

Province -specific prevalence and factors associated with Canadian cannabis use before
and after Cannabis Act and 2 Amendment

by

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Abstract

Following the Cannabis Act in 2018, the Government of Canada amended the Cannabis Act (CA2) in October 2019 to encompass additional cannabis products such as edible cannabis, topical cannabis, and cannabis extracts. This study examined factors associated with an individual's consumption of cannabis in various forms across Canadian provinces over time. National Cannabis Survey (NCS) used for over the years 2018–2020. Chi-square, Multivariate and Multinomial logistic regression tests used to assess cannabis use across Canadian provinces and factors associated with that use. Cannabis use prevalence changed from 15.5% in 2018 (before CA2) to 20.3% in 2020 (after AC2, $p < 0.0001$). Nova Scotia had a higher rate of cannabis use, whereas Quebec and Saskatchewan had a lower rate of cannabis consumption. Overall, the analysis indicated substantial changes in cannabis use after cannabis legalization and AC2 which require consistent monitoring of cannabis use to inform public health practice and policy in Canada.

Dedication

To my mother for her ongoing support throughout my educational journey and my life. I appreciate everything you have given up for me, as well as the emotional support you have given me when I have needed it.

Dedicated to my father, who taught me how to be resilient and optimistic throughout life.

To my younger sister, who has always provided me with emotional support when I needed it.

Finally, in honor of my mother's aunt, who developed asthma as a result of being around secondhand smoke.

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Chapter 1: Introduction

Introduction

This chapter introduces the statement of the problem to be investigated. Thereafter, I will look more into the research objective and question, the significance of the study, and then the definition of key terms.

Statement of the problem

Cannabis is the most common illegal drug used worldwide (Breitbarth et al., 2018; Kesner & Lovinger, 2021; Peacock et al., 2018; Sanchez et al., 2020). An estimated 147 million people, 2.5% of the world population, consume cannabis annually; which means they use cannabis at least once in the past year (Keboa et al., 2020; Pizzol et al., 2019). The 2021 Government of Canada report shows that nearly 60% of Canadians reported ever using cannabis, with 25% using it in the past 12 months (Government of Canada, 2021). The same report revealed a broad spectrum of use across provinces/territories, varying from 17% in Quebec to 38% in the three Canadian Territories (Yukon, Northwest Territories, and Nunavut) (Government of Canada, 2021).

Cannabis use has been found to be more prevalent among young people, males, non-Hispanic Black Americans, people with lower education (less than high school), low annual income, those with mental health conditions, those with parental and/or peer cannabis use, cigarette smokers, other substance users (e.g., alcohol, cocaine, benzodiazepines), and those residing in an urban area (Ebrahimi Kalan et al., 2022; Hawke et al., 2020; Pham et al., 2022; Pickworth, n.d.; Roter mann, 2019, 2020; Sikorski et al.,

2021; Vacafior et al., 2020; Zapata Roblyer et al., 2015). People with the aforementioned socio-demographic characteristics are at greater risk of cannabis-induced dependency (defined to be the situation when a person cannot quit using cannabis despite the fact that it interferes with many elements of their life and is marked by an increasing tolerance, consuming more cannabis, and difficulties in limiting their usage) and sustained use of cannabis than their counterparts. (Coughlin et al., 2019; Ebrahimi Kalan et al., 2022; Hawke et al., 2020; National Academies of Sciences et al., 2017; Pham et al., 2022; Pickworth, n.d.; Rotermann, 2019, 2020; Schell et al., 2022; Smart & Pacula, 2019; Vacafior et al., 2020; Zapata Roblyer et al., 2015).

In October 2018, Canada passed Bill C-46 to legalize cannabis consumption for recreational purposes for adults, which followed the legalization of cannabis for medical use nearly two decades earlier (Rotermann, 2020). The Cannabis Act has three main objectives: to keep cannabis out of the hand of youth, to protect public health and safety, and to keep profits out of the hands of lawbreakers (Government of Canada, 2018b). In October 2019, the Government of Canada amended the cannabis act to encompass additional cannabis products such as Edible cannabis, topical cannabis and cannabis extracts. Accordingly, the Government passed rules to legalize the production and sale of edible cannabis, cannabis extract, and topical cannabis products (Government of Canada, 2018a). However, the Federal Government ceded to the provincial and territorial governments responsibilities for licensing, overseeing distribution and sale, and regulating where cannabis may be consumed (Government of Canada, 2019).

Research objective and questions

The heterogeneity across provinces (in provincial populations, in regulatory framework and in health systems) can lead to different outcomes for use. This may challenge preventive and regulatory measures, especially among vulnerable populations (e.g., people with mental health illnesses). Therefore, it is crucial to understand the province-specific prevalence of cannabis use before and after the Cannabis Act, 2 Amendments in order to inform clinicians and regulatory bodies about how consumption has been affected by various approaches to implementation of Cannabis legalization. In addition, monitoring the factors associated with cannabis use can provide crucial information to Health Policy makers and clinicians to respond more effectively to regulatory decisions. To meet these research activities, I propose the following aims:

Aim 1

To investigate prevalence of cannabis, use among Canadian before and after CA2

Activities to meet Aim 1

- a) Canadian cannabis prevalence data sets based on different provinces and territories will be extracted from National Cannabis Survey for the first three quarters of 2019 as a benchmark year before CA2, and 2020 as a benchmark year after CA2
- b) Provinces and territories' differences in cannabis use among Canadian before and after Cannabis Act, 2 Amendment will be compared. I will compare each province before and after the cannabis act and 2 amendments (within-province). In addition, I will compare provinces with each other in 3 steps: in 2019, in 2020, and between 2019 and 2020 (over time).

- c) After conducting activity b, I will compare our findings with existing literature on how the regulation and sale have varied - date available, private sector involved, and other dimensions.

Aim 2

Assess factors associated with cannabis use among Canadian before and after the Canadian Cannabis Act, 2 Amendment in Canadian provinces.

Activity to meet Aim 2

Measure the association between cannabis use prevalence among Canadians in different provinces with users' socio-economic characteristics, mental and general health status, mode of consumption (edible, smoked, or vaped), Cannabis products, Main reasons for cannabis use, and the source of obtaining cannabis before and after Cannabis Act, 2 Amendment.

Significance of the Study

The heterogeneity across provinces (in provincial populations, in regulatory framework and in health systems) can lead to different outcomes for use. This may challenge preventive and regulatory measures, especially among vulnerable populations (e.g., people with mental health illnesses). On the other hand, while various researchers assessed cannabis consumption patterns and epidemiology before and after the Canadian Cannabis Act, there are no studies assessing cannabis product consumption before and after the Cannabis Act 2 amendments by provinces (Cox, 2018; Government of Canada, 2018b;

Hawley et al., 2020; Pham et al., 2022; Rotermann, 2019, 2020; Zuckermann et al., 2021). Hence, it is crucial to monitor province-specific changes before and after regulatory actions such as Bill C-45.

Definition key terms

Cannabis: The word cannabis denotes all products derived from the plant cannabis sativa which is used for their psychoactive and therapeutic effects (National Center for Complementary and integrative Health(NIH), 2019; World Health Organization, 2022).

Cannabis products come in various forms, such as dried flowers and leaves; hash; Extracts such as shatter, Kief, oil, wax, etc.; and edibles (e.g., candies, butter, baked goods, chocolates, cookies, brownies, candies, and various types of beverages) (Gabrys, 2020)

Cannabis Extract: Cannabis extract is a concentrate made by using a solvent (Gabrys, 2020). Cannabis extract is a particular kind of cannabis concentrate containing a high quantity of THC and produced exclusively through the use of a solvent (Gabrys, 2020). These products vary based on its appearance consistency, taste and smell, and THC and CBD. More common cannabis extract products include Hash, Kief, Wax, Shatter, Rosin, Oil, Softgels and capsules, vape cartridges and disposable pens (Gabrys, 2020). Cannabis extract are generally smoked or vaporized (dabbing) alone or in conjunction with dried cannabis (Gabrys, 2020; Mullins, 2021). These products (cannabis extract) also be ingested, alone or in capsule shape, or used sublingually (Gabrys, 2020; Mullins, 2021). In Canada, cannabis extract for ingesting is limited to 10 mg of THC in each unit and 1000

mg of THC per package(Health Canada, 2020). Likewise, cannabis extract for inhaling is limited to 1000 mg of THC per package(Pusiak et al., 2021).

Edible Cannabis: Edible cannabis products are food or beverage products infused with cannabis extracts(Barrus et al., 2016; Gabrys, 2020). They come in many forms, such as baked goods, candies, gummies, chocolates, lozenges, and beverages(Barrus et al., 2016; Gabrys, 2020; Zipursky et al., 2020). Edible cannabis products vary based on their concentration of THC and other cannabinoids, especially in the legal and illegal sources(Gabrys, 2020). In Canada, edible cannabis is limited to 10 mg of THC per package(Barrus et al., 2016; Gabrys, 2020; Zipursky et al., 2020). On the other hand, in illegal market,one cannabis cookie contained 96 mg of THC(Mahamad et al., 2020).

Cannabis Topical: Cannabis topical are cannabis-infused oils, patches, creams, and lotions are applied to skin, hair, or nails and are exclusively used for external body surfaces(Gabrys, 2020; Health Canada, 2020). In Canada, cannabis topical are limited to 1000 mg of THC per package(Health Canada, 2020).

Dried Flower: Dry flower, known as dried raw cannabis, is cannabis flowers that have been cured and dried(Hutcheson, 2022). Dry flower is one of the least processed kinds of cannabis products in comparison with other forms such as tinctures or tablets. Dry flower also goes through processed further into other cannabis extracts, such as oils and tinctures. It encompasses various cannabinoids (like THC, CBD, and CBG) and terpenes (Aromatic hydrocarbon compounds are related to cannabis taste and aroma.) in varying amounts and different ratios determined by strain(Hutcheson, 2022). Since these types of cannabis require less processing their costs are lower than other products(Northern Green Canada, 2022).

Federal Cannabis Licensed Holder: Health Canada issues a federal license under cannabis regulations required to cultivate, process, and sell cannabis for medical or non-medical purposes(Health Canada, 2018). All federal license holders can administer related activities, including possession, transportation, storage, destruction, research and development, and sale of mass cannabis to other federal license holders and individuals authorized to acquire cannabis products for medical purposes (registered patients(Health Canada, 2018).

Marijuana: Marijuana refers to parts of products from the plant Cannabis Sativa which include a considerable amount of tetrahydrocannabinol(THC) (National Center for Complementary and integrative Health(NIH), 2019).

More than 100 chemical substances called cannabinoids are produced by the cannabis plant. Delta-9-tetrahydrocannabinol(THC) and Cannabidiol(CBD) are the best-known cannabinoids(Canadian Center on Substance Use and Addiction., 2021)

Tetrahydrocannabinol(THC): THC is the primary psychoactive component of cannabis responsible for the “high” individual experience and has remedial and detrimental effects(Canadian Center on Substance Use and Addiction., 2021).

Cannabidiol(CBD): Cannabidiol is another common cannabinoid with little or no psychoactive effect. It is mainly used for medical purposes such as pain relief, anxiety, and other chronic diseases(Canadian Center on Substance Use and Addiction., 2021).

Policy: Policy is a set of ideas, rules, regulations, procedures, actions, incentives, or voluntary practices of governments and other organizations used as a guideline for decision-making and achieving reasonable outcomes(CDC, 2015). In public health, the policy includes advancing and implementing public health laws, regulations, or voluntary

practices that influence health system development and individual behavior to improve overall health(CDC, 2015). Policy plays a vital role in public health functions and services. For instance, policy influences the retail availability of cannabis and thereby affects demand for both legal and illegal cannabis (Wadsworth et al., 2021).

Amendment: An amendment is a formal modification made through the parliamentary or constitutional procedure(Merriam-Webster, 2022). The word comes with the verb to amend, which means to alter for the better. Amendment can append, delete, or update parts of the laws or documents.

Prevalence: Prevalence is the proportion of the population with a specific disease, condition, or attribute at a specific point in time (point prevalence) or over a specified period (period prevalence) (CDC, 2021; Nation institute of mental health(NIH), 2022). While the incidence is concerned only with measuring new cases at a specific time, prevalence accounts for all cases, including new and preexisting ones in the population at a specific time(CDC, 2021; Nation institute of mental health(NIH), 2022).

Administrative modes of cannabis use: Cannabis can be used in various ways depending on cannabis products and consumers' consumption experience. Cannabis legalization has resulted in a proliferation of new cannabis products with different routes of administration such as pipes/vaporizers and edible(Streck et al., 2019; Young-Wolff et al., 2022). Given this, mode of cannabis use must be considered when forming and evaluating policies to legalize cannabis(Streck et al., 2019; Young-Wolff et al., 2022). The mode of cannabis consumption also affects the initiation, severity and duration of drug effects and detrimental health outcomes(Russell et al., 2018). The main routes of cannabis administration are as a following:

Inhalation: In cannabis inhalation, all active ingredients, such as THC absorbed into the bloodstream through the lungs. The time between inhalation and feeling its effect is very quick(Wadsworth et al., 2022). Smoking and vaping are two main ways of cannabis inhalation.

Smoking: Smoking-combusted cannabis products are the most predominant route of administration among consumers in North America(Russell et al., 2018; Wadsworth et al., 2022). In smoking cannabis, the user lights cannabis flowers and inhales the smoke. There are various ways, such as pipes, joints, blunts, and water pipes to smoke cannabis.

Pipes: Pipes are small and handy devices used to smoke cannabis. They are produced in many forms, such as glass, metal, wood, or other materials. Pipes come in a variety of sizes and shapes and are probably the easiest and the most popular way of cannabis consumption(Russell et al., 2018; Streck et al., 2019; Wadsworth et al., 2022). To use pipes, cannabis flowers have been added to the bowl-shaped area at one end, and light.

Vaping: Vaping is another inhalation method that is becoming ubiquitous with recent technological advances. In the vaping process, cannabis flowers or extracts have been heated within the device such that desirable cannabinoids and terpenes convert into vapor. Vaporizing occurs at a lower temperature than combustion; therefore, the user inhales more cannabinoids and harmful tar and carcinogens than smoking. Vaping is becoming popular among cannabis users because of the head-to-head competition in cannabis marketing, increasing cannabis accessibility owing to legalization, perception of vaping as the healthier method, and more discreet administration mode(Chadi et al., 2020;

Knapp et al., 2019). There are many different methods, including vaporizers, vape pens, and dabbing to vape cannabis.

Vaporizers: A vaporizer is a device that helps the user to inhale cannabis vapor via the mouthpiece. It can be used with both cannabis extracts and flowers. In vaporizers, cannabis products add to heating chambers at a set temperature. There is a variety of vaporizers, from tabletop versions to portable versions.

Edible (Oral): When cannabis-infused beverages, cakes, capsules, gummies, and baked goods are ingested they are absorbed via the digestive system. Oral ingestion of cannabis has slower and long-lasting effects than inhalation (Health, 2022; Poyatos et al., 2020). People who use edible cannabis feel its effects within thirty minutes to one hour or longer and peak effect after two or three hours of consumption. This peak effect persists for around six hours (Canadian Centre on Substance Use and Addiction, 2019).

Sublingual: Cannabis can also penetrate the bloodstream by putting it under the tongue and kept in the mouth. A large number of blood vessels existing within the mouth grant cannabinoids immediate access to the bloodstream. Dissolvable strips, sublingual sprays, or medicated lozenges or tinctures are some types of cannabis that can be consumed through sublingual.

Topical: Although topical is not precisely a route of administration of cannabis, it can be considered as a delivery method. A cannabis topical is a cream, lotion, oil, salve, gel, or transdermal patch applied straight to the skin. Topical can provide fast-acting, localized inflammation, stiffness, and pain relief. The cannabinoids enter the skin and

reduce pain and inflammation, which is helpful among elders suffering from localized pain such as arthritis without producing any psychoactive adverse effect.

Summary: Chapter 1 outlines the background of the problem, research objectives, significance of the study, and rationale for this study across Canadian provinces. Following that, key terms definitions have been described. While cannabis products, especially cannabis edibles, topical, and extract, are increasingly popular among the Canadian population, there is a dearth of study on the policy(the Canadian Cannabis Act 2 amendment) related to the legalization of these products. This research can have significant real-world consequences for healthcare professionals and policymakers. It can help them assess, improve, and put into action policies regarding cannabis use, especially in relation to the CA2 Amendment. Following the introduction, I will focus on a literature review of cannabis use and policy.

Chapter Two: Literature review

Introduction:

This chapter aims to review the literature in the field of the epidemiology of cannabis use, cannabis policy in Canada, and factors associated with cannabis use. I searched CINAHL, PubMed, Scopus, and Google Scholar for terms including cannabis, cannabis policy in Canada, new cannabis products, epidemiology of cannabis, and factors associated with cannabis use.

Epidemiology of cannabis use

Cannabis is the most commonly used drug worldwide (Lafaye et al. 2017; United Nations World Drug Report 2022; Vallée 2023; Wilson et al. 2019). According to United Nations estimates in 2020, more than 4 percent of the global population aged 15-64 had used cannabis in the previous year (209 million people)(United Nation World Drug Report, 2022). Over the past decade, cannabis use has increased by 23 percent(United Nation World Drug Report, 2022). Comparatively speaking, cannabis consumption is most prevalent in North America. (Ignaszewski, 2021; Lafaye et al., 2017, 2017; Lowry & Corsi, 2020; United Nations World Drug Report, 2022). A United Nations survey reports that 16.6% of people in North America have used cannabis in the last year.(United Nations World Drug Report, 2022). Cannabis consumption among US citizens aged 18 to 25 increased from 28.8% in 2002 to 35.4% in 2019. Similarly, cannabis consumption among

those aged 26 and older rose from 7% in 2002 to 15.2% in 2019., according to the National Survey on Drug Use and Health study.(Ignaszewski, 2021).

In Canada, cannabis is becoming a widespread substance (Sikorski et al., 2021; Rotermann, 2019; Blest-Hopley et al., 2018). A survey revealed that cannabis is one of the most prevalent addictive substances in Canada following alcohol and tobacco use ((Lopez-Quintero et al., 2011)Amlung & MacKillop, 2019). In 2017, the past-year cannabis use among Canadians over 40 was 5,9% and 9.0% among females and males, respectively (Keethakumar et al., 2021). In addition, more than 20% of adults reported using a vaporizer or e-cigarette as an administration mode for cannabis (Keethakumar et al. 2021). Similarly, although Cannabis use is widespread among Canadian younger adults, major substance use surveys have demonstrated that cannabis use has steadily increased among adults (Rotermann, 2019). According to country-specific surveys, the prevalence of cannabis consumption among adults is increasing in high-income nations such as Canada (Gravely et al. 2020).

Besides adults, cannabis consumption is also a public health issue among young people in Canada (CDC, 2022;Lin et al., 2021; Hawke & Henderson, 2021). In Canada, 23.2% of 16-to 24-year-olds have reported cannabis use in the past month (Coughlin et al., 2022). Other researchers reiterated these results. For example, while the percentage of 8-12th-grade students reporting daily cannabis use in the past month increased from 2.7% in 2007 to 4.1% in 2019, one 1 of the seven high school seniors in the US reported consuming cannabis daily at some point in their lifetime in 2019(Lin et al., 2021). While only 13% of Canadians aged 25 years or older consumed cannabis in the past year, this prevalence was

19% among 15-19 years old and 33% among 20-24-year-old (Doggett et al., 2022). The Canadian survey reported that adolescents aged 15 to 24 years had twice the rate of cannabis use during the past three months compared to adults aged 25 years and older (30% versus 16%) (Mader et al., 2022).

While some studies have revealed that cannabis use patterns vary by province, others have shown that Atlantic Canada has higher cannabis consumption rates than other provinces.(Reece & Hulse, 2019). For instance, although the estimate for the rest of Canada indicates that 27.3% of Nova Scotians reported smoking cannabis in the past three months, the percentages for residents of Quebec and Saskatchewan were lower (10.6% and 13.9%, respectively) (Government of Canada, 2021). A different survey found that the proportion of respondents reporting cannabis usage in the previous three months differed by province, from 13.8% in Quebec to 26% in Alberta. As well, the prevalence of edible usage ranged from 16% to 51% across provinces (Sikorski et al., 2021). In this regard, research revealed that prevalence of edible cannabis use among female increased from 28% in 2019 (Before CA2) to 42.5% in 2019. (After CA2).(Government of Canada, 2021)

Although cannabis use is widespread among Canadian adolescents and young adults, there is a paucity of research on the consumption of cannabis products, especially in the provinces. Therefore, it is crucial to understand the province-specific prevalence of cannabis use among Canadian adolescents and adults to inform clinicians and health policymakers.

Cannabis related policy in Canada

Although the use of cannabis for medical purposes has been legal since 2001 in Canada, recreational cannabis consumption was legalized in October 2018 under the

Cannabis Act, partly with the objective of protecting young Canadians' health through legalization and regulation.. Specifically, the cannabis act has three main objectives including to keep cannabis out of hand of youth, to protect public health and safety and to keep profits out of hands of lawbreakers. Based on this Act, the federal government passed Bill C-45 to set the minimum age for access to cannabis at 18 years. Accordingly, the majority of provinces set their minimum age at 18 or 19, except Quebec, where the age began at 18 and then increased to 21 in 2019(Haines-Saah & Fischer, 2021; Hawke & Henderson, 2021; Watson & Erickson, 2019; Zuckermann et al., 2021). According to the Cannabis Act, the government not only enables personal consumption and possession of cannabis, but also introduces a regulatory framework for manufacturing, distribution, sales, and marketing (Cox, 2018; Hawke & Henderson, 2021). Provinces and territories have regulatory frameworks for determining cannabis distribution, sale, restrictions on possession, cultivation, public health use, and minimum age(Haines-Saah & Fischer, 2021; Hawke & Henderson, 2021; Rotermann, 2019, 2020; Watson & Erickson, 2019; Zuckermann et al., 2021) see Tables 1 and 2 for more details).

Table 1. Cannabis Policies across Canadian Provinces from 2018-2020 (Consumer Regulations and Retail Structure)

Provinces	Cannabis Policy (Consumer Regulations and Retail structure)							
	Minimum Age	Cannabis Edible and extract restriction	Personal cultivation limit	Use in public	Possession limit	Sales' model	Oversight body	Licensed issued of storefronts
NB	19	No	4 plants	No (No or anywhere prohibited under smoke free place act)	No (Must be stored securely and inaccessible to minors)	Hybrid	Cannabis Management corporation	26 storefronts
AB	18	No	4 plants	Limited (Not in areas frequented by children or where smoking or vaping is prohibited)	No	Hybrid	Alberta Gaming and Liquor commission	763 retailers

BC	19	No	4 plants (Not visible from public space)	Limited (Not where smoking prohibited)	Yes(1000g/household)	Hybrid	Liquor and cannabis regulation branch	441 licenses issued
ON	19	No	4 plants	Limited (Not where smoking prohibited)	No	Hybrid	Alcohol and Gaming commission of Ontario	1616 license issued
MB	19	No	No (prohibited, subject to 2,542 fine)	No	No	Private	Liquor gaming and cannabis authority of Manitoba	165 storefronts
NL	19	Yes (Vaping cannot have non-cannabis flavors)	4plants per dwelling house	No (Not in public ,where smoking prohibited or in vehicle or boat, unless by regulation	No	Hybrid	Newfoundland and Labrador liquor corporation	39 storefronts
PE	19	No	4plants (Not accessible to minor, locked and	No (also not in private dwelling housing schools or	No (Must be store in secured space inaccessible to residents under 19)	Public	PEI cannabis management corporation	4store fronts

			not visible if outdoor	easy childhood centers)				
QC	21	Yes (the sales of edible cannabis products that appeal to children and all cannabis vaping products is prohibited)	No	No (use prohibited in outdoor and indoor public places)	Yes (150gr)	Public	Society Quebec the cannabis	90 storefronts
SK	19	No	4 plants	No	No	Private	Saskatchewan liquor and gaming authority	156 storefronts
NS	19	Yes (sale of vape products that use synthetic or artificial flavoring, sugar or sweetness)	4 plants /household	Limited (Not where smoking prohibited)	No	Public	Nova Scotia liquor corporation	43 storefronts

		is prohibited						
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Source: Canadian Center on Substance use and Addiction

Table 2 Cannabis Policies across Canadian Provinces from 2018 -2020(Fees, Revenues and Penalties)

Provinces	Cannabis Policy (Fees, revenues and penalties)				
	Directed Revenue	Pricing and Taxation	Youth Possession <5gr	Possession over 30gr	Consumption in public
NB	2% of gross sales to education and awareness	Jurisdiction pricing model (\$8 to \$16/gram)	Fine (\$70-\$250 for first offense, \$500 for subsequent)	N/A	Fine (\$70-\$500 for first offence, \$1000 for subsequent)
ON	None Announced	Jurisdiction pricing model (minimum price might be set by regulations, \$5 delivery fee for online sale)	Fine up to %200 or referral to approved education or prevention program	N/A	Up to \$1000 for first offense, \$5000 subsequent offenses)
BC	Revenue first applied to administration of cannabis distribution Act	No set price	Fine up to \$2000	N/A	Fine up to \$2000

AB	None Announced	Jurisdiction pricing model (6% of wholesale and valorum markup add in March 2022)	Fine	N/A	Can be set by municipality (e.g.\$100 in Calgary)
NS	None Announced	No set prices	Fine up to \$150, parental notification and restorative justice option)	N/A	Up to \$2000
MB	Licensed retailer require to pay 6% of sales revenue to social responsibility fund that will fund social costs of public education, safety, health and addictions).	Jurisdiction pricing model(\$0.75/gram markup and distribution , plus 9% no PST)	TBD	N/A	Fine (672)
NL	None Announced	Jurisdiction pricing model (common pricing set by cannabis NL)	Fine (\$100 fine, seizure by police)	Fine of \$200 for more than 30 gram but less than 50 gr	Fine of \$50-\$500
QC	Via cannabis prevention and	No set price	Fine (\$100 fine)	Fine (\$250-\$750, doubled for	Escalating fine (fine starting at \$500)

	research fund, minimum of \$25 M/year for 2018-2019 to 2022-2023.			subsequent offence)	
PE	None announced	Jurisdiction pricing model (uniform price set by the corporation)	Diversion (police coNliscation, warning, or diversion with graduate penalties)	N/A	Escalating fines, \$200-\$400 for first offence, \$400-\$700 for subsequent offences).
SA	None Announced	No set price	Fine (\$300 ticket)	Fine (\$200 ticket)	Fixed fine (\$200 ticket).

Source: Canadian Center on Substance use and Addiction

Canadian research showed that among youth who had consumed cannabis in the last year, 23% self-reported using cannabis via vaping devices and 36% stated having eaten or drank cannabis as another mode of consumption (Doggett et al., 2022). Similarly, based on the 2019 Canadian Cannabis Survey results, among people who had consumed cannabis in the past year, 44% reported that they had consumed cannabis in food, which was higher than that reported in 2018 (41%) or 2017 (34%) (Gabrys, 2022). New products such as edible cannabis, extract, and topical cannabis can negatively impact youth health, including, but not limited to, intoxication and psychiatric effects such as confusion, anxiety, psychosis and so on (Allen et al., 2017; Gabrys, 2022; Hudak et al., 2015).

Research has found that cannabis use has changed since the drug's policy and regulations became legal. For instance, Rotermann found that, in 2019 (after legalisation), 16.8% of Canadian Residents aged 15 or older reported having used cannabis in the previous three months, up from 14.9% in 2018 (prior to legalisation) (Rotermann, 2020). Similar to alcohol, cannabis consumption grew between 2018 and 2019, especially among males (17.5% to 20.3%) and those over 25 (13.1% to 15.5%) (Rotermann, 2020b). Nova Scotians and Quebecers, whose respective rates of cannabis usage in the preceding three months were 25.7% and 11.8%, respectively, were higher and lower than the national average in 2019. (Rotermann, 2020). Compared to 10.7% in 2018, 29.4% of cannabis users in 2019 obtained their cannabis from legal sources. (Rotermann, 2020). Similarly, according to another estimate, as of 2020 20% of Canadians aged 15 years and older have used cannabis in the past three months, up from fourteen percent in the first quarter of 2018 and seventeen percent in the first quarter of 2019 (Government of Canada, 2021). According to a different survey, the largest increases in cannabis usage reports in 2018 and

2019 were seen among males, people aged 45-64, and residents of Ontario (Rotermann, 2019). Males aged 18 to 24 (28.8% to 46.4%) and 25 to 44 (23.6% to 30.5%) experienced statistically significant increases in use between 2018 and 2019 (Rotermann, 2019).

Following the adjustment to the cannabis policy, there have been changes to the consumption of new cannabis products as well as to cannabis mode of usage. For instance, the use of edible cannabis has increased among men, going from 29.2% among cannabis users in 2018 to 39.1% in 2020, and among those between the ages of 25 and 44, going from 28.1% in 2018 to 46.1% in 2020.(Government of Canada, 2021). The use of cannabis extracts like hashish or kief, oil and vapour cartridges, and liquids changed both before and after amendments. Accordingly, usage of hashish, cannabis oil, and vaporizers surged in 2020 following the introduction of CA2 year in 2019.(Government of Canada, 2021). For instance, the consumption of hashish or kief decreased from 17.9% in 2019 to 15.9% in 2020. In contrast, consumption of cannabis liquid concentrates climbed from 10.5% in 2019 to 13.6% in 2020. Similarly, the use of cannabis oil cartridges and vapor pens has increased from 18.4% in 2019 to 23.2% in 2020(Government of Canada, 2021). Doggett found that before cannabis became legal in Canada, alternative cannabis usage among young people was popular, including vaping (Doggett et al., 2021). Also, female Canadian youth are more likely than male youth to consume cannabis through eating and drinking (Doggett et al., 2021).

Given the growing interest in new cannabis products among Canadian youth, a better understanding of youth consumption changes before and after the Cannabis Act 2 Amendment especially provincially, is pivotal for public health experts and policymakers to curb cannabis use among youth and protect them from potential harm.

Factors associated with cannabis consumption.

The pattern of cannabis consumption varies according to the individual and social risk factors. For example, recent research has revealed that sociodemographic factors are essential aspects that determine heterogeneity in cannabis use; therefore, monitoring these factors can help develop and implement cannabis-associated preventive strategies, mainly among youth. The study showed that individual and socioeconomic factors, such as sex, living area, annual income, age, education, and employment status, were correlated with cannabis consumption in the past 30 days among young Canadians (Sikorski et al., 2021). Cannabis users are more likely young men with university degrees and low annual incomes living in Ontario, Quebec, or Atlantic Canada (Sikorski et al., 2021). Ratermann investigated the prevalence of cannabis use before and after the Cannabis Act using a national cannabis survey, demonstrated that most cannabis users were between 18-24 years old, male, and living in Nova Scotia (Rotermann, 2020). According to another study (Hammond et al., 2020), cannabis usage is linked to polysubstance use, cigarette smoking, e-cigarette use, and frequent drinking. Cannabis users in Canada are most likely to be males with some college education and associate degrees. (Doggett et al., 2022). In a different survey, 25.9% of men and 23.9% of women said they had used marijuana in the previous year.(Doggett et al., 2021). In comparison to other age groups, cannabis use was more prevalent among those aged 18 to 24 in 2019.(Rotermann, 2019). Additionally, males were more likely than females to consume cannabis throughout most age categories. (Rotermann, 2019). Alberta and Ontario reported higher rates of cannabis usage in the prior three months in the current research (21.5% and 20%, respectively).(Rotermann, 2019). On the other hand, Quebec and Manitobans used cannabis at lower rates than citizens of

other provinces (11% and 13%, respectively).(Rotermann, 2019).Regarding the role of the social determinants of health and polysubstance use in cannabis consumption, it is essential to understand these factors based on regional differences before and after the Cannabis Act.2 amendments. The findings of this investigation will inform health policymakers to design and implement regulatory frameworks for cannabis consumption effectively, considering the potential differences between Canadian provinces.

In summary, in this chapter I focused on research on the epidemiology of cannabis use in Canada, discussed how new cannabis products were becoming more and more popular, especially among young people, and reviewed some literature about cannabis policy across Canadian provinces and the factors associated with cannabis usage. These insights will aid in a more accurate assessment of the Cannabis Act and the Second Amendment that will be presented in the next sections.

Chapter Three: Methodology

Research Design:

This study made use of the cross-sectional, voluntary National Cannabis Survey, whose questions were developed in collaboration with several federal agencies, including Statistics Canada, the survey's sponsor, Health Canada, the Public Health Agency of Canada, Public Safety Canada, and the Department of Justice of Canada.

Research Sample inclusion and exclusion criteria:

Non-institutionalized individuals aged 15 or older who reside in Canada's 10 provinces make up the survey's target group. This sample survey has a cross-sectional design. The Dwelling Universe File makes up the frame. Institutions, group housing, abandoned or inactive homes, homes on Indigenous reserves, and homes situated within the territories were excluded. The NCS sample is composed of two stages: the first stage's sampling unit is the habitation, and the second stage's sampling unit is the individual. The NCS frame was stratified by province, and a simple random sample of homes was chosen independently within each province. Each province received a large enough sample so that the survey could generate estimates at the provincial level. A preliminary sample of 12,000 homes (chosen for collecting every three months) was sent.

For the proposed aims, data will be drawn from 2018 to 2020 National Cannabis Survey (NCS). Ie limit my analysis sample to the whole 2018 and 2019 as the years before modification and Fourth quarter of 2020 as the post-amendment period. NCS collects cannabis data quarterly on a cross-sectional basis from a valid and reliable internet-based electronic questionnaire. (Rotermann, 2020).The NCS has collected self-reported data on Canadian cannabis use every three months since 2018. Cannabis Act, 2 amendments were

legalized on October 2019; Holders of a processing licence must send a written notice to Health Canada at least 60 days before releasing a new cannabis product for sale (Government of Canada, 2019). This notice must include the product's brand name, the class of cannabis to which it belongs (according to Schedule 4 of the Act), and the anticipated release date. As a result, the earliest date that notified products in the new classes could be made accessible for purchase by provincially or territorially approved distributors and retailers is December 16, 2019 (Government of Canada, 2019). That is also the earliest time a licensed provider of cannabis for medical reasons could start providing notified products in the new classifications to customers who have registered with them (Government of Canada, 2019). Therefore, decisions made by the industry and by the provinces and territories will determine the availability of various products within the new classes of cannabis. The access rules and timing for retail sales vary accordingly for each Province. For instance, new products might be on shop shelves in Alberta by the end of December 2019, in Quebec in January 2020, in Nova Scotia by the end of December 2019, and in Saskatchewan in October 2020. Tables 1 and 2 contain more information about the various retail sales regulations in each Canadian province (Government Alberta, 2023; Government of Saskatchewan, 2022; Nova Scotia, Be in the Know, 2023, 2023; SQDC, 2023). As additional analyses I examined the effect of cannabis act; to do this I limit analyses sample to the whole 2018 as pre-legalization of cannabis act and 2019 as post-legalization years

Measures; Predictors and Outcomes including variables tables:

Outcome Variables

Primary outcome or outcome applying to the whole population:

Cannabis use: Canadians who reported using cannabis products in the past three months are categorized as the current user; coded as 1 (Yes) vs 2 (all others non missing responses).

Second outcomes or outcome applying to users only: in order to understand the nature of any changing in cannabis consumption occurred, cannabis use characteristics indicators have been used as follows:

Modes of cannabis use: Canadians who reported using cannabis products based on the mode of consumption in the past three months were categorized as follows: 1 (smoke), 2(vaporize), 3(others) and 4 (Edible). Not stated have been treated as missing outcomes. I assigned “other” as reference group for modes of cannabis use and compared other methods with this group by using multinomial logistic regression.

Cannabis products: Canadians who reported using cannabis based on different cannabis products in the past three months were categorized as follows: I coded 1 for yes responses (used) and 2 for not used. Cannabis dried flowers, Cannabis edible, cannabis liquid non-concentrated, cannabis liquid concentrated, Cannabis Hashish or Kief, cannabis oil cartridge or vape, solid concentrate, others

Sources of Cannabis: Canadians who reported using cannabis products based on source of the cannabis in the past three months were categorized as follows: I coded 1 as yes and 2 as all others none missing responses for the following outcomes: Legal sources, illegal sources, family and friends, Grown by themselves ., and others.

Reasons for Cannabis Use: Canadians who reported using cannabis products based on Reasons using cannabis in the past three months were categorized as follows: I coded 1 as yes (used) and 2(not used) as all others none missing responses for the following outcomes: Because reported reasons for cannabis use were not mutually exclusive I treated this outcomes as binary variable for the following categories: 1. Medical use with document, 2.Medical use without document, 3.Nonmedical use and 4. Both medical and nonmedical use.

Covariates.

I assessed several covariates, including sex, age, education level, living area, marital status, physical and mental health status, and total household income. Definitions of the variables are presented in Tables 3. I treat years based on Policy legislation and amendment periods and this leads to natural adoptions as comparative time periods. So, it allows us to use the years to examine differences pre and post amendments periods. National Cannabis Survey produced quarterly based data, but it has some gaps such as for first three quarters of 2018 (for modes of and reasons for cannabis use) and first three quarters of 2020. So, I are mapping quarters to yearly periods so that to have an each of the quarter with equal weight within years to each the correspond and therefore by this way each of the quarters essentially equally representative of that time periods.

I expected they would be different effect by provinces in terms on cannabis consumption. Since policy and amendment vary provincially, I consider year*province interaction to capture these variations.

Also, since cannabis policy and amendment legislations' periods and Provincial policy towards that have a different effect on consumption of cannabis and nature of any changing in cannabis consumption occurred, I use Year*Provinces interaction terms in our survey to assess any changes of cannabis use and characteristics related to the use within and between years and provinces.

Similarly, I suspect as cannabis use and its characteristics varied by age and years of policy and amendment legislation (for example older peoples willing to use smoking as main modes of cannabis as compared to younger or aged ones might consume cannabis mainly for medical purposes vs nonmedical ones) I applied Year*Age interaction terms in our research.

Table 3. Cannabis users’ Demographic and other Variables That Will Be Used in The Analysis

Variable	Definition	Coded categories for analysis
Age	Age will be assessed by calendar years	0=15-24, 1=25-44, 2= 45-54, 3= 55-64, 4= 65 and over.
Sex	Personal and social identity as a man, woman or Diverse person	0=Male, 1=Female, 3=Diverse
Province/territory	Living area will be assessed by first character of postal code	0=Newfoundland and Labrador, 1=Prince Edward Island, 2=Nova Scotia, 3=New Brunswick, 4=Quebec 5=Ontario, 6=Manitoba, 7=Saskatchewan, 8=Alberta 9=British Columbia

Marital status	All persons aged less than 15 are considered as never married and not living common law	0='Widowed, Separated, Divorced or Single, Never Married', 1='Married or living common-law'
Education Level	Educational attainment refers to the highest level of education that a person has successfully completed.	<p>1= Less than high school degree</p> <p>2= High school degree</p> <p>3= Technical/trade school or community college</p> <p>4= Some university, no degree</p> <p>5= University degree or post-graduate degree</p>

Total household income	Annual income of household before tax	<p>1: Less than \$20,000</p> <p>2: \$20,000 to less than \$40,000</p> <p>3: \$40,000 to less than \$60,000</p> <p>4: \$60,000 to less than \$80,000</p> <p>5: \$80,000 to less than \$100,000</p> <p>6: \$100,000 and over</p>
Physical health status	State of physical health	1=Excellent or Very good, 2= Good or fair , 3: Poor
Mental health status	State of mental well-being	<p>1= Excellent or Very good</p> <p>2= Good or Fair</p> <p>3= Poor</p>

Data Analyses

I reported the weighted frequency and percentage as a proportion for categorical variables. A Chi-square test and Rao-Scott Chi-Square Statistics have been used to explore the provincial differences in Cannabis use before and after the amendment. To examine factors associated with the current consumption of cannabis products, I perform a multivariate logistic regression model adjusting for all demographic and health-related factors. I used weighted logistic regression for binary outcomes and generalized logit model for nominal outcomes (G-Logit). The Generalized logistic (G-Logit) and cumulative logistic (C-Logit) regression models are link functions that express the relationship between the multinomial outcome variable and the predictors that are included in the model. The predictors may include multiple variables, in which case I refer to the model as a multivariate regression model. In this regard, Model was structured using linear terms for each of covariates or predictors and two ways interaction between year and provinces. Further models were considered for higher order terms between province year and age. All data analyzed in SAS v9.4, and statistical significance considered as $p < 0.05$.

Method to Combine Data for Three Year and Quarters in SAS:

Calendar years are used as the comparative time periods for this analysis. Since the NCS is administered quarterly and also has some gaps where the survey was not administered in particular quarters, it is necessary to consistently map quarterly data to yearly periods. I combined the quarterly surveys and adjusted survey weight accordingly

Reasons to use Weighted Data Instead of Unweighted Ones:

Unweighted version corresponds to sampling not so correspond to cannabis user in the Canada just to the respondent in the survey. In order to be able to generalize the result of the analyses to cannabis users in Canada the weight needs to be applied to count for the complex sampling scheme to be representative of the national population that why I applied the weight.

Rescale the Weight Variables to the Yearly Average Population:

The sample weights have been rescaled so that the total weights is equal to the average population over all of the years. The weights from each quarter have been scaled by the number of quarters with available data in each year. I used two separate approaches to re-scale the weight of the survey for the variables. First, the sample weights were rescaled so that total weight to be equal to the average population (see appendeix for formula YR weights). Second, since two variables (IE., Mode of cannabis and reasons for cannabis use) had lack of data or for first three quarters of 2018, therefore, I used different formula (see appendix YRPT WEIGHTS) to account for survey weights.

Ethical Consideration

Researchers accessing confidential data via the Statistics Canada research data center program are not required to obtain Research Ethics Board approval. Instead access is provided via a designated as a deemed employee of statistics Canada for the purposes of data access.

Chapter Four: Results

Table 4 summarizes the primary characteristics of the survey sample for the three years (2018–2020). A majority or plurality of respondents were under 44 years old (48.16%), had high household incomes (28.8%), were married (62.25%), had university or post-graduate degrees (33.55%), and had great mental and general health (68.99% and 61.75%, respectively). While Ontario had the highest percentage of participation, Prince Edward Island had the lowest percentage of Canadians (39.53% and 0.42%, respectively).

Table 4. Characteristics of study Population (n=46150)

Characteristics	Frequency(unweighted)	Percent(unweighted)
Gender		
Male	21270	46.09%
Female	24776	53.69%
Diverse	104	0.23%
Age Group		
Age 15 to 24	2508	5.43%
25 to 44 Year	13435	29.11%
45 to 54 Year	7263	15.74%
55 to 64 Years	9769	21.17%
65 Year and over	13175	28.55%

Total House Income		
Less than 20,000 dollars	5787	12.54%
20,000 to less than 40,000 dollars	10087	21.86%
40,000 to less than 60,000 dollars	8681	18.81%
60,000 to less than 80,000 dollars	6588	14.28%
80,000 to less than 100,000 dollars	5072	10.99%
100,000 and over	9935	21.53%
General Health Rating		
Excellent or very good	27193	58.92% %
Good or fair	17700	38.35%
Poor	1257	2.72%
Mental Health Rating		
Excellent or very good	31740	68.78%

Good or fair	13798	29.9%
Poor	612	1.33%
Marital Status		
Widowed, Separated, Divorced or Single, Never Married	19150	41.5%
Married or living common-law	27000	58.5%
EDUCATION_LEVEL		
Less Than high school degree	3551	9.86%
High school degree	10684	23.15%
Technical/trade school or community college	14156	30.67%
Some university, No degree	2552	5.53%
University Degree or Post- graduate degree	14207	30.78%

PROVINCE		
Newfoundland and Labrador	3323	7.2%
Prince Edward Island	3345	7.25%
Nova Scotia	3757	8.14%
New Brunswick	3585	7.77%
Quebec	6855	14.85%
Ontario	8213	17.8%
Manitoba	4004	8.68%
Saskatchewan	3933	8.52%
Alberta	4384	9.5%
British Columbia	4751	10.29%

Primary outcome or outcome applying to the whole population.

Cannabis Use:

Cannabis use Before and after Cannabis Act, 2 Amendment, Yearly comparison:

Cannabis consumption has increased after the passage of the Cannabis Act and the 2nd Amendment. While 15.45% of Canadians consumed cannabis in the past three months in 2018, 17.43% did so after the legalization of cannabis for recreational use, and 20.31% did so after the Cannabis Act, 2 Amendment (Figure 1). Similarly, Cannabis use in 2018 vs 2019 and 2020 were lower means that the use of cannabis in 2020 and 2019 were significantly higher than in 2018($p<0.05$). See Table 5 for more details

Factors Associated with Cannabis use:

Our results showed that men were more likely than women to use cannabis (12.47% versus 18.46% and 13.89% versus 20.98% in 2018 and 2019 respectively, $p<0.001$). Cannabis consumption among women increased over time from 12.47% in 2018 to 19.35% in 2020. Likewise, use of cannabis among men raised from 18.46% to 21.25% in 2020. Use of cannabis among men remained higher than women after cannabis legalization, but after CA2 that difference was not significant (19.35% vs 21.25% in 2020) (Figure 2). Moreover, use of cannabis among young adults (15-24) increased over time (from 27.85% in 2018 to 31.54% in 2020) and similarly among 25-44 years old use of cannabis raised from 21.29% in 2018 to 30.36% in 2020. $p<0.001$) (Figure3). In addition, adjusted odds of cannabis use were higher in men vs women, divorced or singles vs married, High School Vs University, Poor vs excellent mental and general health rating (Table 6).

**Cannabis use differences within and between provinces before and After
Cannabis Act, 2 Amendment:**

Descriptive Results:

The use of cannabis varied by province in Canada. Over three years, while use of cannabis among Nova Scotians was highest than other provinces, that was lowest among Quebeckers. The percentage rise in cannabis use was greatest among New Brunswickers after the Cannabis Act (from 16.43% in 2018 to 21.00% in 2019) . Contrarily, cannabis consumption in Manitoba remained stable between before and after the passing of the Cannabis Act (16.93% in 2018 and 16.28% in 2019). While in Manitoba use of cannabis dramatically increased after Cannabis Act, 2Amendment (from 16.28% in 2019 to 23.27% in 2020), it was decreased in New Brunswick, Saskatchewan, Quebec, and Newfoundland. See figures 4-10 for more details.

Analytical Results:

In terms of cannabis use change within provinces over time, Cannabis consumption increased significantly in ON in 2020 compared to 2018 and 2019 (OR 2018 vs 2020=0.582 CI=0.44-0.75 and OR 2019 VS 2020 0.682 CI=0.53-0.87, respectively). The consumption of cannabis was also significantly higher in BC in 2020 than it was in 2018 and 2019 (OR 2018 VS 2020=0.689, CI=0.51-0.92 and OR 2019 VS 2020 =0.727, CI=0.54-0.97, respectively). (Figure 11). On the other hand, regarding cannabis change between provinces, the β difference between NS and Canada (other provinces) increased over time. For instance, while β difference of NS vs Other provinces was 0.38 in 2018, it

increased to 0.55 in 2020 respectively (p value <0.0001), indicating that, when other factors were taken into account, cannabis consumption in NS was significantly higher than in other provinces and this gap increased over time .On the other hand, while the β difference of cannabis use between Quebec vs Canada in 2018 was -0.800, it reduced to -0.66 in 2019 and -0.62 in 2020 respectively(P<0.001), indicating that this gap between Quebec's cannabis consumption and other provinces still remained although it reduced over time over time .

According to year*province interaction, there are provincial differences in the impact of the year on cannabis use. Cannabis consumption has increased significantly over the years in some provinces, but not statistically significantly in others. For instance, cannabis use in QC VS NLNL was higher in 2018 than it was in 2020 (β difference = 0.1533 and P = 0.0341). It could imply that as the years went on, cannabis consumption in QC vs NL increased as well. On the other hand, cannabis consumption was significantly lower in Manitoba vs NLNL in 2019 than it was in 2020 (β Difference=-0.1675 and P=0.0303). (Figure 9).

Figure 1 Cannabis use percentage in the past three month For Three Years (2018-2020).

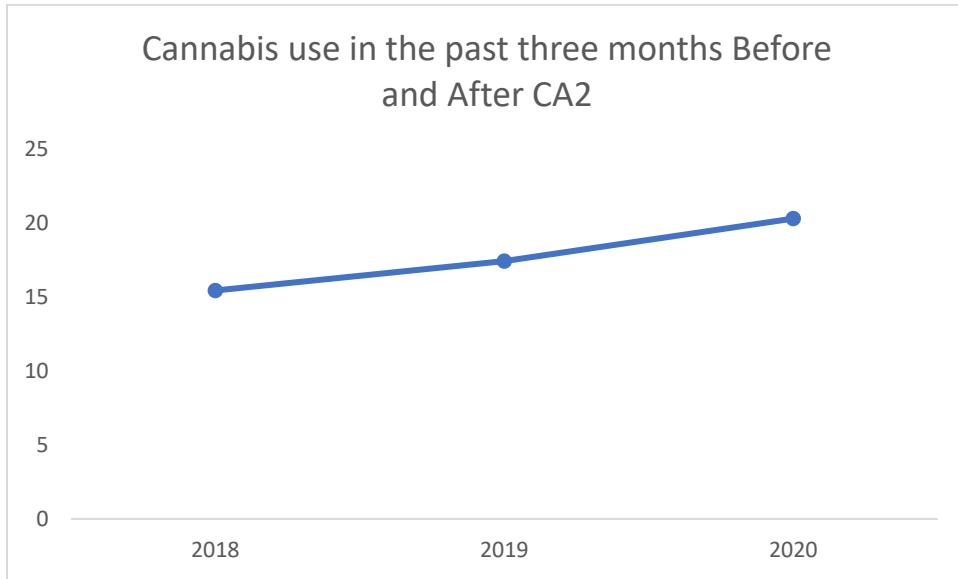


Table 5 β difference of Cannabis use over Three Years (before and after cannabis act and amendment)

<i>B</i>			
Label	β	Standard Error	P value
2018 vs 2019	-0.1487	0.04557	0.0011
2018 vs 2020	-0.1082	0.03191	0.0007
2019 vs 2020	0.04051	0.02964	0.1718

Figure 2. Cannabis use in the past three month based on Gender.

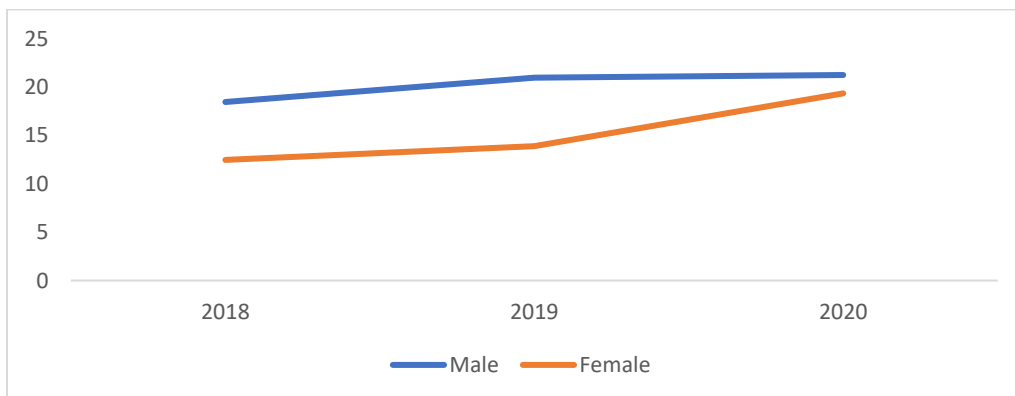


Figure 3 .Cannabis use percentage in the past three month based on different age groups before and After CA2.

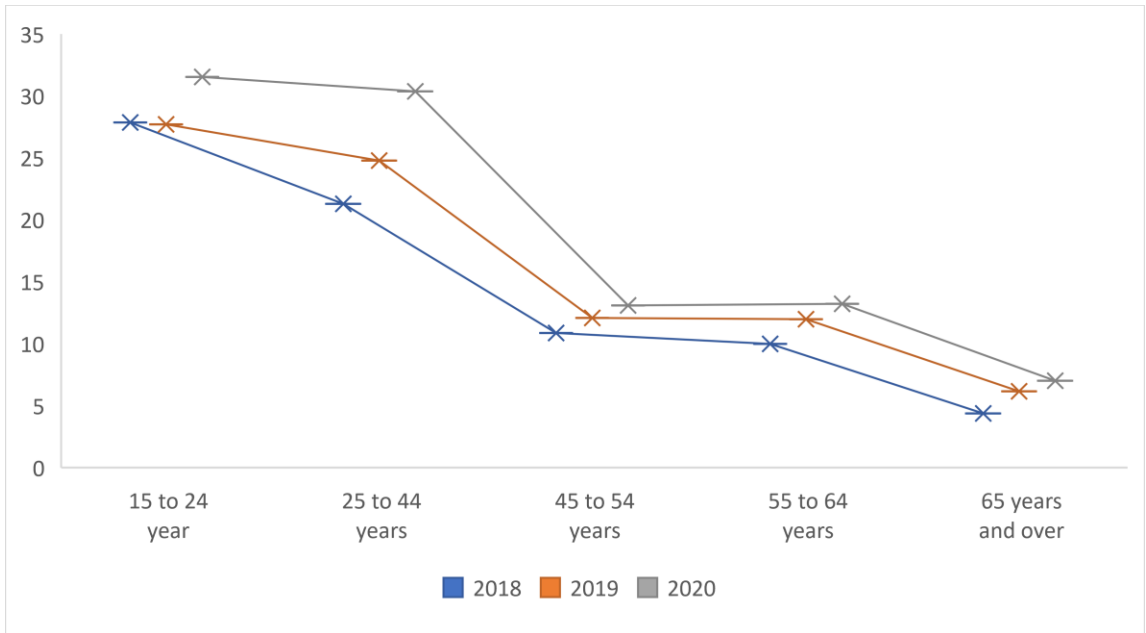


Figure 4 Prevalence of Cannabis use in the past three months in AB over time

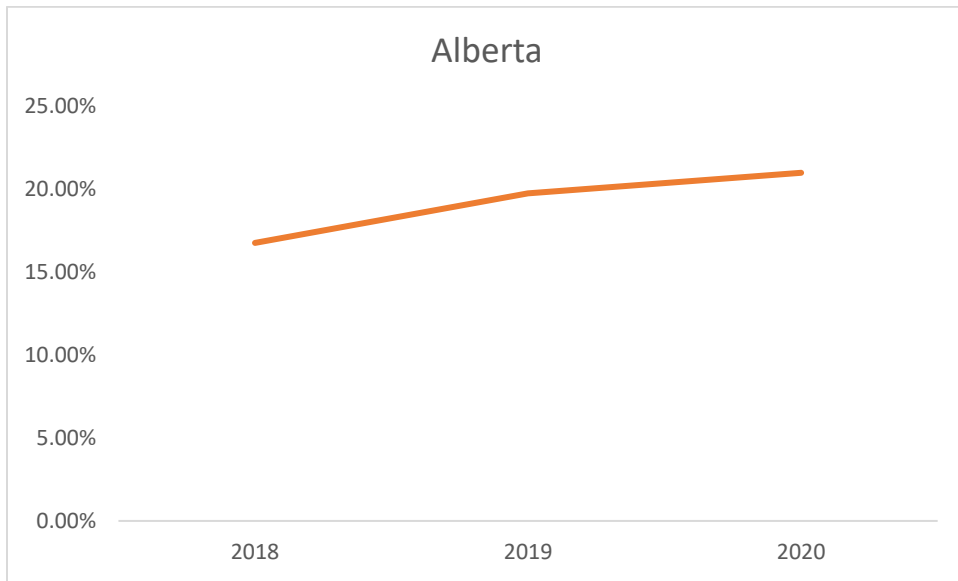


Figure 5. Prevalence of Cannabis use in the past three months in BC over time

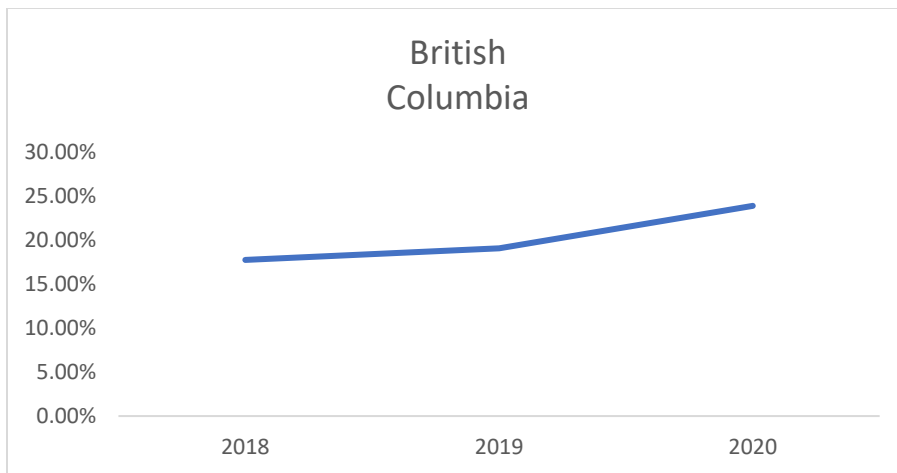


Figure 6. Prevalence of Cannabis use in the past three months in MB over time

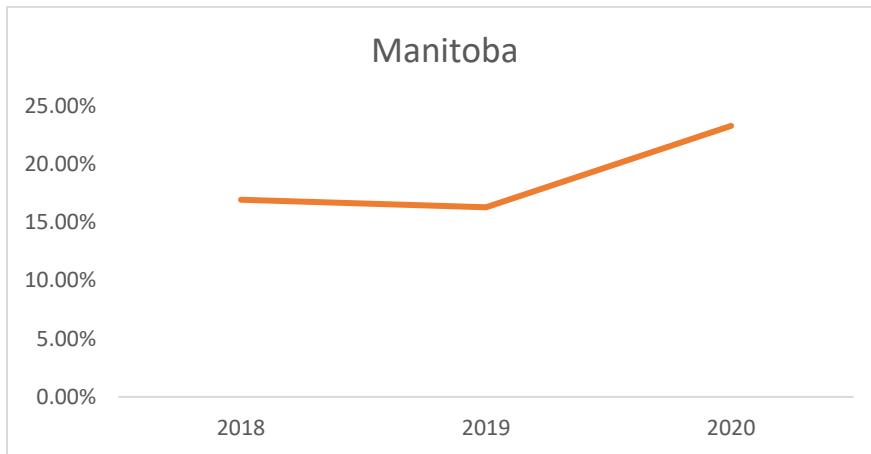


Figure 7. Prevalence of Cannabis use in the past three months in QC over time

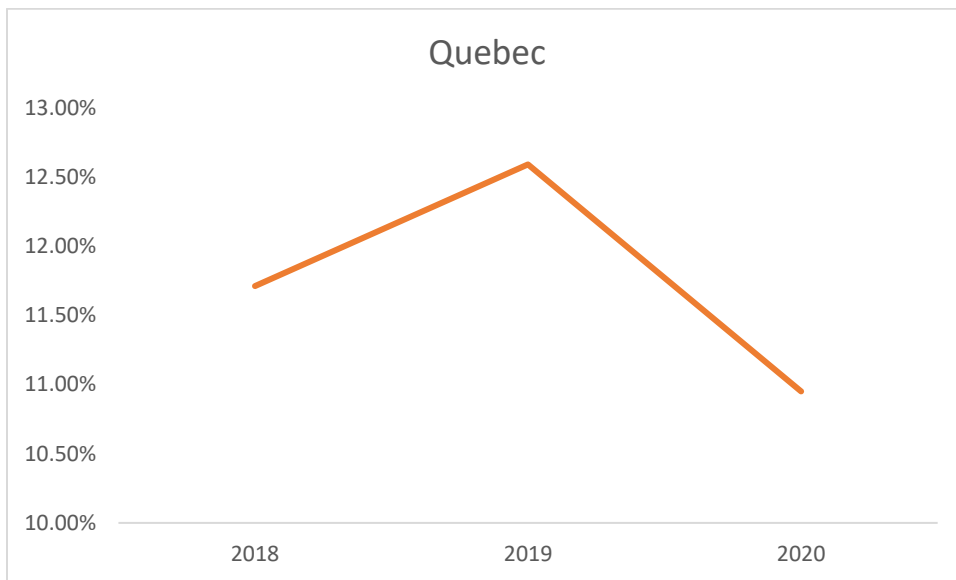


Figure 8. Prevalence of Cannabis use in the past three months in SK over time

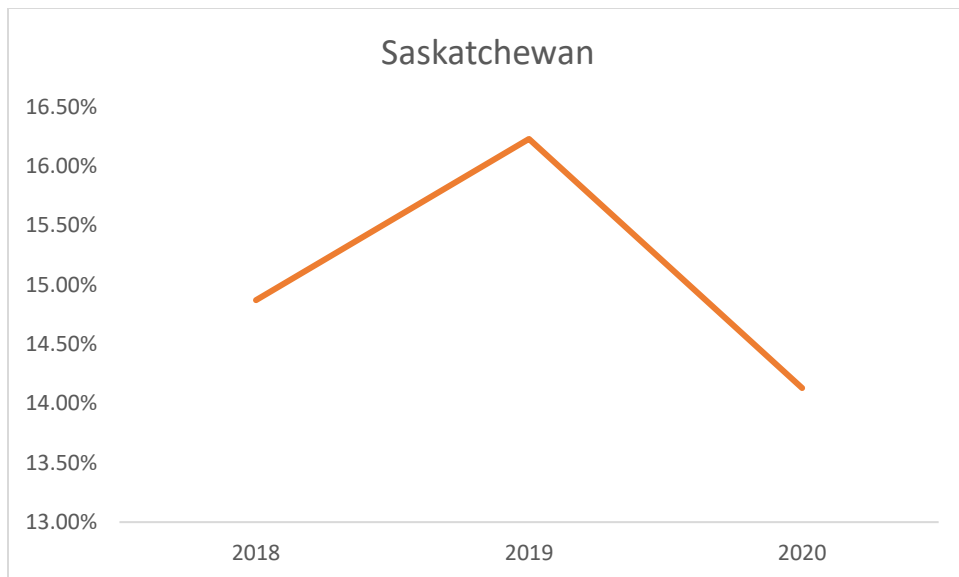


Figure 9. Prevalence of Cannabis use in the past three months in ON over time

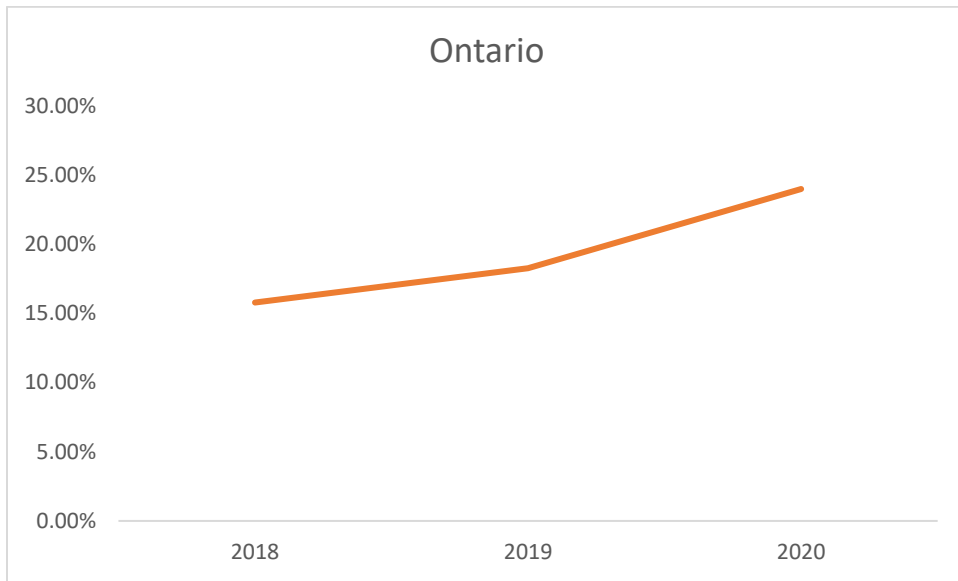


Figure 10 Prevalence of Cannabis use in the past three months in Atlantic Canada over time

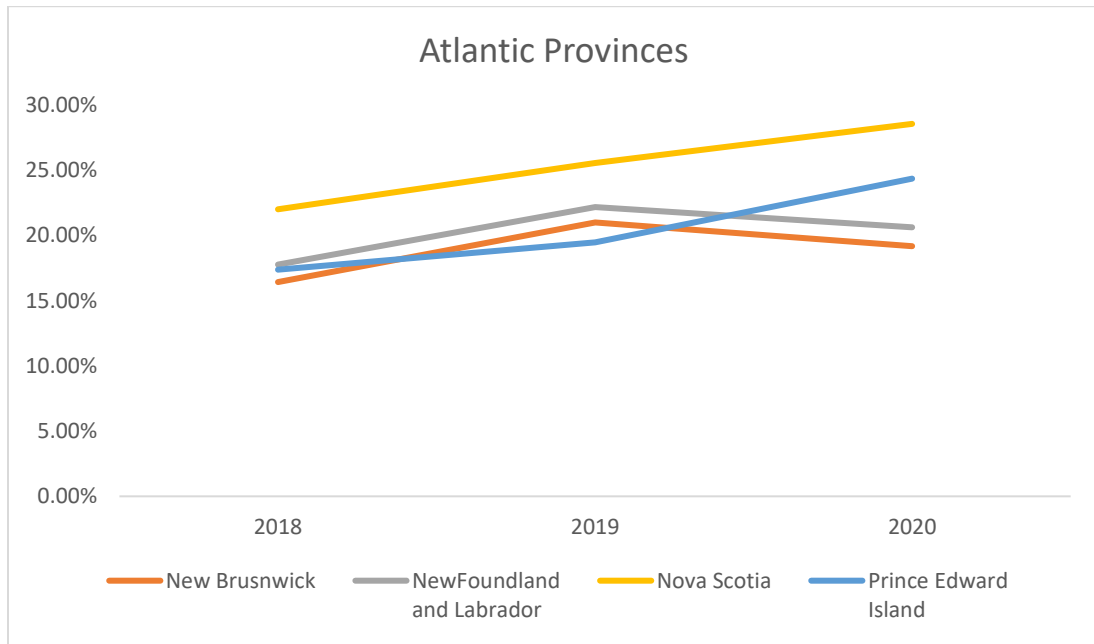
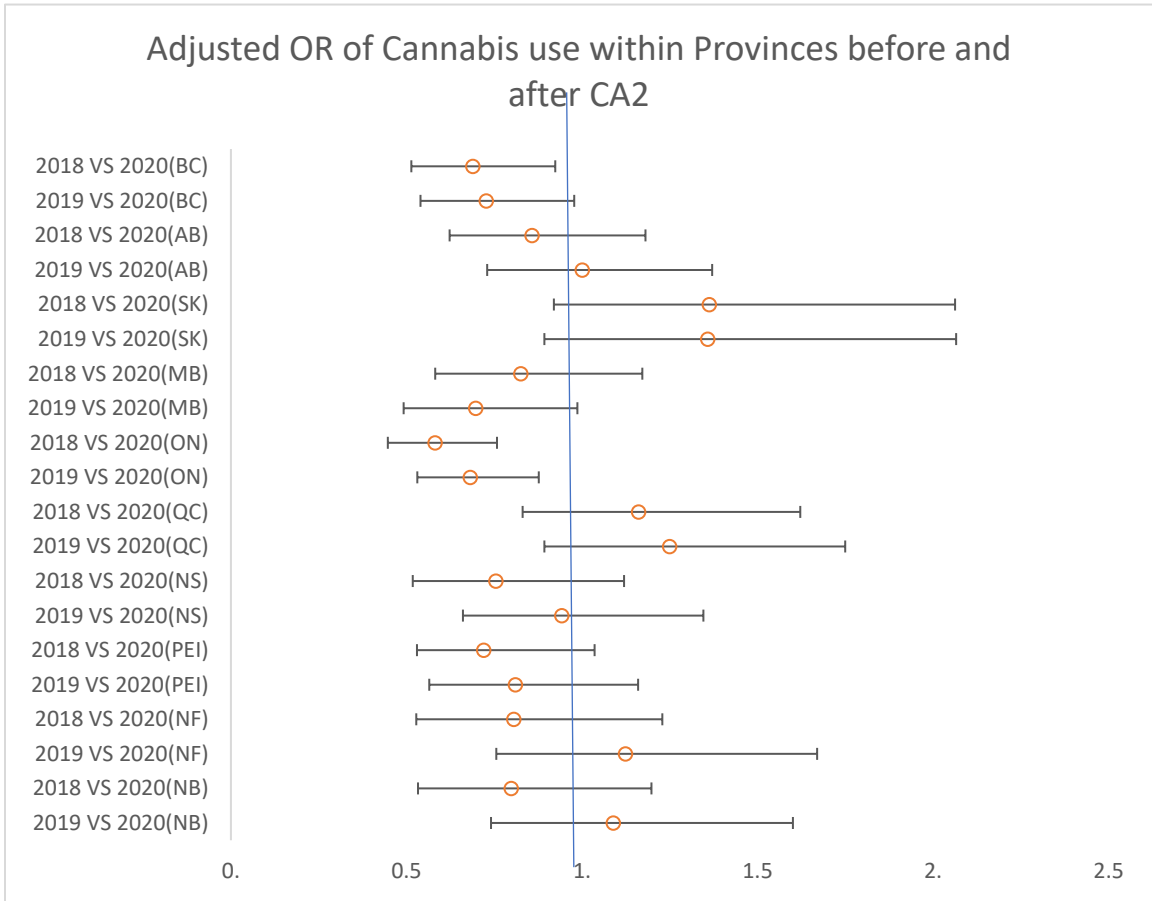


Table 6 Adjusted Odd Ratio of Factors associated with Cannabis use in Canada.

Odds Ratio Estimates			
Effect	Odds Ratio	95% Confidence Limits	
Female vs Male	0.669	0.602	0.745
Married or living common-law vs Widowed, Separated, Divorced or Single, Never Married	0.640	0.565	0.725
Excellent or very good vs Poor(GHR)	0.463	0.332	0.646
Good or fair vs Poor(GHR)	0.493	0.357	0.681
Excellent or very good vs Poor(MHR)	0.474	0.315	0.713
Good or fair vs Poor(MHR)	0.734	0.489	1.103
100,000 and over vs Less than 20,000 dollars	1.147	0.947	1.390
20,000 to less than 40,000 dollars vs Less than 20,000 dollars	1.026	0.850	1.237
40,000 to less than 60,000 dollars vs Less than 20,000 dollars	1.032	0.851	1.252
60,000 to less than 80,000 dollars vs Less than 20,000 dollars	1.025	0.831	1.263

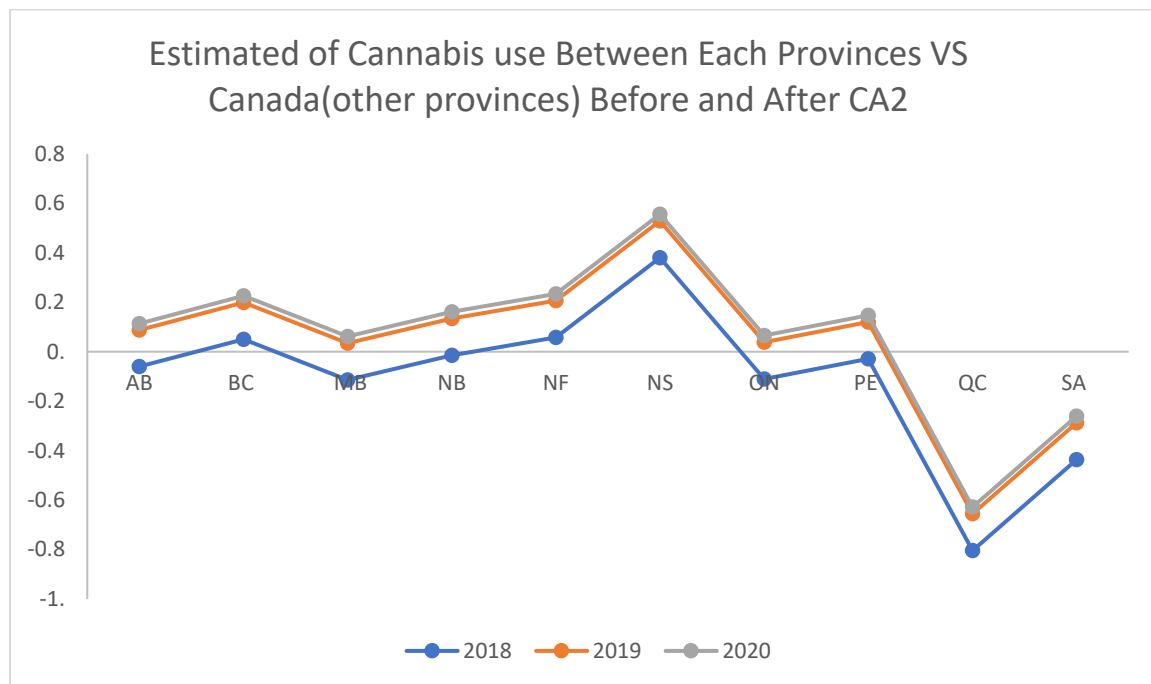
80,000 to less than 100,000 dollars vs Less than 20,000 dollars	1.008	0.813	1.250
High school degree vs University Degree or Post-graduate degree	1.465	1.254	1.711
Less Than high school degree vs University Degree or Post-graduate degree	0.907	0.715	1.150
Some university, No degree vs University Degree or Post-graduate degree	1.248	0.982	1.586
Technical/trade school or community college vs University Degree or Post-graduate degree	1.577	1.383	1.799

Figure 11 Adjusted OR of cannabis use within Provinces before and after Cannabis Act, 2



Amendment

Figure 12. β of Cannabis use Between Each Provinces VS Canada Before and After CA2



Secondary outcomes:

Modes of cannabis use:

Modes of cannabis use before and after Cannabis Act, 2 Amendment, Yearly comparison:

In our descriptive results edible cannabis consumption has significantly increased after the enactment of the Cannabis Act ($\beta = -0.57$ for 2018 vs 2019, $P < 0.05$). That is, whereas 9.8% of Cannabis users consumed Edible cannabis in the past three months in 2018, 13.03% did

so after the legalization of cannabis for recreational use. However, when I conducted a multinomial logistic regression using "Other" reference groups and Adjusted for other confounder factors, the β estimate of edible cannabis consumption was considerably lower after CA2 than it was before CA2 ($p=0.001$). Similarly, vaped as another administrative mode of cannabis use reduced after CA2 compared to before that ($\beta =0.25$ and $P<0.05$). Finally, smoking as mode of cannabis reduced after the cannabis policy and CA2($\beta =0.36$, $p<0.005$).

Factors Associated with Modes of Cannabis use:

Based on consumer factors such as gender, living area, and age, Modes of cannabis use differed. For instance, women were more likely than men to use Edible cannabis (OR=2.65, 95%CI=1.69, 4.150). Moreover, Although Smoking was the main methods of cannabis use among all of the age groups, as age goes up use of Edible will be mainly modes of cannabis use (OR = 1.83, CI=1.02, 3.28 for 55-64 vs 25-44 and OR =3.87 , CI=2.19, 6.86 for 65 and over VS 25-44)(Table11).

Table 7 Adjusted OR of Factors Associated with Modes of Cannabis Use

Odds Ratio Estimates				
Effect	CANMODE	OR	95% Confidence Limits	
Female vs Male	Vaped	0.649	0.423	0.996
Female vs Male	Smoked	0.682	0.486	0.955
Female vs Male	Edible	2.655	1.699	4.150
15 to 24 year vs 25 to 44 years	Vaped	1.123	0.500	2.523
15 to 24 year vs 25 to 44 years	Smoked	1.016	0.522	1.978
15 to 24 year vs 25 to 44 years	Edible	0.364	0.091	1.457
45 to 54 years vs 25 to 44 years	Vaped	0.696	0.386	1.254
45 to 54 years vs 25 to 44 years	Smoked	0.757	0.476	1.205
45 to 54 years vs 25 to 44 years	Edible	1.560	0.826	2.948
55 to 64 years vs 25 to 44 years	Vaped	0.369	0.210	0.648
55 to 64 years vs 25 to 44 years	Smoked	0.467	0.300	0.727
55 to 64 years vs 25 to 44 years	Edible	1.837	1.026	3.289
65 years and over vs 25 to 44 years	Vaped	0.418	0.216	0.810
65 years and over vs 25 to 44 years	Smoked	0.245	0.146	0.410
65 years and over vs 25 to 44 years	Edible	3.877	2.191	6.862
Married or living common-law vs Widowed, Separated, divorced or Single, Never Married	Vaped	1.228	0.773	1.949
Married or living common-law vs Widowed, Separated, divorced or Single, Never Married	Smoked	0.832	0.549	1.262
Married or living common-law vs Widowed, Separated, divorced or Single, Never Married	Edible	1.458	0.892	2.383
General Health Rating- Excellent or very good vs Poor	Vaped	1.537	0.524	4.509
General Health Rating Excellent or very good vs Poor	Smoked	3.976	1.794	8.810
General Health Rating Excellent or very good vs Poor	Edible	0.495	0.214	1.144
General Health Rating Good or fair vs Poor	Vaped	1.707	0.591	4.926
General Health Rating Good or fair vs Poor	Smoked	3.727	1.703	8.158
General Health Rating Good or fair vs Poor	Edible	0.722	0.319	1.635

Modes of Cannabis use differences within and between provinces Before and After Cannabis Act, 2 Amendment:

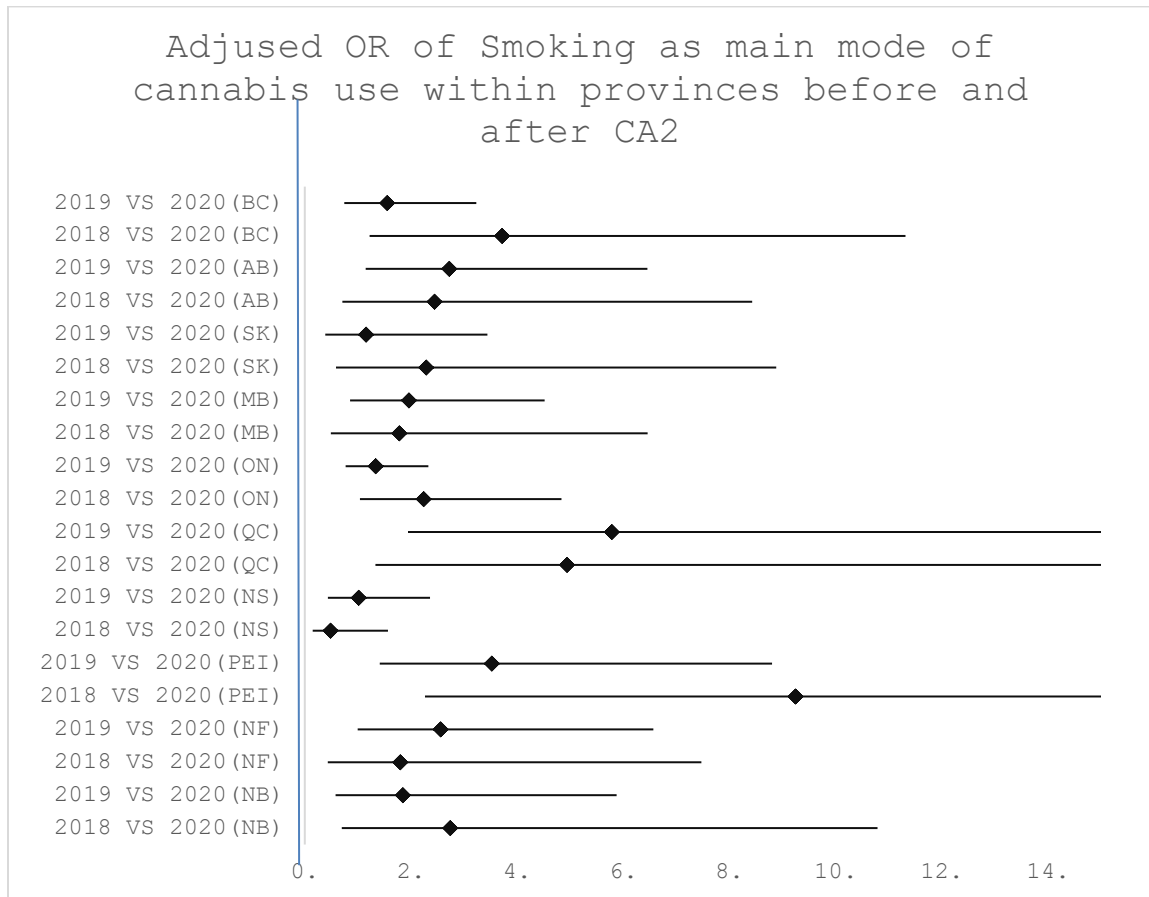
Cannabis administrative modes varied by province in Canada. Accordingly, in BC vaping as an administrative mode of cannabis use was higher than other provinces (β of 2018 vs 2020 was 0.73 $P < 0.007$ and β was 0.92 for 2019 vs 2020 $p < 0.0008$). On the other hand, in NL and NS vaping as cannabis use method was lower compared to other provinces (β at 2018 NL VS other provinces = -0.13 $p < 0.02$, β at 2019 NL VS other = -0.94, $P < 0.02$ and in NS vs other at 2020 $\beta = -0.69$, $P < 0.03$). Smoking as another mode of cannabis use was higher in BC in 2018 and lower in VS other provinces. β of edible as main Modes of cannabis use was lower ON in 2018 and higher in BC and AB in 2019 (β for ON = -0.50, BC = 0.89 and AB = 0.62 and $P < 0.05$) (Table 12).

Table 8 Cannabis Modes use in Each Provinces VS Canada Before and After CA2

Modes of Cannabis Use	β of Vape Use			Estimate of smoked use			Estimate of edible use		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
Provinces									
AB VS Canada	-0.04	0.14	-0.43	0.16	-0.07	-0.73*	0.05	0.62*	0.1
BC VS Canada	0.74*	0.93*	0.36	0.52*	0.3	-0.36	0.33	0.89*	0.37
MB VS Canada	0.07	0.26	-0.31	-0.08	-0.3	-0.96*	-0.54	0.03	-0.49
NB VS Canada	0.57	0.76	0.19	0.44	0.21	-0.45	-0.06	0.51	-0.01
NL VS Canada	-1.13*	-0.95*	-1.52*	0.19	-0.04	-0.7*	-0.17	0.4	-0.12
NS VS Canada	-0.32	-0.13	-0.7*	0.35	0.13	-0.53*	-0.58	-0.01	-0.53
ON VS Canada	-0.02	0.17	-0.4	0.06	-0.16	-0.83*	-0.5*	0.07	-0.45
PE VS Canada	0.38	0.56	-0.01	0.8	0.58*	-0.09	-0.16	0.41	-0.11
QC VS Canada	0.12	0.31	-0.26	1.03*	0.81*	0.14	-0.26	0.31	-0.21
SA VS Canada	0.29	0.47	-0.1	0.23	0.01	-0.65*	-0.18	0.39	-0.13

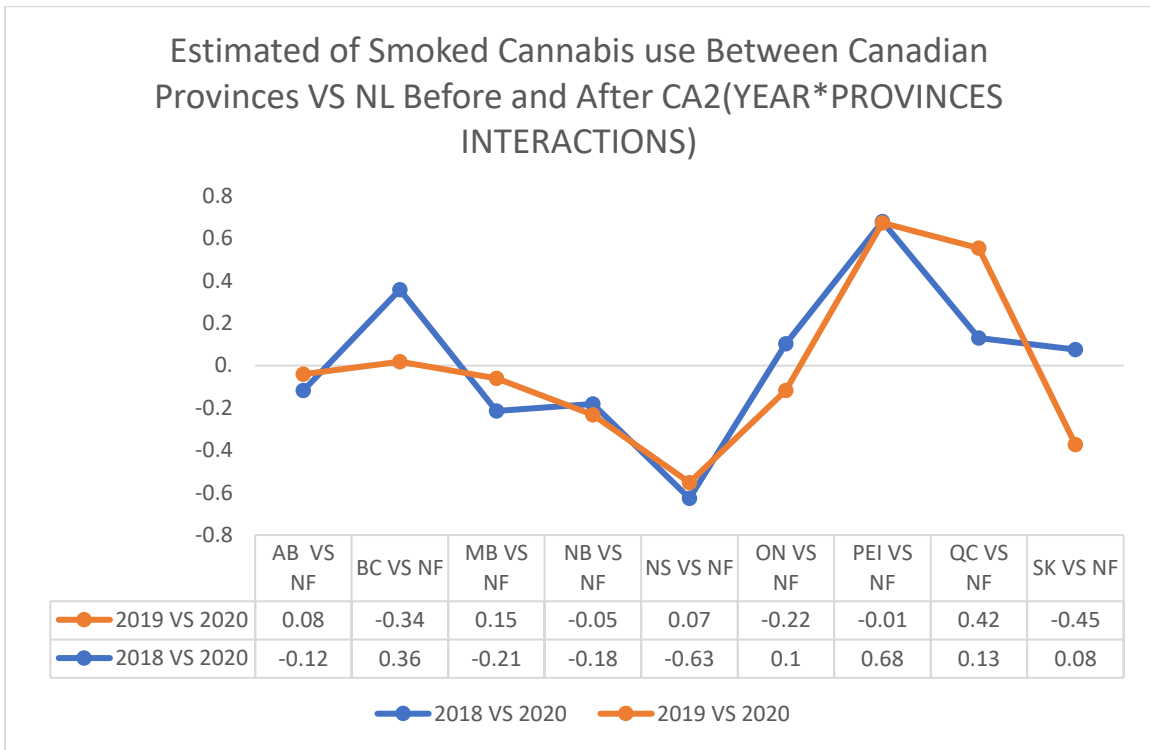
*P<0.05

Figure 13 Adjusted OR of Smoking as main mode of cannabis use within provinces before and after CA2



According to year*province interaction, there were provincial differences in the impact of the year on cannabis use. Cannabis Modes of consumption have changed significantly over the years in some provinces, but not statistically significantly in others. For instance, smoking as the main mode of cannabis use in NS VS NL was higher in 2020 than it was in 2018 (β difference = -0.63 and $P = 0.036$). It could imply that as the years went on, smoking as a main method of cannabis use in NS VS NL increased as well. (Figure 12)

Figure 14 Estimated of Smoked as a mode of Cannabis use Between Canadian Provinces VS NL Before and After CA2



Reason for cannabis use:

Reason for Cannabis use before and after Cannabis Act, 2 Amendment, Yearly comparison:

Prevalence of Non-Medical cannabis use:

The prevalence of non-medical cannabis use has been changed before and after cannabis policy and 2Amendment. While among those who used cannabis in 2018, 49.44% used it

as non-medical cannabis, the percentages were 48.77% and 53.39% in 2019 and 2020 respectively. (Figure 15).

Provincial comparisons: use of non-medical cannabis varied provincially. That is, in AB and BC Non-Medical cannabis use among cannabis consumers was lower than in other Canadian provinces in 2018 (β of cannabis use in 2018 AB vs Canada = -0.76 and $P < 0.0001$, and in BC vs Canada $\beta = -0.67$ and $P < 0.0001$). Similarly, in 2019 use of non-medical cannabis among cannabis consumer at AB and BC were significantly lower than other provinces (β of cannabis use in 2019 AB vs Canada = -0.62 and $P < 0.0001$, and in BC vs Canada $\beta = -0.53$ and $P < 0.0003$). On the other hand, in 2020, ON, PEI and QC use of non-medical cannabis was higher than other provinces (β of non-medical cannabis use in 2020 was = 0.35 $P < 0.006$, in PEI = 0.39 $P < 0.01$ and in QC = 0.88 $P < 0.0001$). (Figure 16)

Figure 15. Percentage of Non-Medical Cannabis use before and after CA2

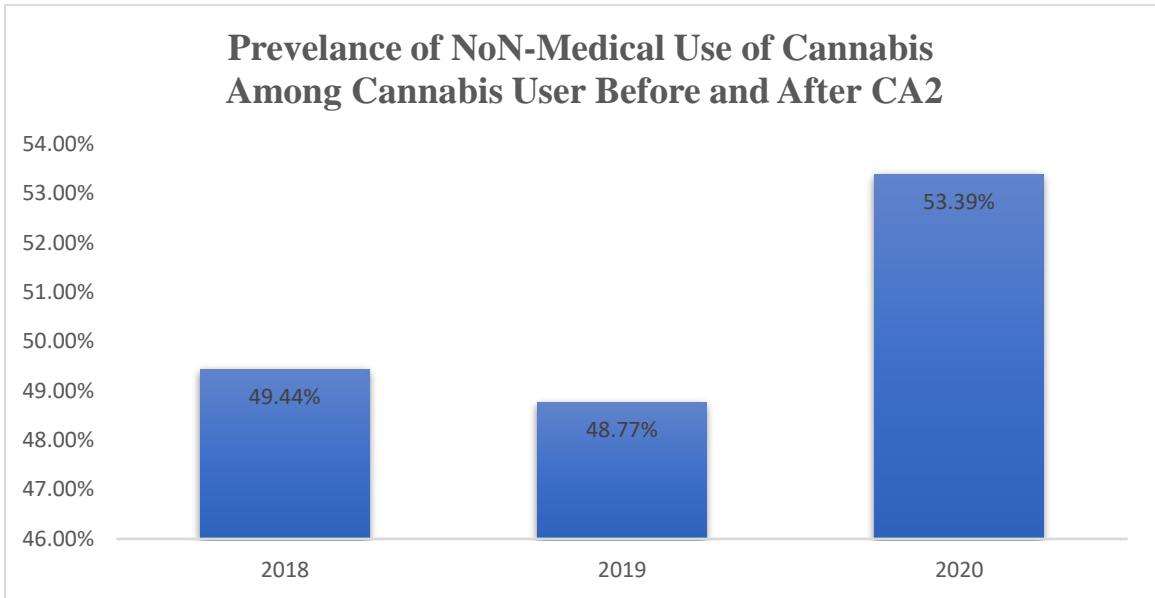
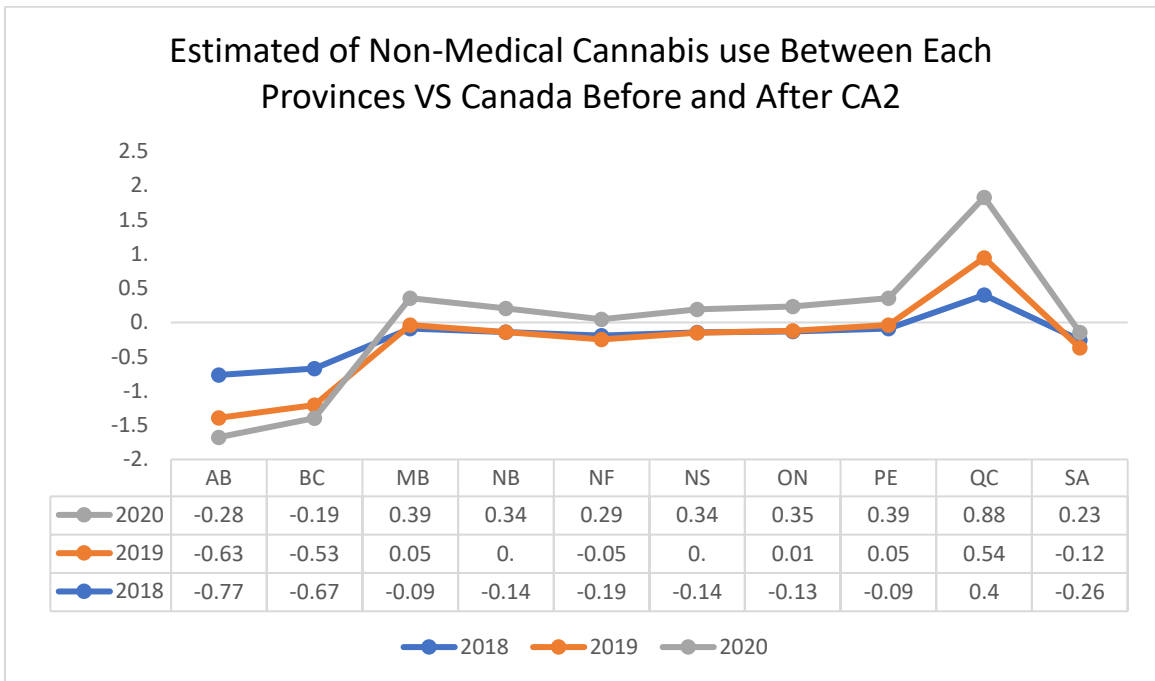


Figure 16 β of Non-Medical Cannabis Use between Each Provinces VS Canada Before and After CA2



Factors Associated with Non-Medical Cannabis use:

Non-medical cannabis use was significantly higher among males, 15-24 ages, people with excellent or very good general and mental health rating, being single, widows or separated and having a university or postgraduate degree. (Table 9)

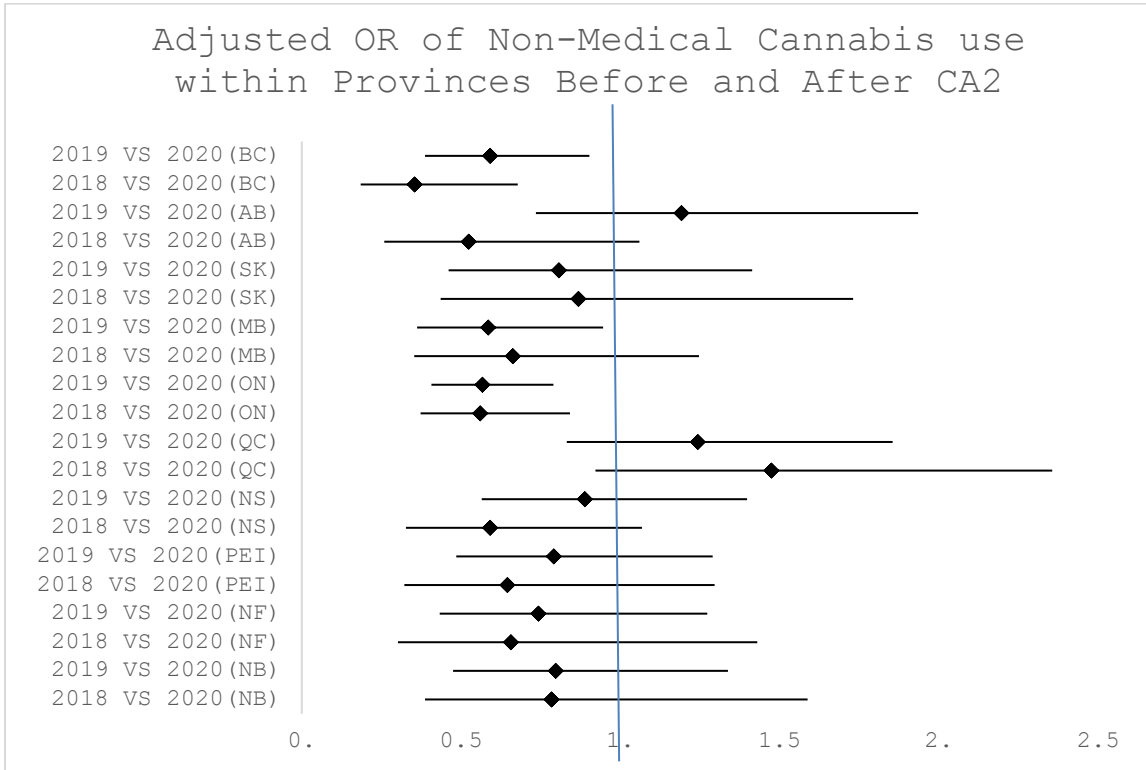
Table 9 Adjusted OR of Factors Associated with Non-Medical Cannabis use.

Odds Ratio Estimates			
Effect	Odds Ratio	95% Confidence Limits	
Female vs Male	0.692	0.545	0.879
15-to-24-year vs 25 to 44 years	2.324	1.552	3.479
45 to 54 years vs 25 to 44 years	1.034	0.751	1.424
55 to 64 years vs 25 to 44 years	0.697	0.503	0.965
65 years and over vs 25 to 44 years	0.435	0.299	0.633
Married or living common-law vs Widowed, Separated, divorced or Single, Never Married	0.736	0.555	0.974
General Health Rating-Excellent or very good vs Poor	5.068	2.186	11.749
General Health Rating Good or fair vs Poor	3.542	1.536	8.171
Mental Health Rating- Excellent or very good vs Poor	4.799	2.127	10.824
Mental Health Rating- Good or fair vs Poor	3.872	1.747	8.585
EDUCATION_LEVEL Less Than high school degree vs University Degree or Post-graduate degree	0.539	0.328	0.887
EDUCATION_LEVEL Some university, No degree vs University Degree or Post-graduate degree	0.555	0.327	0.941
EDUCATION_LEVEL Technical/trade school or community college vs University Degree or Post-graduate degree	0.746	0.554	1.004

Non-Medical cannabis use within provinces before and after CA2:

Non-Medical Cannabis use also varied within provinces before and after CA2. Accordingly, Although in most of the provinces non-medical cannabis use have been increased after cannabis policy and CA2 as compared with pre-legalization and 2Amendment, only in BC, MB and ON there was statistically significant in using non-medical cannabis over time.. For instance, in ON and BC Non-Medical Cannabis use significantly increased after cannabis policy and 2 Amendment. (Adjusted OR in ON 2018 vs 2020=0.56 CI (0.37-0.84) and Adjusted OR 2019 vs 2020=0.57 CI (0.41-0.79)). See Figure17 for more details.

Figure 17 Adjusted OR of Non-Medical Cannabis use within Provinces Before and After CA2

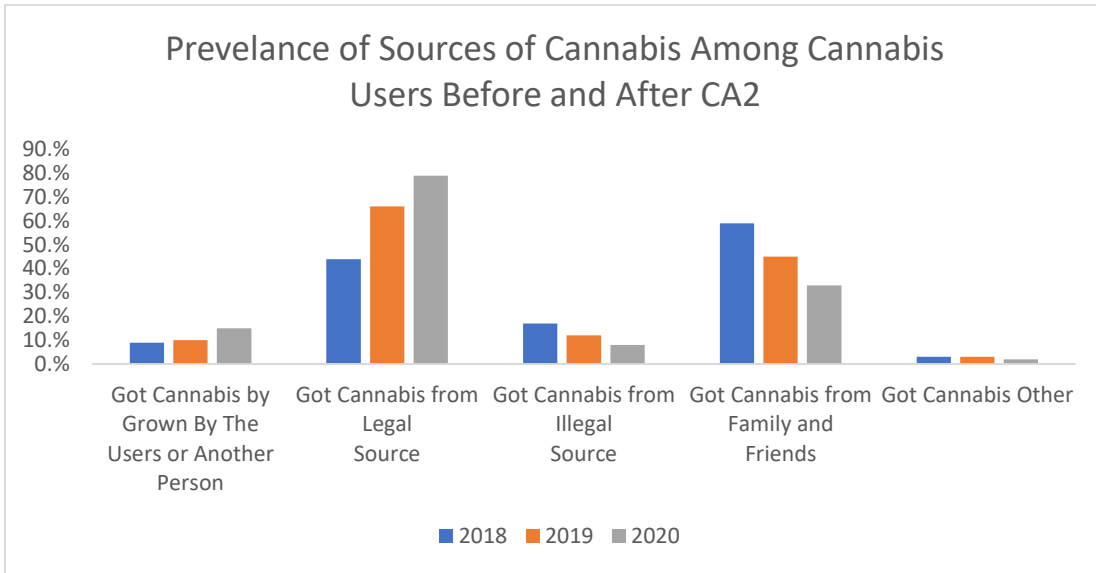


Sources of cannabis use:

Sources of Cannabis use before and after Cannabis Act, 2 Amendment, Yearly comparison:

Among those who used cannabis, getting cannabis from illegal sources and from family and friends was less likely in 2020 compared with 2018. On the other hand, obtaining cannabis from legal sources have significantly increased after the cannabis policy and CA2 (2020) as compared with pre-legalization and 2Amendment periods (2018 and 2019) $P < 0.05$. (Figure 18).

Figure 18. Prevalence of Cannabis different sources before and after CA2



Factors Associated with Sources of Cannabis use:

Sources of cannabis were associated with Gender, Total house incomes, marital status, General Health rating and Education levels. For instance, obtaining cannabis from illegal sources were higher among men vs women and among consumers had a low education level vs university degree (Adjusted OR=0.66; 95% CI 0.50-0.87 and OR =2.29; 95% CI 1.44-3.65) and getting cannabis from legal sources were higher among cannabis users who had a university degree vs high school degree. (Tables 10 and 11).

Table 10 Adjusted OR of Factors associated with getting cannabis from illegal source among cannabis users.

Odds Ratio			
Effect	OR	95%Confidence Limits	
Female vs Male	0.61	0.439	0.854
15 to 24 year vs 25-44 year	1.64	1.087	2.49
45 to 54 years vs 25-44 years	0.72	0.510	1.02
55 to 64 years vs 25 to 44 years	0.57	0.39	0.85
65 years and over vs 25 to 44 years	0.41	0.25	0.66
Married or living common-law vs Widowed, Separated, Divorced or Single, Never Married	0.690	0.508	0.938
GHR(General Health rate) Excellent or very good vs Poor	1.407	0.687	2.883
GHR_ Good or fair vs Poor	1.476	0.734	2.967
MHR(Mental Health rate)_ Excellent or very good vs Poor	0.676	0.325	1.409
MHR_ Good or fair vs Poor	0.623	0.300	1.295
THI(Total House income) 100,000 and over vs Less than 20,000 dollars	0.542	0.280	1.051
THI_ 20,000 to less than 40,000 dollars vs Less than 20,000 dollars	0.700	0.409	1.197
THI_ 40,000 to less than 60,000 dollars vs Less than 20,000 dollars	0.764	0.432	1.351

THI_ 60,000 to less than 80,000 dollars vs Less than 20,000 dollars	0.499	0.261	0.955
THI 80,000 to less than 100,000 dollars vs Less than 20,000 dollars	0.528	0.263	1.059
EDUCATION_LEVEL High school degree vs University Degree or Post-graduate degree	2.296	1.443	3.654
EDUCATION_LEVEL Less Than high school degree vs University Degree or Post-graduate degree	1.419	0.731	2.755
EDUCATION_LEVEL Some university, No degree vs University Degree or Post-graduate degree	1.035	0.511	2.095
EDUCATION_LEVEL Technical/trade school or community college vs University Degree or Post-graduate degree	1.818	1.20	2.75

Table 11 Adjusted OR of Factors associated with getting cannabis from legal source among cannabis users.

Odds Ratio Estimates			
Effect	OR	95% Limits	Confidence
Female vs Male	0.890	0.735	1.077
Married or living common-law vs Widowed, Separated, Divorced or Single, Never Married	1.225	1.003	1.496
GHR_CAT Excellent or very good vs Poor	0.504	0.309	0.821
GHR_CAT Good or fair vs Poor	0.679	0.420	1.096
MHR_CAT Excellent or very good vs Poor	0.765	0.423	1.384

MHR_CAT	Good or fair vs Poor	0.847	0.474	1.512
THI_NEW	100,000 and over vs Less than 20,000 dollars	0.742	0.528	1.042
THI_NEW	20,000 to less than 40,000 dollars vs Less than 20,000 dollars	1.084	0.786	1.496
THI_NEW	40,000 to less than 60,000 dollars vs Less than 20,000 dollars	0.843	0.596	1.193
THI_NEW	60,000 to less than 80,000 dollars vs Less than 20,000 dollars	0.891	0.628	1.263
THI_NEW	80,000 to less than 100,000 dollars vs Less than 20,000 dollars	0.825	0.564	1.208
EDUCATION_LEVEL	High school degree vs University Degree or Post-graduate degree	0.667	0.508	0.875
EDUCATION_LEVEL	Less Than high school degree vs University Degree or Post-graduate degree	0.459	0.308	0.685
EDUCATION_LEVEL	Some university, No degree vs University Degree or Post-graduate degree	0.916	0.596	1.406
EDUCATION_LEVEL	Technical/trade school or community college vs University Degree or Post-graduate degree	0.798	0.626	1.015

Sources of cannabis use between and within provinces before and after CA2:

Sources of cannabis use changed provincially. Logistic regression analysis indicated that in 2018 getting cannabis from legal sources was significantly lower in each province vs Canada than what was the case in 2019 and 2020 where it was significantly higher in every province. For instance, in 2019 B-coefficient of getting cannabis from a legal source in NB vs Canada was -1.09 $p < 0.001$, and in 2020 it was 0.38 $p < 0.02$. (Table 12). Sources of cannabis use also varied within provinces before and after CA2. Accordingly, in most of the provinces getting cannabis from legal sources have been increased within provinces after cannabis policy and amendment in contrast to pre-legalization and amendment. For example, in NB Adjusted OR of getting cannabis from legal sources in 2018 vs 2020 was 0.13 , 95% CI $0.05-0.32$. On the other hand, getting cannabis from illegal source have been reduced after cannabis policy and 2Amendment in NS (Adjusted OR 2018 VS 2020 was 4.79 ; 95%CI $1.88-12.18$ and AOR 2019 vs 2020= 4.02 ;95% CI= $1.52-10.65$). (Figure 20 and 18).

Table 12 Estimate of getting cannabis from legal sources between each provinces VS Canada before and after CA2

Cannabis Sources	Legal			Illegal			Growth by Users			Got from Family and Friends		
	2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	2020
AB VS Canada	-0.52*	0.77*	0.95	0.36	0.	-0.34	0.17	0.14	-0.04	0.43*	-0.17	-0.67*
BC VS Canada	-0.85*	0.44*	0.62	-0.38	-0.75*	-1.09*	-0.82*	-0.86*	-1.04*	0.7*	0.1	-0.4*
MB VS Canada	-0.95*	0.34*	0.52	0.96*	0.6*	0.26	3.03*	3.*	2.81*	0.75*	0.15	-0.34*
NB VS Canada	-1.09*	0.2	0.38	0.11	-0.25	-0.6*	-0.77*	-0.81*	-0.99*	0.39*	-0.2	-0.7*
NL VS Canada	-0.68*	0.62*	0.8	0.8*	0.44*	0.1	0.39	0.36	0.18	0.51*	-0.09	-0.58*
NS VS Canada	-0.92*	0.37*	0.55	0.16	-0.20	-0.54*	-0.41	-0.44	-0.62*	0.74*	0.14	-0.36*
ON VS Canada	-0.99*	0.31*	0.49	0.31	-0.05	-0.39	-0.83*	-0.87*	-1.05*	0.63*	0.03	-0.47*
PEI VS Canada	-0.79*	0.51*	0.69	-0.3	-0.66*	-1.00*	-0.53*	-0.56*	-0.75*	0.64*	0.04	-0.46*
QC VS Canada	-1.45*	-0.16	0.02	0.85*	0.49	0.15	0.29	0.26	0.08	0.42*	-0.18	-0.67*
SA VS Canada	-0.99*	0.31*	0.49	0.67*	0.31	-0.03	0.3	0.27	0.08	0.44*	-0.16	-0.66*

Figure 19 Adjusted OR of Legal Source of Cannabis use within Provinces Before and After CA2

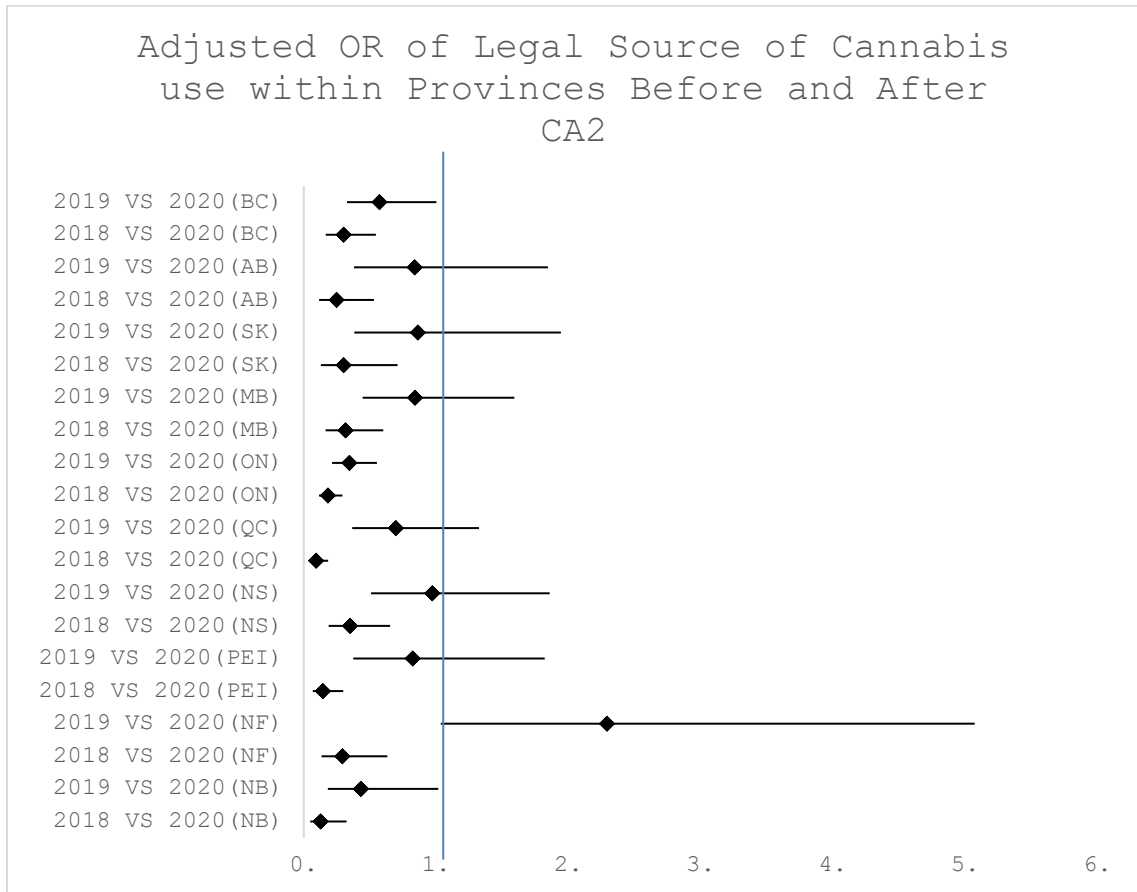
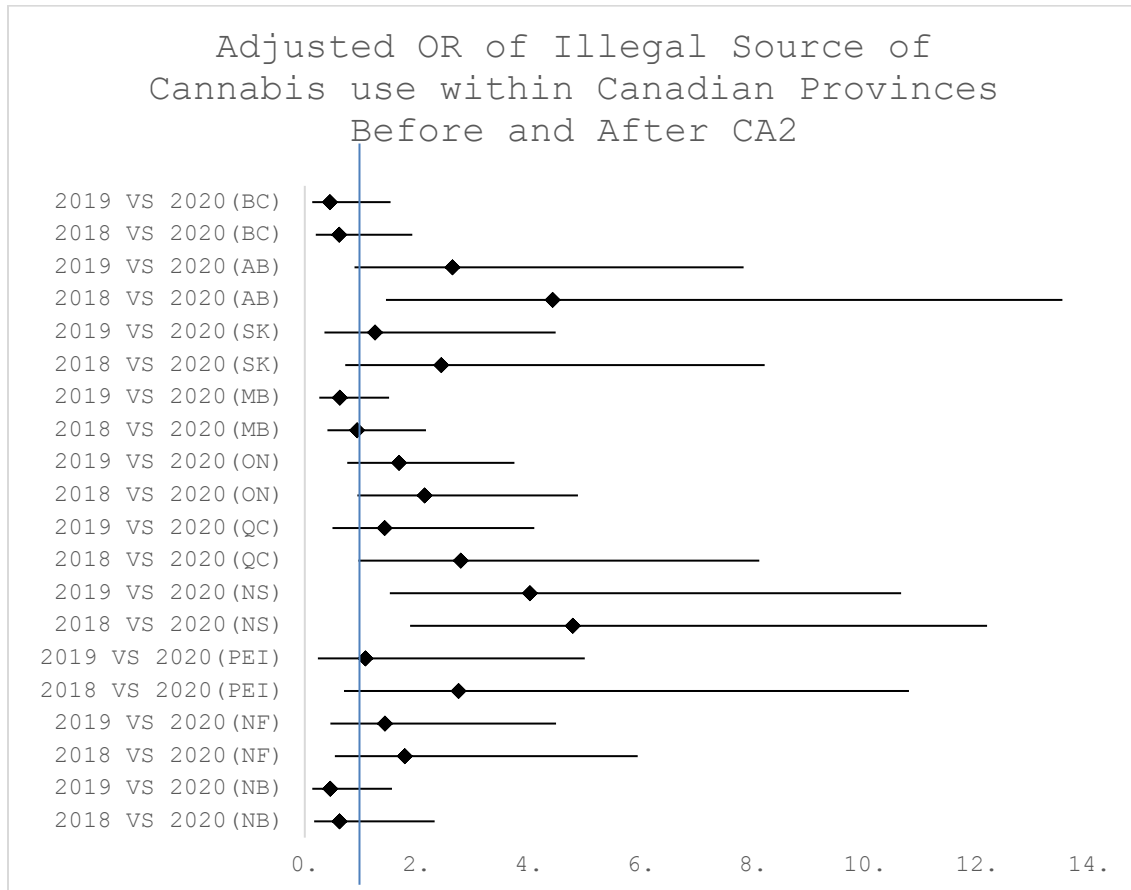


Figure 20. Adjusted OR of Illegal Source of Cannabis use within Provinces Before and After CA2



According to year*province interaction, there were provincial differences in the impact of the year on Sources of cannabis use. That is, getting cannabis from legal sources has changed significantly over the years in some province's vs NL as reference Provinces. For instance, obtaining cannabis from legal sources in BC vs NL and ON vs NL was lower in 2020 than it was in 2018 (β d difference = 0.43 and P = 0.001, and 0.29 p=0.009 in BC and ON respectively). However, getting cannabis from legal sources was higher in BC vs NL and ON vs NL in 2020 compared with 2019(β d difference = - 0.33 and P = 0.01, and -.58 P<0.00901 in BC and ON respectively).)(Table13).

Table 13 Estimate of Different cannabis Sources between each province’s vs NL before and after CA2 (Year *Province)

Sources of Cannabis	Legal		Illegal		Growth by User		Got from Family and friends	
	2018 VS 2020	2019 VS 2020	2018 VS 2020	2019 VS 2020	2018 VS 2020	2019 VS 2020	2018 VS 2019	2019 VS 2020
Year*Provinces Interaction								
AB VS NL	0.01	0.01	0.46	0.17	0.15	0.16	-0.06	-0.15
BC VS NL	0.43*	-0.33*	-0.26	-0.12	0.42*	-0.09	-0.32*	0.16
MB VS NL	0.12	-0.04	-0.19	-0.22	-0.82*	-0.22	-0.02	0.17
NB VS NL	-0.37	-0.02	-0.56	-0.23	0.57*	0.29	0.57*	0.05
NS VS NL	0.25	-0.01	0.16	0.39	0.53*	0.1	-0.4*	- 0.31*
ON VS NL	0.29*	-0.58*	-0.11	0.31	0.31	0.05	-0.09	0.25*
PE VS NL	-0.37	0.2	0.32	-0.22	-0.02	-0.03	0.15	-0.21
QC VS NL	-0.4*	0.21	0.03	-0.08	-1.06*	-0.32	0.25	0.09
SA VS NL	0.12	-0.01	0.23	-0.08	-0.19	-0.02	-0.11	0.26

Cannabis Products

Prevalence of different Cannabis Products Before and After Cannabis Act, 2 Amendment, Yearly comparison:

The use of cannabis in different products has been changed before and after cannabis policy and 2 amendments. That is, use of edible cannabis among cannabis users have increased after CA2 in contrast to before that. For instance, edible cannabis prevalence was 66.35% in 2019 and 80.51% in 2020(Rao-Scott Chi-Square $p < 0.0001$). Likewise, β of edible cannabis use in 2019 vs 2020 was -0.3395 and $P < 0.002$. Similarly, the use of cannabis liquid non-concentrated has been raised after the cannabis policy and 2 Amendment. Accordingly, while in 2018 prevalence of cannabis liquid non-concentrated was 10.50%, it was 30.92% in 2020 ($P < 0.0001$). On the other hand, the use of dried flowers and cannabis hashish have been reduced after cannabis legalization and amendment. For example, cannabis hashish percentage was 39.55%, 33.56% and 34.15% in 2018, 2019 and 2020 respectively. ($P < 0.05$). Finally, while prevalence of cannabis dried flower was 90.96% in 2018, it reduced to 85.62% in 2020($P < 0.0064$).

Factors Associated with various cannabis products:

Edible cannabis was more prevalent among female than males (AOR 1.75; 95%CI 1.19-2.57). Education level, total house incomes, Mental and general health rating, marital status and age groups were associated with using different cannabis products. Having said that, Cannabis dried flower were more common among younger, people had high total house incomes and university degree (65+Years VS 25-44 AOR=0.41 CI 0.22-0.76). Cannabis Hashish were more prevalent among users had a low total income (AOR= 0.38

CI 0.17-0.85 80K-less than 100k vs less than 20k). Cannabis users with a poor mental health rating used more cannabis liquid non-Concentrate and oil cartridge and vape pens than users had an excellent mental health rating (AOR=0.18 CI 0.054-0.61, AOR=0.27 CI 0.12-0.64 for cannabis liquid non-Concentrated and vape pens respectively). Cannabis others which included topical cannabis were more common among female and users were elders than males and younger ones (AOR female vs Male =1.699 CI1.09-2.64 and AOR 65+ Years vs 25-44=2.69 CI=1.25-5.80). Cannabis solid concentrated were ubiquitous among Youth and users had a lower education (AOR 15-44 vs 25-44=2.07 CI=1.01-4.24 and AOR high school degree vs university degree =3.62 CI=1.82-7.18).

Different Cannabis Products Consumption Between and within provinces before and after CA2:

Use of Cannabis products varied provincially before and after CA2. Accordingly, use of edible cannabis was more common in BC, MB, and NS and lower in Q and SK before and after cannabis policy and CA2. Use OF cannabis Hashish was higher in NS before and after CA compared with other provinces. Use of cannabis liquid non-concentrated were higher in AB and BC and Lower in QC and SK after CA2. Use of cannabis solid concentrated was lower in SK before and after cannabis policy and CA2 and higher in MB and NS before and after CA2. While use of cannabis other was higher in BC, that was lower in NB and QC before and after CA2. And finally, use of cannabis oil and vape was higher in BC and ON after CA2. (Table 15 and 16).

According to year*province interaction, there were Provincial differences in the impact of the year on Different cannabis products. That is, getting cannabis from legal sources has changed significantly over the years in some provinces. For instance, obtaining cannabis from legal source in BC and ON was lower in 2020 than it was in 2018 (β difference = 0.43 and P = 0.001, and 0.29 p=0.009 in BC and ON respectively). However, getting cannabis from legal sources were higher in BC and ON in 2020 compared with 2019(β difference =- 0.33 and P = 0.01, and -.58 P<0.00901 in BC and ON respectively).).

Consumption of different cannabis products also changed within provinces before and after CA2. That is, while use of edible cannabis, cannabis liquid non-concentrated, cannabis other and cannabis oil cartridge or vaped increased after CA2 in some provinces, use of other products such as dried flowers, Cannabis Hashish and cannabis liquid concentrated were reduced after cannabis legalization and the CA2 Amendment. For instance, use of Edible cannabis has been increased in PEI after CA2 (AOR 2019 VS 2020=0.23 CI 0.07-0.72).

Table 14 Adjusted OR of different cannabis products use within provinces before and after CA2

Edible Cannabis	OR	CI-	CI+
2019 VS 2020(PEI)	0.23	0.07	0.72
2019 VS 2020(NS)	0.35	0.12	0.99
Cannabis Liquid non-Concentrated			
2018 VS 2020(NL)	0.0003	0.001	0.001
2019 VS 2020(PEI)	0.128	0.019	0.882
2019 VS 2020(ON)	0.232	0.057	0.953
2018 VS 2020(MB)	0.106	0.013	0.877
2019 VS 2020(MB)	0.048	0.007	0.32
2019 VS 2020(SK)	0.054	0.005	0.529
2019 VS 2020(AB)	0.226	0.062	0.83
2018 VS 2020(BC)	0.003	0.001	0.133
Hashish Cannabis			
2018 VS 2020(QC)	6.364	1.967	20.586
Cannabis Dried Flowers			
2018 VS 2020(NL)	3.255	1.073	9.876
2019 VS 2020(NL)	3.516	1.199	10.312
2018 VS 2020(AB)	3.984	1.563	10.155
2019 VS 2020(AB)	2.543	1.01	6.401
Cannabis Oil Cartridge or vape			

2018 VS 2020(NB)	0.18	0.03	0.97
2018 VS 2020(QC)	0.22	0.06	0.74
2019 VS 2020(QC)	0.17	0.05	0.56
Cannabis Others	OR	CI-	CI+
2019 VS 2020(NB)	7.95	1.5	42.133
2018 VS 2020(QC)	0.16	0.027	0.95
2019 VS 2020(QC)	0.08	0.01	0.629
2018 VS 2020(ON)	0.262	0.091	0.752
Cannabis Liquid Concentrated			
2018 VS 2020(NB)	4.27	1.07	17.14
2019 VS 2020(NB)	4.12	1.19	14.31
2019 VS 2020(QC)	0.38	0.15	0.96

Chapter Five: Discussion

Overview

This nationally representative study is among the first that examined cannabis use and associated factors after implementation of CA2 across Canadian provinces. Our findings showed that once cannabis was made legal and the Cannabis Act, 2 amendment was passed, cannabis consumption and its characteristics changed over time. I also found that cannabis use and its characteristics varied provincially before and after cannabis act and CA2. This chapter contextualize the finding in relation to previous literature and discuss the implications of findings for future education, research, practices, and policies.

Our study showed that following the legalization of CA2 and cannabis legislation, cannabis consumption rose. The prevalence of cannabis use, for instance, increased from 17% in 2018 to 20% in 2020. These findings are in line with previous studies (Rotermann, 2019a). For instance, a study found that, compared to pre-legalization, cannabis use generally increased (Yousufzai and colleagues, 2022) post legalization. Similarly, Rotermann found that overall rate of cannabis use climbed from 14.5% to 18% between the years of 2018 and 2019. This increase was primarily among males (Rotermann, 2019b).

The current survey also revealed that cannabis consumption differed by province. QC and SK for example, had lower prevalence of cannabis usage over the previous three months, whereas NS had the highest rate of cannabis use. This finding is supported by the finding earlier studies (Lowry & Corsi, 2020). Compared to pupils in other provinces, Quebec students were less likely to report regularly using cannabis, according to Zuckerman's report (Zuckermann et al., 2021a). In NS, a different poll found that whereas 20% of persons reported using cannabis in the previous three months in the first quarter of

2018, that rate fell to 18.2% in the same period in 2019. (Rotermann, 2019a). The difference between Nova Scotia's cannabis laws and policies and those in other provinces may help to explain the outcome. For instance, while in NS cannabis users can grow up to four plants themselves, in QC residents are not permitted to grow their own plants. In addition, in QC the legal age for buying, selling and possessing cannabis is 21, home storage limit is 150 grams, in NS 19 is legal age for use, selling and possession cannabis, there is no limitation for home storage of cannabis in NS. While cannabis possession over 30 gr is fined in QC, there is no information about this limitation in NS. In QC sales of edible cannabis which is appeal to children and vaping products are prohibited, there is no such prohibition for edible cannabis in NS and rest of Canadian provinces.

In contrast, both before and after the passage of the CA2, Quebec had lower rates of cannabis usage in the previous three months than other provinces. (10.1 percent in the first quarter of 2018 and 11% in the first quarter of 2019) (Rotermann, 2019a). Similarly, in 2020, 10.6% of Quebecers reported using cannabis in the previous three months, compared to approximately a quarter of people in Nova Scotia (NS) at the time (Government of Canada, 2021). Contrary to other provinces, Quebec may have lower rates of cannabis use due to its restrictive cannabis laws. For example,

Cannabis use also changed within provinces before and after the enactment of cannabis act and second amendment. For example, in ON and BC, findings from regression analysis [namely AOR] found that cannabis consumption in 2020 was greater than in 2018 and 2019 after controlling for differences in other covariates. In accordance with the

finding from the present study, the literature demonstrated that use of cannabis increased after Cannabis Act in BC and ON compared with pre-legalization (Bayrampour & Asim, 2021; Government of Canada, 2021; Zuckermann et al., 2021b).

Based on the sociodemographic characteristics of the consumers, cannabis use was found to vary across a range of factors. Cannabis usage was more common among males between the ages of 15 and 44, divorcees, those with poor mental and general health, and those with low education attainment. The findings of other investigations are consistent with these results (Keethakumar et al., 2021, Sikorski et al., 2021, Bayrampour & Asim, 2021,; Yousufzai et al., 2022; Nguyen & Mital, 2022; Reece & Hulse, 2019). For instance, Sikorski and colleagues found that cannabis usage was most prevalent among Canadian teenagers and young adults, with 36% and 44% of those aged 16 to 19 and 20 to 24 reporting using the drug in the previous year, respectively (Sikorski et al., 2021). According to other studies (Government of Canada, 2021; Yousufzai), men use cannabis more frequently than women do, particularly when smoking and vaping it. Another study found that among Canadian youth between the ages of 18 and 24 who had used cannabis during the previous three months, the prevalence was 28.1%, 34.8%, and 35.6% in the years 2018, 2019, and 2020, respectively (Government of Canada, 2021). As a result of this study, it was also shown that frequent cannabis usage was substantially correlated with poor mental health. Based on our findings, huge disparities exist in the cannabis use among Canadians that need to be accounted in designing and implementing preventive and treatment strategies, as well as, in legalization of cannabis products.

Our findings revealed that cannabis consumption modes changed over time. In other words, after controlling for some confounders such as age, gender, mental and

general health status, education level and marital status the administrative use of cannabis through edibles has reduced since the passing of the cannabis legislation. The edibles form of cannabis administration was significantly lower after CA2 than it was before (Beta-coefficient 2019 vs 2020=0.36 p=0.001). Also, the current study showed that alternative cannabis consumption methods, such as smoking and vaping, decreased after CA2. The results of the current investigation are reflected in earlier publications. For instance, study used NCS data indicated that percentage of consumed cannabis in food or drink increased from 13.2% in 2019 to 18.6% in 2020 and while use of smoking as a way of consuming cannabis was 65.3% in 2018 and 58.3% in 2020(Government of Canada, 2021) . Comparing pre-legalization to post-legalization, a study indicated that emerging adults used more cannabis on average and more frequently while they were vaping and smoking it (Yousufzai et al., 2022). As a result, the heterogeneity of results between our study and the aforementioned study may have been caused by the fact that the assigned outcomes were different from the current study. In our research, I did not measure the average frequency of cannabis usage.

Our research also showed that provincial variations exist in cannabis administration methods. While cannabis users in BC used vaped products more than users in other provinces as a main way of cannabis use in NL and NS cannabis consumers used vaped products less than other provinces. Route of cannabis administration also varied within provinces before and after cannabis legalization and amendment. For instance, smoking as mode of cannabis use was higher in 2018 vs 2020 in AB (OR =2.72 CI=1.14-6.45). likewise, in ON smoking as administrative route of cannabis reduced after CA2 compared before that (OR 2018 VS 2019=2.24, ci=1.03-4.83). This may explain the lack of studies

about modes of cannabis use between and within Canadian provinces and calls for future investigations in this field. Moreover, although smoking still is dominant mode of cannabis use, other modes of consumption such as edibles are becoming more popular over time. These findings are in line with previous studies (e.g. Rubin-Kahana et al., 2022; Sikorski et al., 2021). In general, future regulatory actions and studies should consider other modes of cannabis consumption when designing and implementing laws/studies.

Our research showed that the non-medical usage of cannabis changed over time. That is, compared to before the passage of the cannabis act and CA2 (2020), the use of cannabis for recreational purposes rose (2018). This outcome is comparable with Canadian cannabis survey data, which revealed an increase in cannabis use among Canadian young people (20–24 years old) over the previous year, with prevalence growing from 44% in 2018 to 52% in 2020. (Rubin-Kahana et al., 2022). The prevalence of cannabis usage for non-medical purposes increased following the cannabis act and CA2 compared to before, according to a study done by Health Canada (Health Canada, 2022) Similarly, since legalization, the prevalence of non-medical cannabis usage among young adults in Washington has doubled (Kilmer et al., 2022). Use of non-medical cannabis use also varied within provinces before and after passing cannabis Act and CA2. For instance, in ON and BC use of cannabis for non-medical purposes raised after legalization cannabis and CA2. There is paucity of research regarding non-medical cannabis use within provinces before and after CA2 and Amendment in Canada and beyond.

I also found that source of cannabis has changed as a result of the cannabis Act and CA2. As a result, our research showed that after the passage of the cannabis Act and Amendment, fewer people obtained cannabis via illegal, family, or friend sources.

Following cannabis legalization and amendment, more people are obtaining cannabis from legitimate sources. These findings are consistent with earlier literature (Amlung & MacKillop, 2018; Goodman et al., 2022; Government of Canada, 2020; Nguyen & Mital, 2022). According to a different survey, 51.3% of cannabis users obtained their supply illegally in 2018, that proportion fell to 35.4% in 2020. (Government of Canada, 2021). Moreover, the percentage of people who obtained cannabis through family or friends fell from 47% to 28.6% in 2018 and 2020, respectively (Government of Canada, 2021).

For instance, in New Brunswick, the prevalence of obtaining cannabis from a legal source went from 35% in 2018 to 82.5% in 2020. Also, while the prevalence of purchasing cannabis from legal sources was higher in BC than in other provinces in 2018, it was higher in PEI than in other provinces in 2020. Our research also revealed that Quebec had a smaller percentage of residents who obtained cannabis from legal sources in 2018 and 2020 than other provinces. After the Cannabis Act and CA2, most of the provinces saw an increase in the amount of cannabis obtained from legal sources compared to before that (2018 vs 2020). On the other hand, in AB and NS getting cannabis from illegal sources reduced after cannabis Act and Amendment. Our finding is in line with other studies (Rotermann, 2020b). A previous study indicated that getting cannabis from legal source have increased over time and cannabis sources varied provincially so that with a lower likelihood of legal sourcing in Québec of products whose legal sale was restricted (e.g., edibles) (Wadsworth et al., 2023).

Our study found that the consumption of various cannabis products altered both before and after the Cannabis Act and Amendment. This result is consistent with earlier literature (Goodman et al., 2020; Government of Canada, 2021). One study, for example,

found that the consumption of edible cannabis climbed from 43% in 2018 to 48% in 2019 and 53% in 2020. (Hall et al., 2023). Also, according to current data, users' consumption of dried flowers decreased dramatically from 90.77% in 2019 to 85.62% in 2020. While dried flowers were still the most popular product type before and after the Cannabis Act, a different survey found that the percentage of dried flowers fell over time while the use of edible cannabis climbed dramatically. Our research also showed that after the Cannabis Act and Amendment (2020), use of cannabis solid concentrated and cannabis hashish decreased compared to before that (2018). In contrast to this finding, another study revealed that between 2018 and 2020, hashish and cannabis solid concentrate use remained steady (Hammond et al., 2022). It is likely that utilizing multiple data sources and methodologies led to a variety of findings. For instance, while Hammond employed the International Cannabis Policy Study (ICPS) and Nielsen Consumer Insights Global Panel to collect data from respondents and estimate past 12-month cannabis usage in their research, I used the NCS and past three-month cannabis use in our study.

Also, I found that usage of cannabis products varied by province. After the cannabis policy and CA2, QC and SK had lower edible cannabis use rates than other provinces. Before and after the cannabis act and amendment, hashish use was also more prevalent in Nova Scotia than in other provinces. Following the cannabis Act and CA2, QC and SK had lesser use of cannabis solid concentrated than other provinces. The consumption of cannabis liquid non-concentrated also grew after the Cannabis Act and Amendment were passed in most provinces, except for NL. Studies on the various cannabis products available throughout Canadian provinces are lacking. According to a study, the use of edible cannabis was higher in NB and lower in SK and QC in 2021. (Government Of Canada,

2023 Our research also revealed that the use of various cannabis products, including topical cannabis, was higher in BC and lower in NB and QC. These findings are consistent with prior research (Government of Canada, 2023). It is probable that the more restrictive cannabis policy in QC and SK, particularly for edible and liquid goods, are what caused the lower rate of cannabis products in those states. More specifically, Quebec chose the public model for retail distribution, did not allow the cultivation of cannabis plants, and set a possession limit of 15 grammes. Legal edibles are also limited to products that do not appeal to children and have THC limits of 5 mg per unit and 30% for all other cannabis products.

In conclusion, this study identified some similarities and differences in cannabis use and its characteristics compared to the previously published literature. Overall, our findings underscore the importance of considering the province-level differences in cannabis use and its characteristics in CA and calls for consistent monitoring of cannabis use among Canadians. Though it is not possible to state that differences in policies across provinces led to differences in use across provinces over time, it seems likely that policy differences did play some role. In addition, our findings inform development and implementation of cannabis related regulatory actions as well as provides critical information about existing disparities in cannabis use and related features [e.g., mode of consumption]. Future studies are warranted to consider both medical and recreational cannabis use and how past and ongoing laws can affect its use.

Strengths and limitations:

Several strengths should be noted. First, data were collected prior to the Cannabis Act's passage, shortly after, and again following changes to the act that made it possible for a wider range of products to be developed and sold legally, which is one of the study's many advantages. Second, our study assesses not only cannabis use in the past three months but also characteristics related to this consumption. Third, I assessed cannabis use within and between provinces over time which has important province-specific policy implications. Next, to ensure that the analyses were representative of the Canadian population, survey sampling weights were used.

Some limitations should be noted. First, although households with residents aged 15 or older are the NCS's target demographic, residents of institutions, the homeless, and those who reside on indigenous reserves are not included. Second, NCS data is self-reported and are prone to recall biases or reporting bias which may be originated from social desirability bias particularly before cannabis legalization. Third, fear of punishment and social desirability, both of which have the potential to be biased factors, may be particularly pertinent to this analysis. Moreover, our study did not include data for reasons for cannabis use and mode of consumption for the first three quarters of 2018 since NCS did not collect these data at the given time. Next, although our study includes the fourth quarter of 2020 as post-legalization of cannabis amendment, it is possible that some of the provinces follow the amendment policy later. Finally, causation cannot be inferred from the data because it is cross-sectional in nature.

Conclusion:

This study covers a period of three years, from the time of legalization until one year after the amendment. The use of cannabis experience significant changes within and between CA provinces. The present study revealed that although getting cannabis from legal sources increased after the enactment of CA2, cannabis consumption-especially new products of cannabis and using cannabis for non-medical purposes- increased. The study also indicated that smoking cannabis is still the main mode of cannabis consumption, while the popularity of other routes such as vaping and edibles are on the rise. I also found that cannabis consumption varied within and between provinces. For instance, QC and SK were the lowest and SK was the highest province in terms of using cannabis and ON, BC, and MB use of cannabis increased after Cannabis Legalization and 2Amendment compared Pre-Legalization and Amendment. These changes will have an impact on how cannabis is regulated and how policies are implemented to promote less harmful cannabis use. Processed cannabis products come with both potential benefits and risks, including non-combusted delivery methods and higher THC concentrations from subpar manufacturing practices. Therefore, although the current legalization of edible cannabis, cannabis extract, and cannabis topical set out a framework for cannabis consumption, manufacturing, selling, and marketing, it can also increase the availability of vaporized and edible cannabis products. Likewise, this amendment facilitates cannabis product consumption, bringing some unknown and unique health risks. Taken together, monitoring cannabis use alongside evolving cannabis-specific regulations and how it differs between provinces will be necessary for constant monitoring of policies around these products, updating regulatory

actions based on changes in cannabis use patterns, and last but not least, will be vital to minimizing the harms, especially among young Canadian people.

Appendixes

Appendix 1: Equation for Weighted Variable

WTMP = Population weight variable

YR Weights

$Q1 = \text{SUM}(\text{WTMP})$ # Quarter 1 population for a single year

$Q2 = \text{SUM}(\text{WTMP})$ # Quarter 2 population for a single year

$Q3 = \text{SUM}(\text{WTMP})$ # Quarter 3 population for a single year

$Q4 = \text{SUM}(\text{WTMP})$ # Quarter 4 population for a single year

$P1 = (Q1 + Q2 + Q3 + Q4) / 4$ # Average population for year 2018

$P2 = (Q1 + Q2 + Q3 + Q4) / 4$ # Average population for year 2019

$P3 = (Q4) / 1$ # Average population for year 2020

$P_{\text{bar}} = (P1 + P2 + P3) / 3$ # Average population overall years (2018-2020)

$W1 = (\text{WTMP} / 4) / (P1 / P_{\text{bar}})$ # Rescaled population weights for 2018

$W2 = (\text{WTMP} / 4) / (P2 / P_{\text{bar}})$ # Rescaled population weights for 2019

$W3 = (\text{WTMP} / 1) / (P3 / P_{\text{bar}})$ # Rescaled population weights for 2020

Appendix 2: Rescaling weighted variable for Reason for cannabis use and modes of cannabis use

I rescaled weighted variables according to the two outcomes such as reasons for cannabis use and administrative mode of cannabis use due to lack of data for these outcomes for first three quarters of 2018 year.

YRPT Weights

$Q1 = \text{SUM}(\text{WTMP})$ # Quarter 1 population for a single year

$Q2 = \text{SUM}(\text{WTMP})$ # Quarter 2 population for a single year

$Q3 = \text{SUM}(\text{WTMP})$ # Quarter 3 population for a single year

$Q4 = \text{SUM}(\text{WTMP})$ # Quarter 4 population for a single year

$P1 = (Q1 + Q2 + Q3 + Q4) / 4$ # Average population for year 2018

$P2 = (Q1 + Q2 + Q3 + Q4) / 4$ # Average population for year 2019

$P3 = (Q1 + Q2 + Q3 + Q4) / 4$ # Average population for year 2020

$P_bar = (P1 + P2 + P3) / 3$ # Average population over all years (2018-2020)

$W1 = (\text{WTMP} / 1) / (P1 / P_bar)$ # Rescaled population weights for 2018

$W2 = (\text{WTMP} / 4) / (P2 / P_bar)$ # Rescaled population weights for 2019

$W3 = (\text{WTMP} / 1) / (P3 / P_bar)$ # Rescaled population weights for 2020

Appendix3: Estimate of Different cannabis products' use.

Table 15. Estimate of different cannabis use products' use between each provinces' VS Canada

Cannabis Products	Edible Cannabis			Cannabis Dried Flowers			Hashish Cannabis			Cannabis liquid non-concentrated		
	2018	2019	2020	2018	2019	2020	2018	2019	20120	2018	2019	2020
Provinces												
AB VS Canada	0.13	-0.06	0.77*	0.16	0.09	-0.47*	0.14	-0.52	-0.41	-0.74*	0.28	2.12*
BC VS Canada	0.64*	0.45	1.28*	0.41	0.34	-0.22	-0.17	-0.84	-0.72	-0.33	0.7	2.54*
MB VS Canada	0.87*	0.68*	1.5*	-0.13	-0.2	-0.76*	-0.28	-0.94*	-0.83	-0.36	0.66	2.5*
NB VS Canada	-0.01	-0.2	0.63*	0.44	0.37	-0.19	0.18	-0.48	-0.37	-1.11*	-0.09	1.75*
NL VS Canada	0.18	-0.01	0.82*	0.29	0.22	-0.34	1.03*	0.36	0.47	-5.11*	-4.09*	-2.25*
NS VS Canada	0.54*	0.35	1.18*	0.26	0.18	-0.38	1.2*	0.53	0.65*	-1.35*	-0.33	1.51*
ON VS Canada	0.54	0.35	1.18*	-0.14	-0.22	-0.77*	0.84*	0.18	0.29	-0.72*	0.3	2.14*
PEI VS Canada	0.09	-0.1	0.73*	0.59*	0.51*	-0.05	0.29	-0.38	-0.27	-1.44*	-0.41	1.43*
QC VS Canada	-3.79*	-3.98*	-3.15*	0.34	0.26	-0.3	0.36	-0.3	-0.19	-1.66*	-0.64	1.2*
SA VS Canada	-0.69*	-0.88*	-0.05	0.14	0.07	-0.49*	0.47	-0.2	-0.09	-0.13	0.89*	2.73*

*p<0.05

Table 16. Estimate of Different cannabis products’ use between each province’s vs Canada

Cannabis products	Cannabis liquid Concentrated			Cannabis Solid Concentrated			Cannabis Others			Cannabis Oil Cartridges and Vape pens		
	2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	20120
Provinces	2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	20120
AB VS Canada	0.49	0.54*	0.36	1.58*	1.31*	-0.11	0.22	0.18	0.12	-0.16	-0.23	0.31
BC VS Canada	-0.07	-0.02	-0.19	1.92*	1.65*	0.22	1.19*	1.15*	1.09*	0.38	0.3	0.85*
MB VS Canada	0.33	0.38	0.21	1.03*	0.76*	-0.67*	-0.14	-0.18	-0.24	0.04	-0.04	0.51
NB VS Canada	-0.05	0.	-0.17	1.03*	0.76*	-0.67	-0.84*	-0.88*	-0.93*	-0.31	-0.38	0.16
NL VS Canada	-0.3	-0.26	-0.43	1.21*	0.94*	-0.48	0.03	-0.01	-0.06	-0.37	-0.45	0.09
NS VS Canada	0.45	0.49*	0.32	0.72*	0.45	-0.97*	-0.19	-0.23	-0.29	-0.17	-0.25	0.3
ON VS Canada	-0.15	-0.1	-0.27	0.56	0.3	-1.13*	0.35	0.31	0.25	0.45	0.37	0.91*
PE VS Canada	0.08	0.13	-0.04	0.88	0.61	-0.81	0.1	0.06	0.01	-0.61	-0.69	-0.14
QC VS Canada	-0.24	-0.19	-0.36	0.41	0.14	-1.28*	-0.92	-0.96*	-1.01*	-0.55	-0.63	-0.09
SA VS Canada	-0.29	-0.24	-0.41	-2.8*	-3.07*	-4.5*	0.66*	0.62*	0.56	0.01	-0.07	0.48

*P<0.05

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California. *Addictive Behaviors Reports*, 15, 100416.
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Yousufzai, S. J., Cole, A. G., Nonoyama, M., & Barakat, C. (2022). Changes in Cannabis Consumption Among Emerging Adults in Relation to Policy and Public Health Developments. *Substance Use & Misuse*, 57(5), 730–741.
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Zipursky, J. S., Bogler, O. D., & Stall, N. M. (2020). Edible cannabis. *CMAJ: Canadian Medical Association Journal*, 192(7), E162. <https://doi.org/10.1503/cmaj.191305>

Zuckermann, A. M. E., Battista, K. V., Bélanger, R. E., Haddad, S., Butler, A., Costello, M. J., & Leatherdale, S. T. (2021a). Trends in youth cannabis use across cannabis legalization: Data from the COMPASS prospective cohort study. *Preventive Medicine Reports*, 22, 101351. <https://doi.org/10.1016/j.pmedr.2021.101351>

Curriculum Vitae

EDUCATION

2021- Ongoing

Master of Applied Health Service Research.
Department of Health and Nursing
University of New Brunswick, Fredericton, NB,
Canada
Thesis Title: Provinces Specific and Factors
Associated with Cannabis Use Across Canada
Before and After the Cannabis Act.2
Amendment.
Current GPA: 3.75

2009 –2013

Master of Epidemiology
Department of Health
Tehran University of Medical Sciences, Tehran,
Iran. **GPA: 3.5**
Thesis Topic: Assessing Causes and Rates of
Mortalities among the Population of Tehran
during 2005-2009

2004 –2008

Bachelor of Nursing
Department of Nursing
Tabriz University of Medical Sciences, Tehran,
Iran. **GPA: 3.6**

Professional Experiences

2021-2023

Mental Health Staff
New Brunswick Community Residence
Fredericton, NB, Canada.

2015 – 2021

Mental Health Nurse and Epidemiologist
Razi psychiatric Hospitals

Duties:

- Collaboration in Behavioral and mental health researches
- Teaching Infections Principles and Controls to hospital staff
- General Mental Health Nursing Duties
- Teaching physical exercises to patients (Futsal plays and Jogging)

Tabriz University of Medical Sciences, Tabriz, Iran.

2019 – 2020

Emergency Medical Technician

Duties: Handling Emergency Medical Situations

Medical Emergency Center, Tabriz, Iran.

2018 –2019

Position: Instructor

Duties: Teaching Principles of Epidemiology, Geographical Distribution of Diseases in Iran

Sarab University of Medical Science, Sarab, Iran.

2015 –2016

Position: Teacher

Duty: Teaching Principles of Epidemiology, Biostatistics, Community Health

Bonab University of Medical Sciences, Bonab, Iran

HONORS & AWARDS

2018

The excellent teacher in the field of Epidemiology

Sarab University of Medical Sciences
Sarab, Iran.

2017

The excellent teacher in the field of Epidemiology

Bonab University of Medical Sciences
Bonab, Iran

PUBLICATIONS

ARTICLES

- 1 1.Fatemeh Dehghan Firuzabadi, Mahsa Hajizadeh, Forough Yazdanian, Farima kahe, **Ghader Dargahi**, .Olfactory Recovery Time Evaluation of COVID-19: A Systematic Review and Meta-Analysis. Otolaryngology- Head and Neck Surgery. Under review.
- 2 Hanieh Beyrampour-Basmenj; Morteza Milani; abbas ebrahimi kalan; Ziyad Ben Taleb; Kenneth D Ward;**Ghader Dargahi** Abbasabad; Zeynab Aliyari-Serej; Mohammad Ebrahimi Kalan Corresponding author: Dr Abbas ebrahimi kalan. An overview of the Epidemiologic, Diagnostic and Treatment approaches of COVID-19: What do we know? Public Health Reviews. Public health rev, 17 June 2021. <https://doi.org/10.3389/phrs.2021.1604061>
- 3 Ehsan Sarbazi 1 Mohamadreza Sarbazi Saber Ghaffari-fam Towhid Babazadeh Sohrab Heidari KhadijehAghakarimi Ismail Jamal Ali Sherini 5 Javad Babaie **Ghader Dargahi** . Factors Related to Delay In Initiating Post-Exposure Prophylaxis For Rabies Prevention Among Animal Bite Victims: A CrossSectional Study in Northwest of Iran. Bull Emerg Trauma 2020;8(4):236-242
- 4 Herizchi S, **Dargahi Abbasabad Gh**, Delnavaz P, Torkmandi H, Dezhampoor S,Roshanas B,Modaber R,Abdi M. Factors Involving in the Substance Abuse among Medical Students and its Association with medical students' general health: mixed-method study. Preventive Care in Nursing & Midwifery Journa2020; 10(1): 1-8
- 5 Saber Gaffari-fam; Yosef Lotfi; Amin Daemi; Towhid Babazadeh; Ehsan Sarbazi; **Ghader DargahiAbbasabad**, Hamed Abri. Impact of health literacy and self-care behaviors on health-related quality of life in Iranians with type 2 diabetes: a cross-sectional study" (HQLO-D-20-00230R2).Health and Quality ofLife Outcomes
- 6 S. Ghaffari-fam, E. Sarbazi, F. Ardabili, T. Babazadeh, **G. Dargahi**, H. Jafaralilou; (2020, May-June), The role of Health Literacy in Hypertension Control: a cross-sectional study in Iran, Annali di Igiene, (ISSN 1120-9135) 2020, Vol. 32, issue 3
- 7 Saber Ghaffari-fam; Kamiar Kouzekanani; Towhid Babazadeh; Hossein Ali Nikbakht; **Ghader Dargahi**;Khalil Maleki "Assessing the Link between Head Lice Infestation and Selected Cognitive-Behavioral Factors in Sample of Iranian Female Adolescents . Journal of Heliyon. <https://doi.org/10.1016/j.heliyon.2020.e03959>.
- 8 Ranjbar, Fatemeh , Moazeni, Farzad , Abdi, mohammad , khoshnou, Hasan , khademi, elmira , **DargahiAbbasabad**, **Ghader**‡. Spatial Memory and Polycystic Ovary Syndrome. Iranian Journal of Obstetrics, Gynecology and Infertility. IJOGI, Vol. 23, No. 5, pp. 1-9,July2020
- 9 Naser Derakhshani, **Ghader Dargahi**, Hojat Gharaee, Shabnam Vahedi, Nima Pourgolam. Barriers andfacilitators of road traffic injuries prevention in Iran: a qualitative study. Injury and violence.Volume 11, Suppl. 2 July 2019 Publisher: Kermanshah University of Medical Sciences URL: <http://www.jivresearch.org>.

- 10 Naser Derakhshani, , Ramin Rezapour, **Ghader Darghahi**, Mehdi Nikoomanesh, Hojat Gharaeed. Comparative study of stewardship of Road traffic injuries prevention with a focus on the role of health system: Three pioneer countries and three similar to Iran. Volume 11, Suppl. 2 July 2019 Publisher: Kermanshah University of Medical Sciences
[URL: http://www.jivresearch.org](http://www.jivresearch.org).
- 11 **Dargahi Abbasabad, G.**; Banan Khojasteh, S.M.; Eskandari Naji, H.; Zamani, M.; Hajipour H.; Serati Nouri, H.; (2018). Interleukin-6 Single Nucleotide Polymorphism and Susceptibility to the Prostate Adenocarcinoma and its Bone Metastasis in an Iranian Population. *Asia Pacific Journal of Cancer Prevention*. 19 (6), 1717-1720
- 12 Javan, M.; Zamani, M.; Aslani, S.; **Dargahi Abbasabad, G.**; Beirami Khalaj, M.; Serati Nouri, H.; (2017). Cytokine Modulatory Effects Of Sesamum Indicium Seeds Oil Ameliorate Mice with Experimental Autoimmune Encephalomyelitis. *Archives of Asthma, Allergy and Immunology* 2017; 1: 086-093
- 13 Somi, M.; Hajipour, B.; **Dargahi Abbasabad, G.**; Hemmati, M.; Ghabili, K.; Khodadadi, A.; Vatankhah, A.; (2011, Jan-Feb). The Protective Role of Lipoic Acid on Methotrexate Induced Intestinal Damage. *Indian Journal of Gastroenterology* 2010, 30(1):38–40
- 14 **Dargahi Abbasabad, G.**; Karimi, A.; Moradi, G.; Vosoughi Nayyeri, M.; Azarifard, B.; (2012). Study of Demographic Factors on Incidence of Accidents in Heavy Metal Industries between 2001 to 2010: A Study in a Shift Work Rotation System in Iran. ISSN 2090-4304 *Journal of Basic and Applied Scientific Research*, TextRoad Publication. J. Basic. Appl. Sci. Res., 2(7)6392-6396.
- 15 Vosoughi Nayyeri, M.; Asgari, M.; Jahed, G.; **Dargahi Abbasabad, G.**; Golestanifar, H.; Parastar, S.; (2012, June). Investigation of Knowledge and Attitudes of Students in Tehran University of Medical Sciences on Health Actions in Emergencies. *Scientific Journal of Rescue & Relief*. 4 years. Issue 2 (local journal) 2012. Volume 4
- 16 **Dargahi Abbasabad, G.**; Rahmani, A.; Sattarzadeh, N.; Ebrahimi, H.; Hajipour, B.; Karimi, A.; (2014, February). Attitudes toward Surrogacy amongst Iranian Fertile and Infertile Women in 2005. *Archives Des Sciences Journal* (ISSN: 1661-464X), Vol. 3(1) pp. 005-011.
- 17 Rastegar-Kashkouli, A., Jafari, M., Karami, S., Yousefi, P., Taravati, A. M., Khavaran, A., Rastegar, D., Jafari, M. R., Alemohammad, S. Y., **Abbasabad, G. D.**, Shahbaz, M., & Kalan, M. E. (2023). Association between type 2 diabetes mellitus and multiple myeloma: Fact or fiction. *Journal of Nephro pharmacology*, 12(2), Article 2.
<https://doi.org/10.34172/npj.2023.10604>

- 18 Mohammad Ebrahimi Kalan, Rime Jebai, Wei Li, Prem Gautam, Seyedeh Yasaman Alemohammad, Zeinab Mortazavizadeh, Kenneth Ward, Aditya Chakraborty, **Ghader Dargahi Abbasabad**, Raed Behaleh, Zoran Bursac, Ziyad Ben Taleb. COVID-19 and tobacco products use among US adults, 2021 National Health Interview Survey. <https://www.authorea.com/doi/full/10.22541/au.168240604.47901324>.

CONFERENCES PRESENTATIONS & POSTERS

- Dargahi Abbasabad, G.; Derakhshani, N.; Direct Estimation of Life Expectancy in Tehran Population at 2008. The first student festival Journal of health science in country. 2015. Mazandaran, Iran.
- Dargahi Abbasabad, G.; Derakhshani, N.; Eshtiagh, B.; The study of knowledge and attitude of Hospital managers to strategic planning in 2013 at the Gazvin University of Medical Science Hospitals. International Conference on Management, Accounting and Economic Sciences on Kish Island. 2015. Kish, Iran.

PROFESSIONAL CERTIFICATES

- Online PRIMORE Masterclass Interprofessional PC (primary care) Research European Forum for Primary Care (EFPC). September 27-29, 2020.
- R and Stata Software Workshop, Tabriz University of Medical Sciences, May 2017, Tabriz, Iran.
- Emergency Medical Care, Alborz University of Medical Sciences, Dec 2012, Alborz, Iran.
- First period of summer course in teaching epidemiology and research methods with focus on Meta-analysis and systematic review, MSc-PhD level, Pasteur Institute, Sep 2011, Tehran, Iran
- Geographical information system Workshop, MSc-PhD level, Pasteur Institute, Jul 2010, Tehran, Iran
- Research Method in medical science, Iran University of Medical Sciences, Nov 2009, Tehran, Iran.

Research Interest

Mental health, Substance use disorders, Tobacco, Cancer, Burden of Diseases, Health Policy, Spatial Epidemiology

LANGUAGES

- Persian (Native)
- Azerbaijani (Native)
- English

MEMBERSHIP

**Nov 2018 –
Present**

- Committee of Ethics in Medical Research. Sarab University of Medical Sciences, Sarab, Iran

COMPUTING SKILLS

Software

- STATA
- SAS

General Application

- SPSS
- Epi info
- GIS
- statistics
- Word
- Access
- PowerPoint
- Excel