children and adolescents into food and drink [38].

Currently, cannabis-infused food and drink are very popular. This is due to an increase in consumers choosing cannabis-infused food and drink from establishments. The leading supply chain point with the highest cannabis food and drink, according to the distribution channel, was the cannabis-infused food and drink [39]. This can be attributed to the growing popularity of cannabis products since the law was liberalized [40]. The study results enabled the researchers to propose two approaches to handling the consumption behavior of cannabis-infused food and drink, namely 1.) The university administrators could provide public relations about the dangers of cannabis-infused food and drink on brains to raise awareness of recreational access to cannabis-infused food and drink and 2.) Government agencies should speed up to provide knowledge to reduce social concerns about cannabis misuse especially to prevent vulnerable groups from accessing cannabis-confused food and drink after the liberalization of cannabis laws [41].

However, there is constant opportunity for improvement. The geographic information system (GIS) should be utilized for identifying appropriate locations for cannabis-infused food and beverage establishments. Relevant laws and regulations will be considered, along with the population density in each area of Pathum Thani province. Additionally, when releasing guidelines or laws in the future, future studies should analyze and identify appropriate positions and locations of establishments. Foreign laws of the U.S.A. and Netherlands prescribe that cannabis establishments should not be situated within 10 km of a university or school [42] [43] and [44]. Thailand does not currently have a law that addresses this issue. The Ministry of Higher Education, Research, and Innovation has the only rules, though, and they mandate that all universities keep a close eye on things and post a notice banning any cannabis-infused food and drinks. Apart from regulating the venue, it is imperative to verify the buyer's eligibility by presenting their ID card and stating that individuals who are not yet 20 years old should not be permitted to consume cannabis-infused food and drink. Next research might also include the spatial-temporal components or comparisons between locations to yield more detailed results. For the limitation, this study was focused on cannabis-infused food and drink, it cannot be generalized to be described in another purpose of cannabis use, and this study was placed on an adolescent group, so it cannot be demonstrated to other age groups. For the interview, It is a brief interview about the distribution of food and drinks infused with cannabis. To make the description of the distribution characteristics more complete, more questions should be asked about customer group characteristics, the best-selling cannabis menu, restricting the type of customer, components of cannabis used, amount of cannabis used per week, etc.

5. Conclusion

The consumption of cannabis-infused food and drink data and mapping can be beneficial for public health officers, lecturers, administration to visualize and understand the distribution and trends of cannabis-infused food and drink and to prepare for waning and awareness of the undergraduate students in the universities of Pathum Thani province by providing the appropriate knowledge and raise awareness to see the health effect from largely and continuously consumption.

The GIS indicates the distribution of cannabis-infused food and drink establishments in the mapping. These results can be potentially used to impose policies of the government and related institutes for prevention and control of the accessibility for consuming cannabis-infused food and drink of undergraduate students at the appropriate level by controlling the selling of establishments around the university. Additionally, the GIS can aid health planners and university administration in appropriately assessing and identifying spatial to better guide evidence-based health planning decisions for control of the consumption of cannabis-infused food and drink inner and near the university. The recommendation for future study, the findings of this study can be applied to develop an intervention program to change the consumption behavior of cannabis-infused food and drink among undergraduate students in Pathum Thani province. The intervention program should be focused on enhancing knowledge and awareness of cannabis to facilitate appropriate activities. The next research should select two out of the five universities based on their high proportion of consuming cannabis-infused food and drink, considering their potential to implement the intervention program and place them in both the intervention and control groups. The intervention and control groups must have similar characteristics, including age structure, size, study environments, student lifestyle, and culture, all of which may affect the consumption of cannabis-infused food and drink.

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