THE DEVELOPMENT OF A CANNABIS KNOWLEDGE ASSESSMENT TOOL (C-KAT) AND BEHAVIOURAL INTENTION (BI) SCALE

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ABSTRACT

Background: Given the anticipated increase in the use of cannabis due to legalization, there is a need for more cannabis education for the general population. Since youth are particularly vulnerable to the effects of cannabis, new education programs are being implemented in some school curriculums. Evaluative tools are needed to assess cannabis knowledge, understanding and intention for use. Such tools could help determine whether these new cannabis awareness and education programs are effective.

Methods: During the first phase of this study (questionnaire development) a Cannabis Knowledge Assessment Tool (C-KAT) and Behavioural Intention (BI) scale were created through a multistage iterative process. The C-KAT development involved the use of the Delphi method, whereby a purposive sample of healthcare professionals, policymakers, academics, patients who used medical cannabis and teenage students served as the content and development experts. Four rounds of the questionnaire were distributed prior to reaching consensus on the C-KAT content. The BI scale was developed through consultation with six additional educators (with expertise in assessment, questionnaire development and biostatistics) and three students. During phase two of the study (testing), the C-KAT and BI scale were administered as a pre- and post-test in four schools (Grades 7 and 9) in Saskatoon, SK. The data were analysed to determine whether knowledge scores and behavioural intentions of the students changed after participating in a cannabis education program (REACH; Real Education About Cannabis and Health).

Results: The questionnaire was administered to 132 students, of which 73 (55.3%) were in grade 7 and 59 (44.7%) were in grade 9. In total there were 84 (63.6%) females, 46 males (34.8%) and 2 (1.5%) students who identified as "other". The C-KAT scores increased in all students overall, and within each grade, gender, and school ($p < 0.05$) following the REACH program, but the

overall scores for the BI scale had no statistically significant change between pre- and post-test. Follow up could not be obtained with 281 students due to disruption of the study by the COVID-19 pandemic (March 2020).

Conclusion: According to the C-KAT scores, grade 7 and grade 9 students appeared to increase their knowledge about cannabis after participating in the REACH program. However, BI scores with respect to intentions for cannabis use were not impacted. More study is warranted to determine the overall usefulness of the developed questionnaires.

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LIST OF ABBREVIATIONS

2-AG	2-Arachidonoylglycerol
AEA	Anandamide
BI	Behavioural Intention
CB1	Cannabinoid 1 receptors
CB2	Cannabinoid 2 receptors
CBD	Cannabidiol
CBN	Cannabinol
C-KAT	Cannabis Knowledge Assessment Tool
ECS	Endocannabinoid system
FDA	Food and Drug Administration
MRI	Magnetic resonance imagining
MTF	Multiple-True-False
MMAR	Marijuana Medical Access Regulations
MMC	Multiple-Multiple Choice
MMPR	Marijuana for Medical Purposes Regulations
OECD	Organisation for Economic Co-operation and Development
PET	Positron emission tomography
PCA	Principal Component Analysis
PISA	Programme for International Student Assessment
PPAR	Peroxisome proliferator activated receptors
REACH	Real Education About Cannabis and Health
Safe SHIP	Safe School Health Improvement Project
SHINE	School Health Initiative with Nursing Education
SMOG	Statistical Measurement of Gobbledygook
THC	Tetrahydrocannabinol
TRP	Transient receptor potential

1. INTRODUCTION

Cannabis is a psychoactive drug with possible dose-dependent medicinal properties, which were first identified in traditional Eastern medicine around 5000 years ago. [1]Although it has been around for many years, its consumption has been illegal in many parts of the world. In Canada, cannabis used for medicinal purposes was legalized in 2001[1] while adult recreational use of cannabis became legal on October 17, 2018.[2] This legalization presents increased opportunities for research on cannabinoid compounds and their use in various medical conditions. Cannabis is being explored for the treatment of many different medical conditions ranging from seizure disorders and multiple sclerosis[3] to neuropathic pain.[4,5] Given the anticipated increase in the use of cannabis due to legalization[6] it will be important for people to be educated so that it may be used in a safe and informed manner.

In 2016, the UN World Drug Report concluded that cannabis was the most widely used illicit drug within the general population and younger populations worldwide, and cannabis consumption continues to increase.[6] Youth are particularly vulnerable to the adverse effects of cannabis if consumption begins at a young age.[7] Based on the Canadian Addiction Survey and the Canadian Alcohol and Drug Use Monitoring Survey, the age of first consumption of cannabis in youth fluctuated between an average low of 15.5 years and an average high of 16.1 years from 2004 to 2012,[7] and the use of cannabis in Canadian youth is among the highest in the world.[8] Data indicates that the frequency of substance use increases substantially from early adolescence, peaks in early young adulthood and declines throughout adulthood.[9] In 2017, 1 in 5 individuals from the age of 15 to 19 and 1 in 3 individuals from the age of 20-24 reported using cannabis. [8] In 2016 it was reported that 17.6% of postsecondary students had consumed cannabis within the last 30 days.[8]

The recreational use of cannabis is not without risk. A higher frequency of cannabis use in adolescents is associated with increased reports of depression and anxiety later in life.[10] Studies have shown that those who consume cannabis more frequently over long periods of time experience physical, mental health, and cognitive challenges[11,12] while developing tolerance and dependence to the drug.[13] These data highlight the urgent need for increased knowledge and education concerning the use of cannabis.

The Canadian government has faced considerable challenges implementing the legislation of legalized recreational cannabis use. Some of the reasons include various levels of public knowledge, concern for substance abuse in vulnerable populations, and the effects on those with low socioeconomic status.[14,15] While educational interventions exist to address public concerns and prevent youth from cannabis misuse or promote the awareness of both beneficial and adverse effects of the drug,[16–18] these appear to be few and far between. Furthermore, these may be viewed as outdated, as they were created in an era where the consumption of cannabis was illegal. Of the limited educational programs that exist, there appears to be no evaluations of the effectiveness of these interventions in the literature. Evaluative tools are needed to assess cannabis knowledge, understanding and intention for use. Such tools could help determine whether these new cannabis awareness and education programs are effective and to measure baseline knowledge and intent in various populations.

In 2019, the Real Education About Cannabis and Health (REACH) program was developed and implemented in 4 schools in Saskatoon, SK. The intent of this program was to educate school aged children about cannabis so that they can make informed decisions about its use. The purpose of this project was to develop a tool which could evaluate the effectiveness of cannabis educational programs such as this one.

2. OBJECTIVES

Objective 1: Develop a cannabis knowledge assessment tool (C-KAT) through the iterative multistage collection of expert opinions from health care professionals, students, policy makers, patients, and academics involved in this field of research through the use of the Delphi Method.

Objective 2: Develop a behavioural intention (BI) scale through consultation with experts in assessments, questionnaire development and biostatistics.

Objective 3: Determine if the developed questionnaire (C-KAT and BI scale) results in any changes in knowledge or behaviour intent after participation in a cannabis education program.

3. BACKGROUND

The understanding of cannabis in society and in science continues to evolve. Therefore, the perceptions of cannabis risks are continuously changing while the scientific details of the effects of cannabis on the body emerge. As Canada takes a public health approach to the legalization of recreational cannabis, there has been an increase in public awareness campaigns and education programs, especially aimed at youth. One such education program is the Real Education About Cannabis and Health (REACH) program implemented in Saskatoon, Saskatchewan. Initiatives such as REACH must be evaluated to determine the scale of their impact on youth's knowledge of cannabis and healthy approaches to cannabis use. This task can be managed with assessments of knowledge and behavioural intention developed through formal consensus formats such as the Delphi Method.

The following sections will delve into the background of cannabis and approaches to the assessment of knowledge, which will be necessary for the development of the Cannabis Knowledge Assessment Tool and Behavioural Intention Scale.

3.1. Cannabis Throughout the Ages

Cannabis is a plant that has been used for recreational purposes due to its psychoactive effects and as a medicinal drug. Policies and regulations regarding the consumption of cannabis have continuously changed throughout the years and around the world.

The earliest documentation of cannabis use was in the early 3rd Millenia BCE where the plants known as hemp served various purposes.[19] Practically the fibers derived from the plant were used in instrumentation such as rope and clothing. It was also widely consumed in medicines and food and its psychogenic properties were employed in religious and spiritual practices.[20] Cannabis domestication seems to have been first noted 12000 years ago during the early Neolithic period in East Asia where it was cultivated and processed in various forms.[21] Cannabis cultivation was also documented in the Sumerian and Assyrian culture where the plant was often employed as a remedy for bronchitis, bladder infections, rheumatism and insomnia.[22] The wide use of cannabis and its by-products as medicine occurred in central Asia approximately 5000 years ago.[1,23,24] The first use of cannabis as medicine was by Chinese Emperors who passed their teachings down by word of mouth and later in Chinese books of herbal remedies.[25] For example,

various Chinese pharmacopeias documented the use of cannabis in relieving blood clots, tapeworm, and constipation.[25]

Although the specific origins of the use of cannabis remain a mystery, its introduction globally stem from its transition from Persia into Arab culture in 1230 CE and then again to Egypt in 12 CE.[26] During this period of time cannabis was consumed as an edible in a form known as hashish.[26] Use of the plant expanded into Africa and was introduced into Europe by Napoleonic Soldiers enroute from Egypt and then transported to the western hemisphere by colonizers via Chile around 1545.[27]

For years, cannabis has served as a remedy for various ailments including migraines, gout, dandruff, amenorrhea and depression.[28] However, the use of cannabis has been debated and subsequently legislated throughout time. The earliest known legislative action against cannabis is during the medieval period in traditionally Islamic countries, in which its use was punishable by capital punishment.[29] By the 1800s cannabis was banned and criminalized in Egypt and Morocco and later throughout the world, such as the United States, The United Kingdom, New Zealand, South Africa, Canada and Jamaica.[30] Legislations enforced the prohibition of the use, import and export of the plant.[30] One reason for its prohibition was the fear of recreational cannabis leading to increased rates of crime and violence, which motivated the banning of the substance around the 1930s and 1940s.[1] However, in the last few decades interest in the use of medicinal cannabis has once again increased and medicine containing cannabis components or synthetic cannabis are available by prescription in some countries.[31]

Aside from medicinal and agricultural uses, cannabis may also be used in a recreational capacity due to its psychoactive effects. According to the United Nations Office on Drug and Crime, cannabis is currently the most popular recreational drug in the world, and cannabis consumption has continued to increase in the last few decades.[15] Such increases have been shown to be due to a decreased perception of risk associated with cannabis and due to the legalization of cannabis in some parts of the world.[32,33] Individuals aged 15 to 19 and 20 to 24 are the largest demographic for cannabis consumption in most countries, including Canada.[15]

The global increased rates of cannabis use are also in part due to the rapid advances in cannabis cultivation technology in the last two decades, which have increased cannabis production in almost every country.[15] As a result of these new technologies, selective breeding of

the cannabis plants for a more psychoactive experience along with the availability of new modes for cannabis consumption, such as vapes, oral sprays and topical methods, have increased.[34]

3.2. Cannabis and the Endocannabinoid System

Cannabis comes from the genus *Cannabis* in the Cannabaceae family of plants. This family of plants is native to countries with temperate and tropical climates and has several species, including two of the more commonly known species, *Cannabis sativa* and *Cannabis indica*.[24] While cannabis is composed of over 400 known chemicals, the compounds of interest in cannabis research are often the phytocannabinoids. [24] Cannabinoids that are produced in the human body are called endocannabinoids and are ligands for the endocannabinoid system (ECS), and function as signaling molecules on the cannabinoid receptors in the ECS. The two major endocannabinoids are anandamide (AEA) and 2-Arachidonoylglycerol (2-AG).[35] Although other peptides and arachidonic acid derivatives that interact with the ECS continue to be discovered, AEA and 2-AG remain the most studied.[35] When phytocannabinoids are ingested they have an effect on the ECS. [36] Currently, synthetic cannabinoids, such as nabilone which mimics THC, are also being developed and researched for their therapeutic uses. [1]

It was not until the 1980s that the location of action of the phytocannabinoids, the cannabinoid receptors (CB1 and CB2), along with endocannabinoids such as AEA and 2-AG, were isolated.[37] CB1 and CB2 differ in their primary protein sequence, signalling mechanisms, tissue distribution along with sensitivity and selectivity for activating and inhibiting compounds.[38] However, both these receptors are part of the G-protein coupled receptor (GPCR) family.[37] Therefore, activation of the cannabinoid receptors inhibits some calcium channels along with adenylyl cyclase while activating protein kinases and some potassium channels.[38,39] As part of the ECS, these receptors facilitate the inhibition of neurotransmitter release through their variety of effects on synaptic function, gene transcription, and cell motility.[38] The endocannabinoids, AEA and 2-AG, function through retrograde signalling. Endocannabinoid synthesis enzymes are present in the postsynaptic terminal of the neuron.[40] Therefore, following their synthesis in the post synaptic terminal, AEA and 2-AG are released and travel through the synaptic cleft to the presynaptic terminal[40] which is the opposite of the common pathway for signal transmission. At the presynaptic terminal, the endocannabinoids act on CB1,[37,39,40] resulting in decreased neurotransmitter release from the presynaptic terminal and therefore synaptic depression. [40]

CB1 is present in low levels in peripheral organs, however it is the most abundant GPCR in the brain.[37] In the rodent brain, CB1 concentrations are highest in the basal ganglia, substantial nigra, globus pallidus, cerebellum, and hippocampus which are sensory and motor regions.[37] As a result, CB1 is involved in cognition, memory reward, pain perception, and motor coordination.[36] CB1 is present from embryonic stages therefore indicating its importance in neural development. However, the distribution and abundance of CB1 changes throughout development. In the neonatal brain, CB1 is mostly present in white matter but this decreases later in life and the overall concentration of receptors increases from adolescence to adulthood.[41] While DNA variants can result in CB1 gene polymorphisms, the importance of these variations of the receptor are not yet established and may involve predisposition to addiction or cannabis dependence[35,42] and neuropsychiatric conditions.[42] The structural changes of CB1 and CB1 variations during activator binding continue to be studied to determine the signalling process along with pharmacological and physiological properties of the receptor.[35]

CB2 is more commonly distributed in the immune and gastrointestinal system[20] and is also present throughout the central nervous system (CNS), such as in microglial cells, but is not as abundant as CB1 in this region.[37] The expression of CB2 has been shown to increase under some pathological conditions, such as nerve injury, and is therefore considered a protective system.[37,40] Following tissue injury and/or inflammation, CB2 expression can increase up to 100-fold.[40] As a result, CB2 and synthetic CB2-specific activators are widely studied for clinical use.[37] Although a link has been made between CB2 and increased schizophrenia risk,[43,44] uncertainty remains regarding which type of CB2 is involved in this link.[40] While the two major cannabinoid receptors in the ECS are CB1 and CB2, transient receptor potential (TRP) channels and peroxisome proliferator activated receptors (PPARs) can also be activated by the phyto- and endocannabinoids.[1,40]

The main phytocannabinoids known thus far include delta-9-tetrahydrocannabinol (THC), cannabidiol (CBD) and cannabinol (CBN). The primary psychoactive component of cannabis, THC, was first isolated from the cannabis plant in 1964[45] and then later synthesized for use in research in 1967.[46] THC binds to ECS receptors in the central and peripheral nervous system to modulate neurotransmitter release similar to the endocannabinoid ligand, AEA. Therefore, THC is termed a mimetic phytocannabinoid for AEA.[47] Acute pharmacological effects of THC due to binding and activation of CB1[1] include euphoria, relaxation, perceptual alterations, increased

appetite, time distortion, anxiety and panic, impaired attention and memory, an increased risk of psychotic symptoms, disorientation, and psychomotor effects.[48] Additionally, it has been noted THC under prolonged storage will breakdown to CBN, therefore the ratio of CBN to THC can be used to determine the age of cannabis samples.[49]

CBD was one of the first cannabinoids to be isolated in the 1930s, however as CBD does not have the psychoactive effects of THC there was limited initial research interest in CBD.[37] CBD functions as the mimetic phytocannabinoid for 2-AG and has been observed to enhance learning while exerting antipsychotic, anti-inflammatory and anti-anxiety effects.[50] However, CBD reduces the reuptake of AEA, thus antagonizing the side effects of THC such as anxiety, sedation and tachycardia.[1,50] Both THC and CBD have been noted to have analgesic effects;[1] however, it has been shown that THC's analgesic activity is a result of its activation of CB1 while CBD's analgesic effects results from its binding of pain-mediating proteins such as TRP channels and anti-inflammatory mechanisms at injury sites.[1] While there are over 100 cannabinoids in cannabis, including CBN, due to THC's psychoactive properties and CBD's anti-inflammatory properties, these two cannabinoids are currently the focus of most research.

Since THC and CBD exert different actions, the ratio of each of these cannabinoids in cannabis products can result in different effects on the user. For example, Karniol et al.[9] performed a double-blind study in which 40 healthy male volunteers were given different concentrations and combinations of the cannabinoids. The experimental groups included 30 mg of THC, 15, 30 or 60 mg of CBD or mixtures of 30mg of THC with either 15, 30 or 60 mg of CBD. The group ingesting 30 mg of only THC demonstrated increased pulse rates, decreased motor function and intense psychological reactions. The group taking different concentrations of CBD without THC experienced no effects in the abovementioned parameters; however, CBD was successful in blocking these negative effects of THC when combined and helped reduce the anxiety associated with THC.[9] Furthermore, different cannabis plants contain varying ratios of THC and CBD due to the strain type of the plant, along with environmental and harvesting conditions such as cultivation, storage and age at time of harvest. For example, the *Indica* strains of cannabis have a greater ratio of CBD content than THC, while *Sativa* strains have a higher THC content than CBD.[36,51] Also, hemp that is used for industrial products, such as textiles, has been regulated to contain less than 0.3% THC while cannabis in the 1960s contained around 2%

to 3% THC.[37] However, newly developed and often unregulated strains of cannabis may contain up to 25% THC.[37]

3.3. Medicinal Use of Cannabis

Understanding the components of cannabis and their functions in the endocannabinoid system allows researchers to explore the use of cannabinoids in medicine and create synthetic drugs that mimic cannabinoids for beneficial medicinal purposes. The implementation of laws and sanctions were developed by each country that legalized cannabis for medicinal use. The legalization of medicinal cannabis in Canada occurred in 2001[1] and will be explored in this section along with an overview of current medicinal cannabis uses.

3.3.1. Legislative Actions Related to Medicinal Use of Cannabis

Prior to legalization, public opinion in Canada had been in favour of cannabis decriminalization. Over half (51%) of those polled in 1997 supported the sentiment while 71% of Canadians were in favour of the use of cannabis for medicinal purposes.[52] The legalization of medicinal cannabis, which occurred in 2001, resulted in the creation of the Marijuana Medical Access Regulations (MMAR), which entitled specific individuals to access the dried cannabis in a medicinal capacity.[1] The MMAR allowed patients to apply for access to Health Canada's supply of dried cannabis through authorization from their health care practitioner, and/or apply for personal-use production licensing.[1] In 2014, MMAR was transitioned into the Marijuana for Medical Purposes Regulations (MMPR) as Canadian officials created conditions for cannabis to be produced and distributed in a commercial capacity by licensed producers.[1] Following the implementation of MMPR, patients with appropriate authorization from their physician could access dried cannabis for medicinal purposes by submitting their documentation to a Health Canada-approved licensed producer of cannabis.[1] Physician authorization documents are equivalent to a prescription and specify the specific strain and THC content of the product, when necessary, along with patient information and daily intake specifications.[1] As cannabis was treated like a narcotic under the MMPR, it was recommended that physicians use patient-physician agreements, informed consent and frequent follow-ups when recommending medicinal cannabis.[1]

In 2015, the restriction of medical cannabis to dried products was lifted and those with medical need were provided access to other cannabis products such as cannabis oil, fresh plant buds and leaves along with dried cannabis. [53] However, medical users found that they did not

have reasonable access to the drug they required due to commercial restrictions and in 2016 the Access to Cannabis for Medical Purposes Regulations (ACMPR) replaced the MMPR. [53] The ACMPR provided a framework for safe and sanitary commercial production by licensed producers. It also allowed licensed producers to sell cannabis plant seeds which allows individuals to produce their own cannabis plants for medicinal use. [53]

Since implementation of the *Cannabis Act* for recreational cannabis use in 2018, the regulations surrounding medicinal cannabis have also changed and replaced the ACMPR.[54] Along with buying from licensed sellers or registering to grow their own cannabis plant for medicinal purposes, patients are also able to purchase the drug at authorized retail outlets and online sales platforms, permitting of legal age limits and provincial policies.[54] These changes have greatly increased access for medical users.

3.3.2. Cannabis as Medical Treatment

Initially the MMPR only permitted dried cannabis goods to be accessed. However, regulations continued to evolve to provide sufficient avenues for accessing cannabis products in different available forms.[1] The ideal route of administration of medicinal cannabis depends on the ailment that is being targeted and the preferred method of the patient. Cannabis can be consumed through variety of routes, including smoking, vaporization, oral or sublingual ingestion. Often, medicinal cannabis smoke is not preferred due to the concerns of carcinogenic chemicals, but vaporization, oral ingestion or sublingual tinctures are also available.[1] For those with respiratory illness, oral ingestion methods of cannabis such as oils and edibles are preferred. There is, however, an increased latency of effect with this method, which may lead to some patients readminister a repeat dose too early.[1] Currently, inhalation methods such as smoking and vaporization are the most frequently used method of medicinal cannabis consumption.[1] Less frequently used methods include transdermal ointments, ophthalmic drops and rectal suppositories.[1] Further research is required to determine the use and therapeutic benefit of these routes of administration, as this is currently unknown.

Although cannabis has been used in traditional medicine and religious ceremonies for many centuries in countries such as China and India, its use in western medicine practices only started to be explored in the 19th century.[1,50] By the late 19th century, medicinal cannabis was widely accepted for a variety of conditions, especially pain.[1] With evidence for the clinical uses of cannabis continuing to emerge,[1] some cannabis-based medications have been approved for

clinical use. In 2005, Canada approved Sativex (nabiximols) for multiple sclerosis.[1,23] Sativex is a sublingual spray that contains THC and CBD.[23] Since its approval, Sativex has become available in more than 27 countries[23] and its use is also being investigated for fibromyalgia.[1] In 2018, the United States Food and Drug Administration (FDA) approved the use of Epidiolex, which is an oral solution of pure CBD for the treatment of epileptic seizures.[55] Epidiolex has been researched in controlled trials in youth with epilepsy and has been found to be tolerable for patients while significantly improving motor seizures.[56] Other FDA approved medications containing cannabinoids include dronabinol and nabilone, which are often prescribed as antiemetic medication for cancer chemotherapy,[57,58]and appetite stimulation for patients, such as those with HIV,[3] anorexia, or ALS.[59,60] Nabilone has been found to increase quality of life and decrease pain severity in patients with therapy-resistant chronic pain when administered in conjunction with current therapies.[61] Patients with fibromyalgia experienced improvements in pain management and quality of life following nabilone use.[61] Furthermore, orally administered cannabis extract has been found to reduce the frequency of muscle spasms and thereby increasing motility in patients affected by multiple sclerosis.[3,59]A large study in 2015 showed that a majority of patients with fibromyalgia, arthritis and neuropathic pain reported substantial or complete relief from their pain with the use of cannabis.[62] These patients also reported being able to decrease their intake of other medications, including opioids.[62]

In 2004, around 4% of Canadians over the age of 14 indicated using cannabis once or more in the past year to self-treat a medical condition.[1] While medicinal cannabis programs show that 0.68 to 1.5g of cannabis are used per day by medical users, patient self-reports in Canada show up to 10g being used per day and 40% use more than 14g per week.[1] Therefore, the self-reported amount of consumption may far exceed the typical amount recommended medically. Several individuals in Canada (including some youth), continue to self-medicate without an authorization.

3.4. Legalization of Recreational Cannabis

Although medical cannabis use has been legal in Canada for around two decades,[1] the recreational use of cannabis continued to have an illicit status until the implementation of the *Cannabis Act*, on October 17th, 2018.[2] Worldwide, Canada is the second country, (following Uruguay in 2015), and the first country in North America to legalize recreational cannabis consumption on a federal level.[64] While peer-reviewed research was limited prior to the creation

of the *Cannabis Act*,[64] the legalization of cannabis has since allowed for increased areas of cannabis research,[54] including studies on the impact of recreational legalization on medical users, changes in societal perceptions of cannabis, use in youth and the short term or long term benefits and consequences of cannabis use. In this section a summary of the *Cannabis Act* is presented, along with the implications of recreational cannabis legalization on the perceptions of cannabis and the use of cannabis in youth and adolescence.

3.4.1. The Cannabis Act

As indicated by the Government of Canada, the purpose of the *Cannabis Act* is to "protect public health and public safety" by specifically restricting access and initiation of cannabis in youth, providing opportunities for legal production of cannabis to decrease illicit production and other illicit activities surrounding cannabis thus reducing the burden on the criminal justice system, to regulate the quality of cannabis supply and increase public education of health risks related to cannabis use. [63]

The *Cannabis Act* ensures that the production, distribution, sale and possession of cannabis in Canada is regulated.[65] Provinces and territories also play a role in regulation, and therefore, there is a lack of consistency in cannabis governance across Canada.[66] Quebec has the oldest legal age of cannabis use at 21 years old while Alberta has the lowest with 18 years old.[67] All other provinces have set the legal age of cannabis use at 19 years old.[67] All provinces have a public possession limit of 30 grams of dried cannabis or equivalent [63, 67] and recreational cannabis must be purchased through licensed cannabis retailers. It is a criminal offense for individuals 18 or over to possess cannabis that they know is from an illegal source and penalties include a fine or imprisonment. [63] However, to protect the well-being of the public and those in distress, no person seeking medical or law enforcement help during a medical emergency for themselves or for someone else at the scene will be charged or convicted if illicit cannabis use is detected. [63]

The provinces and territories in Canada are also responsible for developing their own regulatory framework for the retail of recreational cannabis.[68]As a result, the legal cannabis stores in Canada are government-operated, privately-operated or a mixture of both (hybrid) and can be operated through physical and/or online stores. As of September 2019, private and hybrid retail models accounted for 65% of cannabis sales.[68] From March 2019 to July 2019 there was an 88% increase in the number of cannabis retail stores in Canada, from 217 to 407,[68] and in 2021, a total of 1183 legal cannabis stores were reported.[69] The lowest number of stores per capita is in Quebec

and Ontario and the highest is in Alberta and Yukon.[69] As the number of licensed retail options increase for cannabis purchase, the perceptions and prevalence of recreational cannabis is also expected to change.

3.4.2. Recreational Use

The recreational use of cannabis is often motivated by the psychoactive effects of the substance and the enjoyment of the "high" that this can produce.[70] A study found that medicinal cannabis users who sought cannabis with high THC content were more likely to report also using cannabis recreationally while those seeking high CBD content were less likely.[71] These findings support other studies that report recreational users prefer cannabis with high THC content for the psychoactive effects[72] while CBD is beneficial for medicinal uses and is not preferred by recreational users.[73] A 2016 national survey performed in the United States showed that among those who use medicinal cannabis, 77.5% reported also using cannabis recreationally[74] while another study in 2019 with a smaller sample size reported 55.5% of those using medicinal cannabis also used cannabis recreationally.[71] There rates are higher than the rates of past-month cannabis use among American adults over 18 years old[71] meaning there is greater recreational use in those already using cannabis medically. The route of administration for recreational cannabis can also depend on the desired experience of the "high" for users. For example, psychoactive effects of cannabis have varying onset depending on the route of administration. Smoking, vape, tinctures have a fast onset while edibles will have a delayed effect and topical cannabis has no psychoactive properties.[71]

Although recreational cannabis is often used to enhance wellbeing, there is not much evidence to prove that cannabis use significantly improves quality of life.[70] In fact, in some studies a dose-dependent effect is noted in which the consumption of cannabis beyond an amount can reduce quality of life.[70] While studies have shown that cannabis has a comparatively low effect on quality of life when compared to other substances such as alcohol and tobacco, cannabis may have higher risk of harm in vulnerable populations such as youth and those predisposed to psychotic disorders.[70]

Recreational use can be motivated by a variety of factors, including social, conformity, enhancement, coping, perception changes and mind-expansion effects or simply the intoxication experience.[70] In youth, cannabis is often used for enjoyment and for social connection, but it is also used because of conformity and as a coping mechanism for negative emotions.[75] Among

adolescents, perception of decreased risk is the greatest motivator for increased cannabis use since legalization.[70] Research has shown that recreational legalization of cannabis can result in changes to perceived harm of the substance along with perceived social and legal.[76] In a study by Amroussia et al.,[76] perceived social risk is defined as how an individual believes others will react to them being a cannabis user while perceived legal risk is their belief about the severity of legal consequences of cannabis use. A focus-group study investigating the attitudes, perceptions, and behaviours of young adults toward recreational cannabis use in Nevada following legalization of recreational cannabis. The study found that participants were aware that there were rules and regulations surrounding recreational cannabis purchase and use but most participants had limited or vague knowledge of these regulations. While many of the participants did not believe that the legalization of recreational cannabis effected their use or nonuse, most agreed that legalization has improved perceived social risks of use. Also, recreational legalization was perceived as a harm reduction strategy as it may reduce use of worse substances, allow for better control of cannabis products and use and decreased the presence of drug dealers and negative consequences such as incarceration. In fact, it was found that following cannabis legalization in Canada, there was a 55%-65% decrease in cannabis-related crimes among youth.[77] Robinson et al.,[78] studied Canadian youths' opinions of legalization pre-legalization and post-legalization, and found that the students did not have negative views regarding cannabis legalization and that there was little effect on their perceptions following legalization.

Research on the prevalence of cannabis use following recreational legalization in Canada and other countries has shown mixed results.[66] In some cases, higher prevalence of cannabis use was reported following legalization. For instance, a study by Miech et al.,[79] examined the cannabis-related behaviours of grade 8, 10 and 12 students in California compared to other states prior to and following the legalization of recreational cannabis in California. The study found that two years following the legalization of recreational cannabis, the students in grade 12 were 25% more likely to have used cannabis in the past 30 days, 20% less likely to strongly disapprove of regular cannabis use and 60% more likely to use cannabis in the next five years as compared to those in grade 12 in other states. However, these grade 12 students also showed high acceptance of cannabis prior to the decriminalization of cannabis, therefore these results could be due to cohort effect and the increased media coverage of cannabis in California instead of the decriminalization of cannabis. As a result, the study predicated that this high cannabis acceptance

would not be present in future cohorts as media coverage of cannabis had since decreased. Furthermore, no specific increases in cannabis acceptance were noted in the California grade 8 or 10 students.[79] Similar to the effects of media coverage on this study, other research mentions that the impact of cannabis legalization may be a result of how legalization is implemented instead of the act of legalization itself.[80,81]

Other literature has shown no impact on adolescent cannabis use patterns. For instance, a cross-sectional cohort study examined the cannabis use of two cohorts of high-risk youth in Canada.[66] Through the use of demographic and assessment questionnaires one cohort was evaluated prior to cannabis legalization and the other following legalization.[66] The study found that the rate of cannabis use, multi-substance use, social circles of use and mental health did not change.[66] The high-risk youth who participated in the study included patients enrolled in an outpatient addictions and substance use treatment program. The survey found that youth reported purchasing cannabis from legal sources following legalization and concealment of cannabis use from legal authorities declined for those over 19 years old.[66] While research is still limited following the legalization of recreational cannabis in Canada, some studies have indicated an increased use of cannabis in the general public, while among young adults it has remained the same and has decreased among adolescents.[82] Furthermore, the Ontario Student Drug Use Survey found no increase in prevalence of cannabis use from prior to legalization compared to after among students.[83] Research in Colorado found no changes in cannabis use among adolescents following legalization in the state, however, most participants believed that cannabis has become easier to access.[84]

As most studies on changes in cannabis perception and use have been performed immediately or closely following the recreational legalization, it is uncertain whether the results will be sustained. Therefore, the risk perception, prevalence and acceptance of cannabis use in Canadian youth requires subsequent research for greater understanding of the effects of legalization.

3.5. Potential Adverse Effects of Cannabis

Currently, most of the knowledge about the adverse effects of cannabis use are based on studies of recreational users. Cannabis use may result in long-term and short-term side effects in some individuals. [36] Furthermore, the side-effects that each individual may experience when consuming cannabis can vary[36], as the rate of absorption and metabolism of the cannabinoids or

the tolerance can vary between cannabis users.[58] For instance, chronic activation of CB1 by THC can cause downregulation of CB1 and result in increased tolerance to cannabis[58] along with potentially increasing intake to counteract these effects. The concentration of THC can also influence the intensity and duration of the effects of cannabis use.[58]

The clinical features of the "high" experienced with cannabis include users' enhanced sensitivity to stimuli such as colours and music along with altered perception of time and increased appetite for sweet and fatty foods.[58] However these clinical features of the pleasurable "high" are also associated with dry mouth, decreased short-term memory and impaired motor skills and can include panic attacks, paranoia or hallucinations when THC levels are high.[58] As a result of the impaired motor skills that are associated with acute cannabis use, impaired driving abilities are a public health concern[58], due to risk of trauma and injury from motor vehicle collisions.[85] Also, the increased appetite caused by cannabis use has been associated with weight gain, which can increase the risk of obesity, a major risk factor in many chronic illnesses such as type 2 diabetes mellitus.[58]

Several studies have also shown a dose-dependent link between cannabis use and psychosis.[36,86,87] The risk of adverse effects, including decreased motivation, addiction, cognitive decline and psychoses, are greater in those with onset of use younger than 18, multi-substance use and family history of psychoses.[56] A longitudinal study by Van Os et al.,[88] showed that cannabis use increased the prognosis of psychosis in those with a family history or predisposition for psychotic disorder; however, cannabis use also increased the incidence of psychosis in those without a predisposition. In addition to increasing risk of psychotic disorders, cannabis use has also been associated with anxiety disorders and suicidal ideations.[85]

Various physical, mental, behavioural and social health consequences have been delineated in correlation to long-term cannabinoid exposure, including symptoms caused by dependency to the drug.[11,12] Chronic exposure to cannabis smoke has been correlated with the exacerbation of symptoms of chronic bronchitis symptoms, decreased lung function and malignant disease.[48] Along with the increased risk of lung injury, other physical adverse effects of cannabis use include cannabinoid hyperemesis syndrome and arrhythmias[85]. As early and regular use along with high THC content are major risk variables for the adverse effects of cannabis, modifying cannabis risk behaviours early in adolescence is an appropriate public health approach to reduce long-term harms from cannabis.

3.6. Cannabis Knowledge in the General Public

Since the implementation of the *Cannabis Act*, public education campaigns have increased surrounding cannabis use. However, studies have found that adults in the general public do not have adequate knowledge of cannabis. For instance, a survey conducted in 2019 assessing cannabis information sources and knowledge about the risks and effectiveness of cannabis found that 74%-81% of participants' knowledge of cannabis was from their own personal experiences and only 18% received information from their primary care provider.[89] Forty percent of the participants also believed that cannabis use did not increase risks, while 72% believed it was effective for treating cancer and 72% believed it was effective in treating depression.[89] The same study found that the 18% of participants who received their cannabis information from their primary care provider had higher scores for knowledge of medical effectiveness.[89] Therefore, those who received information from a trusted and knowledgeable source had more accurate perceptions of cannabis risks.

Another study conducted in Canada in 2011 observed 165 interviews with adult cannabis users and found that there was limited knowledge of the cannabis laws and policies.[90] Once these participants were told about the cannabis laws, they described them as "excessive" and "ridiculous".[90] This study by Brochu et al.,[90] demonstrates that while cannabis laws may be enforced, the adults who actually use cannabis may not be as knowledgeable about them as they should be.

As cannabis use has been shown to be implicated in vehicle collisions and the development of psychoses, it is important for the general public to have sufficient and accurate knowledge about cannabis use and harm reduction when using cannabis. Therefore, the knowledge of cannabis in the general public is an area that requires greater attention as the accessibility to cannabis increases.

3.7. Potential Implications of the Use of Cannabis in Youth and Adolescence

In addition to increasing the knowledge of adults regarding cannabis use, the health and development of youth and adolescents is an important component of public health strategies. Behaviours that begin or are reinforced during adolescence, including substance use, have short-term and long-term impacts on the individual, their current and future families, and their communities.[91] For example, an earlier start of substance use is associated with an increased long-term prevalence of substance use and abuse, in addition to mental health problems, family and

workplace adjustment problems and physical problems.[91] As a result, adolescence is a crucial period for preventive health policy measures.

Adolescence is an essential period for neuro, psychological social development.[91] The limbic system, which is in charge of pleasure seeking, reward processing, emotional response and sleep regulation continues to develop and is followed by changes in the frontal cortex which are responsible for decision making, organization, impulse control and planning.[92–94] Magnetic resonance imagining (MRI) and positron emission tomography (PET) have made it possible to examine the effects of using cannabis at an early age on brain structures. Wilson et al., [95] found that individuals who started using cannabis prior to the age of 17 had abnormalities in brain structure, such as higher percent of white matter volume along with decreased whole brain volume and cortical gray matter. These individuals report deficits in attention, learning, recall, mental flexibility, and processing speed.[95]

As a result of these important changes during this developmental period, logical moral thinking, abstract thinking, rational judgement, and understanding the perspectives of other's increase.[91] At the same time, self-identity and concerns over the opinions of their reference groups also develop. Reference groups include peers and friends, parents and one's community.[96] Stone et al.,[96] studied the effects of perceived social norm trends and changes in cannabis use in the years following recreational cannabis legalization in Washington, and found that cannabis use by a close friend and perceived parental acceptance of cannabis use were associated with adolescent cannabis use. Therefore, the social and emotional changes during adolescence can increase the risk of behavioural problems such as substance use.[91]

In addition to experiencing the negative acute and long term effects of cannabis use, youth have an increased risk of developing cannabis dependence, therefore leading to maladaptive social behaviours.[97] Furthermore, frequent use of cannabis may have more damaging effects on the developing adolescent brain resulting in increased reports of psychotic disorders, depression and anxiety later in life,[10] and 5 to 8 point drops in IQ scores.[98] Cannabis use in adolescents in comparison to their adult counterparts has been proven to be more detrimental. For instance, Lynskey et al.,[99] performed a review of studies which reveal that adolescents who consume cannabis have been shown to have lower grades, higher rates of dropout and higher rates of unemployment. Additionally, youth are more likely to participate in higher-risk activities, such as unprotected intercourse and driving while intoxicated, due to the cognitive and decision-making

impairment of cannabis. [100] As a result of cannabis use, which alters brain development when used at a young age, youth may be impacting future academic, professional and social aspects of their lives.[100]

3.7.1. Cannabis Education in Youth and Adolescence

The Government of Canada has committed around $46 million toward cannabis public education and awareness campaigns over the next five years.[3] An additional $62.5 million was committed to support community-based and Indigenous organizations in the education of their communities.[101] The federal government has also continued to engage in working groups with the provinces and territories along with Indigenous organizations and communities to discuss public education and awareness campaigns. Some early federal efforts include public opinion research regarding Canadians' knowledge, attitudes, and behaviours related to cannabis along with market research to inform campaigns trying to reach youth, young adults and parents.[101] While the Government of Canada continues to expand their public education campaigns with their partnerships,[101] the most effective method of campaign delivery must be explored for the particular target audience of adolescents and youth.

Often substance abuse is described as a family disease in which genetics and family environment are involved. Family environment factors that can affect substance use in youth include family structure and coping strategies, the parent-child relationship, the parental expectations, and the strength of the extended family network.[102] Therefore, parents and the family unit play an important role in preventing and intervening with substance use. A study performed in 2015 showed that family-based programs that focused on the parent-child relationship were effective in preventing and reducing adolescent cannabis use;[103] however, these results cannot be applied to at-risk populations, as factors such as family dysfunction and family history of substance use problems can create greater challenges for family-based education and therefore may not be as effective.[102] Approaches that apply more intensive programing for such families based on risk factors and with the added goal of improving family functioning and reducing anti-social behaviours have been more effective for at-risk youth. [102] Also, studies have found that parents are unprepared and unsupported when it comes to acknowledging adolescent substance use within the household.[103] Early childhood programs that involve substance use education, supporting parents in helping their children and home visits have been effective in preventing substance use along with the use of family therapy. [102, 103]

When aiming to promote population health or preventing substance use, universal prevention measures are effective as they address an entire target population,[102] such as youth and adolescents. Programs that can be considered universal prevention measures include awareness campaigns, school drug education programs and multi-component community initiatives.[102] Schools are an important site for universal prevention measures as they allow primary prevention efforts to be directed at a specific age range of the population.[102] In their global consultation with adolescents, the World Health Organization found that 47% of participants preferred to received their health information from school and 46% reported being influenced by the health information they received from school.[104] Therefore, school-based programs can effectively influence common risk and protective factors for a range of health behaviours,[105] and in some instances over long-term settings.[106]

A study on school-based interventions that compared knowledge-focused, social-competence-focused, social norms-focused and combined interventions showed that the combined interventions reduced overall drug use.[107, 108] Furthermore, for cannabis use, combined interventions also decreased use at follow-ups after 12 months.[107, 108] Another report written by the Government of Canada detailed that education programs that incorporate life-skill approaches, such as decision-making, communication skills and assertiveness resulted in better outcomes for substance use prevention than programs focused on substance refusal.[102] Previous studies surrounding alcohol and drug education have also shown that abstinence-focused measures lack student engagement.[103] Therefore, school-based programs that integrate social competence and social influence education regarding cannabis use have protective effects in youth.[107]

School-based cannabis prevention programs were found to be most effective in reducing cannabis use in those between 10-15 years old when they included antidrug information along with refusal skills, self-management skills and social skills training.[107] In a study comparing school-based, family-based, and policy-based interventions, school-based programs were the most effective in reducing substance abuse.[107]

3.7.2. The Real Education About Cannabis and Health (REACH) Program

Real Education About Cannabis and Health (REACH) is a toolkit and curriculum resource for teachers to incorporate cannabis education into the curricula. REACH was developed by a multidisciplinary team of faculty advisors from the College of Nursing and the College of Pharmacy and Nutrition at the University of Saskatchewan, nursing students and a pharmacy

student following the legalization of cannabis in Canada. The faculty advisors believed that the previous teachings of abstinence and complete avoidance could no longer be applied in the context of cannabis legalization. Therefore, REACH was developed to give students the evidence-based tools and knowledge they require to understand cannabis and make healthy, informed decisions.[17] The program has since been approved as a curriculum resource for grades 7 and 9, by the Saskatchewan Ministry of Education.

Along with the multidisciplinary team, youth were extensively involved in the development of the education material in the REACH program. The REACH nurse faculty advisors, nursing and pharmacy students spent the first three months of the 2019 winter semester developing the cannabis education program with the involvement of Grade 7 and 8 students at North Park Wilson School and St. Luke School along with Grade 9 students at Bishop James Mahoney High School and Tommy Douglas Collegiate. Feedback from students and teachers was received and incorporated throughout the development of the program.

Following the development and refining of the program, REACH was added to the curriculum at the Saskatoon schools in the 2020 winter semester.[17] As part of the Safe School Health Improvement Project (Safe SHIP) and School Health Initiative with Nursing Education (SHINE) program, nursing students are given the opportunity to participate in community outreach and education development. As a result, the administration of REACH in the winter 2020 semester was via nursing students and the REACH nursing faculty coordinators.

The REACH program consists of two modules: Module 1, which was developed for middle school students, and Module 2, which was developed for high school students. These modules are consistent with the grade 7 and grade 9 Saskatchewan Ministry of Education's health education curricular outcome, respectively.[17] Each module is comprised of four lessons: (1) Introduction to Cannabis, (2) The Science of Cannabis, (3) Social Science Implications and (4) Peer Pressure, Decision Making and Harm Reduction. Through these modules, REACH aims to help students approach the social context of cannabis use with adequate information on the substance and their health.

Substance abuse continues to be a public health concern in Canada and globally. As a result of the recognition of adolescence as a critical phase in neuro- and social development, and the prevalence of cannabis use in Canadian youth, more focus needs to be put on educating youth and adolescents about the effects and regulations of cannabis. One step in this direction is the

development of standardized cannabis education curricula, such as REACH, and questionnaires that can help assess the learning and behaviours of students following these programs.

3.8. Approaches to the Assessment of Knowledge

Following the introduction of public health and education initiatives, such as the REACH program, evaluations should be conducted to determine the efficacy of the initiative and guide future improvements. The ultimate goal of evaluating effectiveness of an educational program would be to assess changes in behaviour of the target audience (such as impact on cannabis use over time). Unfortunately, such assessments would require large sample sizes, a significant amount of time and resources, including a standardized method of implementation and way of controlling for confounders. Other methods of evaluation, which are easier to conduct, include the assessment of surrogate markers, such as behaviour intention or knowledge improvement.

Questionnaires are a widely used method that allow researchers to explore the opinions, knowledge, attitudes, and behaviours of a large sample size due to their ease of distribution.[109] When developing a questionnaire for the purpose of a research objective, such as a knowledge assessment tool, the method of questionnaire development must be considered. Often, following a literature review by the researchers, a group of experts in the field of interest are gathered to select relevant items for the final questionnaire and provide feedback.[110] However, the methods by which these experts reach a consensus on topics or items to include, along with details such as wording, structure and format of the questionnaire, can vary. Consensus development methods, such as the Delphi method, nominal group technique (NGT), and the consensus development conference (CDC), are often used by researchers when approaching experts for their input in the development of a questionnaire. Such methods will be covered in the following sections.

3.8.1. Delphi Method: An Overview

The Delphi method uses multiple iterations of questionnaires with the goal of informed consensus-building by experts on a topic of interest.[111] The process is often carried out via emailing and online survey platforms. [111] On average, the Delphi method includes two to four iterations of the questionnaire with each round of the questionnaire building and improving on the previous round by incorporating the feedback of experts.[111-113] The process is completed once consensus is reached and no novel ideas are generated by participants.[112-115] Based on studies that have previously employed the Delphi method, consensus is defined as greater than 70% of

participants responding *agree* and *strongly agree* or as greater than 70% responding *disagree* and *strongly disagree* with a statement.[17, 116-119]

The Delphi method is applied in the fields of natural and medical sciences or in policymaking, needs assessment and for finding practical solutions in applied studies.[120] The selection of appropriate participants, also referred to as experts, in the Delphi method is considered the most important step in the process. In regard to the Delphi method, the term *expert* refers to an individual who has "i) knowledge and experience with the issues under investigation; ii) capacity and willingness to participate; iii) sufficient time to participate in the Delphi; and, iv) effective communication skills."[113,121] Although guidelines vary, the number of participants suggested for optimal idea generation and cost-effective timely participation in the Delphi method ranges from a minimum of 10 to an average upper limit of 50 to 100.[111,112] Moreover, de Villiers et al., [122] suggest having 5 to 10 participants per discipline, while Delbecq et al., [123] recommend having the smallest number of participants possible that allows for a representative sample of different expert perspectives.

The first round of the Delphi method is termed the *exploration phase,* which involves open-ended questions to allow for brainstorming by individual experts.[113] The open-ended nature of the first round can also allow for greater expression of views and knowledge by experts, outside of what may be found in a literature review by the researcher.[111] Therefore, the first round is a qualitative survey instrument. Following the first round and the identification of different themes that were notes, the subsequent phases of the Delphi method become more quantitative.[111] The next phase is called the *evaluation phase* and involves the development of second, third and fourth round questionnaires which can use different ranking systems, [111] such as a Likert scale, to determine expert's opinion and feedback on the developing themes from the first round. The remaining rounds allow participants to see the changes made based on the comments from the previous round(s) and make further clarifications. As a result of this research design, the Delphi method allows for member checking which increased internal validity.[124] Furthermore, continuous member checking has been noted to improve the reliability of results.[113, 120, 121, 123,] The multiple iterations allow participants time to reflect on their responses and adjust any feedback based on their reflections. [111] As a result, the validity of the data is enhanced.[120] Also, due to the qualitative and quantitative nature of process, the Delphi method provides researchers with a more complete picture of the topic of interest. [111]

The Delphi method has proved to be effective in facilitating discussion when there is a lack of previous knowledge or research on a phenomenon.[120] As there is incomplete information on the public health and educational effects of cannabis legalization in Canadian students, this consensus method is beneficial. With the recent legalization of cannabis, the Canadian education system will see an increase in cannabis safety in its curriculum, while at the same time there continues to be a lack of standardization and evaluation techniques for this subject area. Therefore, the Delphi method is an appropriate starting point to gather expert opinion for the development of the cannabis knowledge assessment tool.

The Delphi method allows for the aggregation of expert opinion through various platforms, such as series of face-to-face or telephone interviews, and mail, email or web-based questionnaires. However, the use of interviews is not common as one of the intentions of the Delphi method is to eliminate participants' censorship, which could occur in the presence of researchers.[125]

In addition to increasing researcher influence, interviews decrease the ability of researchers to maintain the confidentiality of each participant if interviews are overheard or overlap. Participants may have different opinions regarding a particular subject area (i.e. cannabis) and may feel uncomfortable sharing these opinions in groups or in questionnaires where they are identified.[125–128] Group dynamics in focus groups or one-on-one interviews may also result in participants feeling silenced or timid due to personal preferences or professional standing**.** [125] Therefore, the requirement for confidentiality of experts and the use of online interaction in the Delphi method reduces response bias and conformity bias by eliminating group interaction, dominating opinions and identification.[125, 126] For instance, if the Delphi method is performed through online interaction, participants are emailed individually to preserve confidentiality, limit access to identifiable information, restrict access to the participation list outside the research team, and avoid the presence of group pressure.[112]

Administering the Delphi method online also eliminates face-to-face interactions between participants and the researcher, which allows ease of communication for the participant without being swayed by the researcher's opinions.[111] Other benefits of the online Delphi method include allowing the exchange of ideas without geographical restrictions, reduced expenses and time as compared to other methods and it reduces noise that would be present in data from group

processes.[111] The online Delphi method also facilitates data management and analysis for researchers.[111] Therefore, online platform questionnaires are preferred for the Delphi method.

Due to the multiple iterations of the questionnaire required during the Delphi method and the time-consuming nature of answering each round, the process can be vulnerable to participant drop-out.[111] Other reasons for drop out include participant disappointment with the outcomes of the rounds or distractions and time away between rounds,[111] Also, while confidentiality is often a strength, it can also decrease ownership of ideas or increase the push of a participant's agenda.[111]

Although the Delphi method has weaknesses, the online approach has been found to minimize weaknesses, such as time demands on participants, while maximizing advantages, such as organizing the opinions of a variety of experts.[111] With the novelty of cannabis education and the necessity for unbiased expert opinion in developing assessment tools, the Delphi method is a preferred way to gather opinion. Also, in contrast to key informant interviews and focus groups (which are alternative methods for gathering such opinion), the Delphi method allows for a cost-effective and timely manner for gathering expert opinion.[112]

3.8.2. Other Methods for Formal Consensus Development

As previously mentioned, other methods of formal consensus development in addition to the Delphi method include NGT and CDC. NGT involves a one-time structured face-to-face meeting, often in a focus group setting.[129] This study technique was developed to facilitate group discussion, decision making and therefore problem-solving.[129] For instance, researchers will prepare predetermined questions to ask members of the focus group and lead group discussions. Due to the collaborative nature of the NGT, there is increased ownership of ideas that are being contributed to the research project. [129] Also, the face-to-face meetings allow researchers to build rapport with experts in the field, which is beneficial for the creation of subsequent research groups. [129]

NGTs involve small group sizes, usually of about 6-12 people.[129] The focus group meeting will begin with an introduction and explanation of the meetings objective. Next, researchers allow for silent generation of ideas in which participants will note down or think of their answers to provided questions without consultation with others in the room. Ideas are the shared one by one, with no interruptions or individual debate occurring at this stage. Once every group member has shared their ideas, group discussion is started. Finally, the group will vote and rank the ideas that were presented until consensus is reached.[129]

Contrary to NTGs and the Delphi method, the CDC method provides public forum for discussion of the topic of interest.[130] The panel members in the CDC process are both scientists and laypeople. Judgments are made by this group following the oral presentations of the evidence and literature findings by experts in the field in front of the public forum. These experts are not involved in the decision making. This method was developed by the US National Institutes of Health and is often used in healthcare decision making. [130]

According to James and Warren-Forward, [130] the decision between using the Delphi method, the NTG or the CDC relies on the purpose of the study along with the depth of knowledge available in the field of interest, along with the desired mode of distribution to participants, time, and cost. First, CDC is applicable where there is a greater availability of scientific evidence in the field while the Delphi method and NTG are used when there is a lack of previous evidence on the topic.[130]

Issues that arise with NTG include scheduling conflicts when attempting to organize a meeting between busy professionals and the geographical challenges that may exist. The Delphi method is often carried out online and gives participants a timeframe to submit their responses, therefore geographical distance and busy schedules of participants is not often concern. Also, since NTG does not provide participants confidentiality and/or anonymity, there is a risk of conformity bias and dominance by certain group members. As a result, participants may not express their opinions as freely as they would during the Delphi method, especially about sensitive topics. Lastly, NTG involves only one session of group brainstorming and consensus development, whereas the Delphi method's iterative rounds allow participants time for reflection and self-checking, thus improving validity of the Delphi method results.

3.8.3. Questionnaire Formatting

During the development of a questionnaire, questionnaire formatting involves determining the types of questions that are used along with the language that is used, the mode of questionnaire administration, the number of questions and the time required to complete the questionnaire. This allows researchers to create a questionnaire for their study's needs while taking into account any limitations that must be addressed.[131] Due to limited time and grading resources, researchers often use electronic-format questionnaires with close-ended questions, such as multiple-choice and ranking-style questions.

Multiple-true-false (MTF) questions are a format of multiple-choice question in which the stem and the options of a question are written like a multiple-choice question, however participants must mark each option listed under the stem as either true or false instead of selecting one answer. MTF questions allow participants to consider all of the response options for a question and mark each as true or false. Each item is then scored independently. As a result, MTF allows for a greater number of items to be tested, thus lengthening the questionnaire, which improves the questionnaire reliability.[132, 133] Compared to MTF, single best answer MC questionnaires must have a greater number of questions to be representative of all the same items,[134] which can be daunting for participants. Also, the greater complexity and decreased ability for cluing in MTF questions, when compared to MC questions, ensures the questionnaire is less likely to be subject to ceiling effects.[132] Additionally, MTF items are a less complex version of multiple multiple-choice (MMC) questions, such as k-type questions which often ask, "choose all that apply", as they award partial credit for partial knowledge. In comparison to MMC questions, MTF questions have a greater quantity of unique true-false patterns, thus also increasing their reliability.[133] Therefore, MTF questions do not take much time for participants to complete while also allowing for a range of topics to be tested by administrators.[132]

Although MTF questions also have a greater reliability in comparison to MC or MMC questions,[131-134] there are also disadvantages to the MTF question format. For instance, participants can guess the right answer as there is a 50% chance of being right for each item.[134] For answers that are false, the student is being marked on knowing that an answer is incorrect instead of knowing the correct answer.[134] As the format focuses on items that can be answered true or false, it may end up assessing trivial knowledge and may not encourage learning.[134]

In addition to the types of questions, mode of administration and length of questionnaire, the language used in questionnaires is important for their target audience. In 2015, the Organisation for Economic Co-operation and Development (OECD) evaluated the performance of Canadian youth in reading through the Programme for International Student Assessment (PISA).[116] The findings from the PISA study showed that Saskatchewan secondary school students performed lower than the Canadian average.[116] To maximize readership and participation, it is important to monitor the readability of the questionnaire through methods such as the Flesch-Kincaid formula and the Simple Measure of Gobbledygook (SMOG) index. Both methods score text by reading grade-level. The Flesch-Kincaid formula bases the reading grade

score on the average number of words in a sentence and the average number of syllables in a word. The SMOG index evaluates 10 sentences in the beginning, middle and end of submitted material.[135] Of these 30 sentences, the number of words that are 3 or more syllables are recorded and will correspond with the reading grade level.[135] The SMOG index has been found to be useful in healthcare settings.[135] Compared to the SMOG index, the Flesch-Kincaid formula on average has been found to predict 2-3 grade levels lower.[135] Therefore, use of the two in combination is often recommended.

4. HYPOTHESES

1. There is a positive association between student participation in a cannabis education program and their cannabis knowledge assessment.
2. There is a positive association between student participation in a cannabis education program and behavioural intention score.

5. METHODS

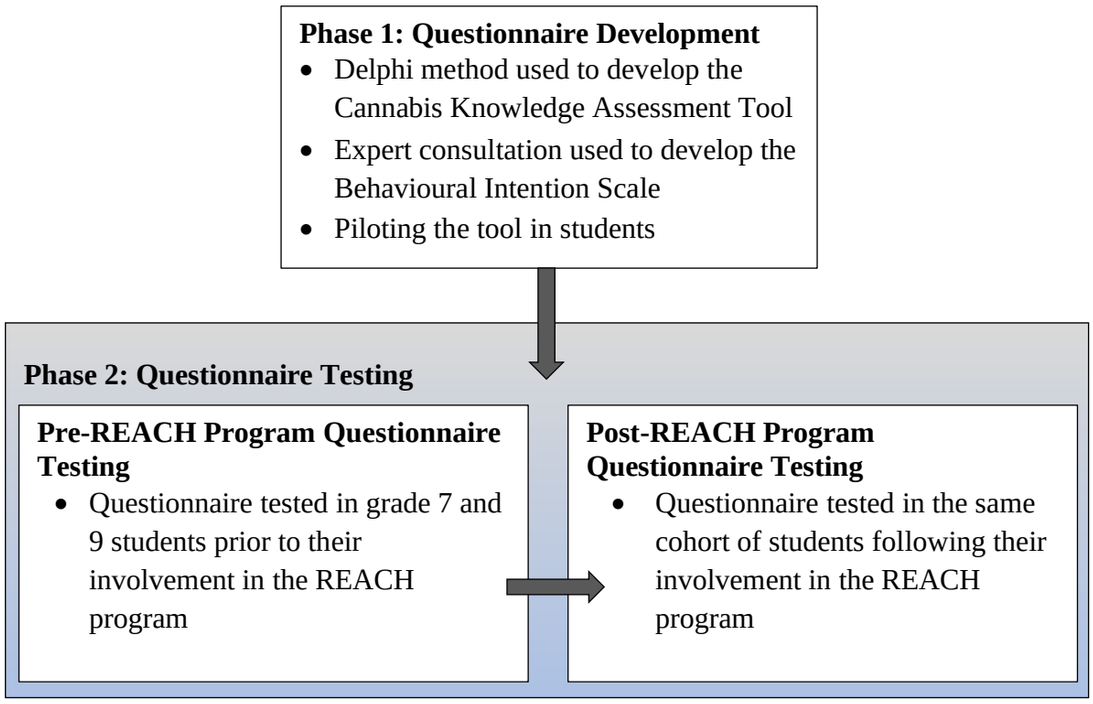
The research team consisted of a Master of Science student and four faculty members at the University of Saskatchewan. Among the faculty members, three were pharmacists while one was a biostatistician, and the group collectively held expertise in the areas of cannabis education, knowledge assessment and questionnaire development.

Development and administration of the questionnaire was approved by the Research Ethics Board (BEH-130 and BEH-1670) along with the respective ethics boards of the Saskatoon Public School Board and the Saskatoon Catholic School Board. This chapter will cover the methods that were applied for questionnaire development, including explanations for each round of the Delphi method, and how the questionnaire was administered then analysed.

5.1. Phase 1: Questionnaire Development

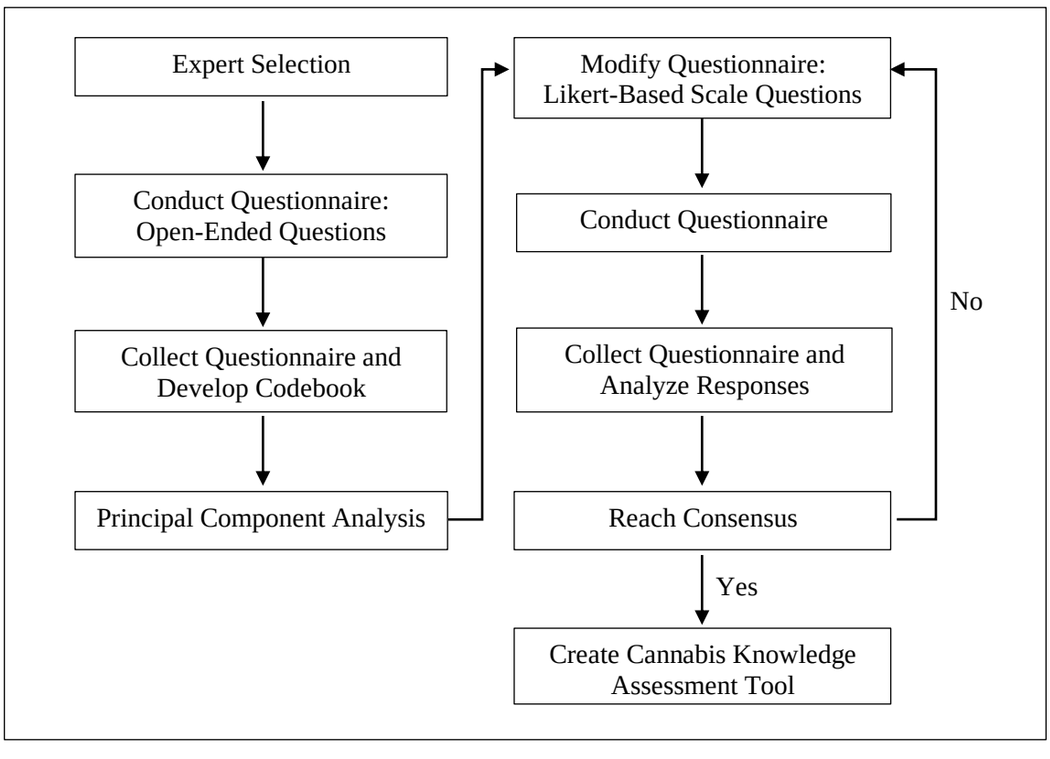
To complete the first and second objectives a Cannabis Knowledge Assessment Tool (C-KAT) and Behavioural Intention (BI) scale were developed with input from a group of stakeholders between the months of July 2019 to November 2019, prior to questionnaire testing (Figure 1).

Figure 1. Summary of the process for development and administration of the questionnaire.



The Delphi method was used to develop the content for the C-KAT (Figure 2). For the Delphi method, the group of 'experts' included a purposive sample of healthcare professionals, policymakers, academics with an interest in cannabis, patients who used cannabis medically, and teenage students. In total, seven healthcare professionals, six policymakers, eight patients, six academics, and seven students were invited to participate. Hence, a total of 34 people were invited to share their perspectives regarding development of the C-KAT.

Figure 2. Flowchart summary of the modified Delphi method used for the creation of the Cannabis Knowledge Assessment Tool.



A variety of perspectives was deemed to be important for identifying gaps in cannabis knowledge and developing the C-KAT. The healthcare professionals who were invited included pharmacists, nurses, harm reduction coordinators, and physicians, based on their interest in cannabis research, their involvement in cannabis education, and/or their knowledge of cannabis' effects on health. Policymakers who were invited to provide input into the questionnaire consisted of law enforcement personnel, cannabis authorized distributors, and advocates from relevant organizations (such as the Canadian Pharmacists Association) that had a close familiarity with the novel rules and regulations surrounding cannabis use. Members from Academia consisted of professors and researchers with a focus on cannabis research and/or educational development. While healthcare professionals, policymakers, and academics could contribute knowledge about mitigating risks and enhancing safety of cannabis use, we reasoned that a patient subset was necessary for providing context through the perspective of lived experience with both cannabis use and procurement, hence patient users were also invited to provide input. Finally, since the purpose of the C-KAT was to evaluate students' knowledge of cannabis, it was important to invite students to participate in the Delphi method, and so students from elementary to postsecondary school were invited to participate.

A brainstorming session was held amongst the researchers to generate a preliminary list of potential participants in the Delphi method. Each individual was contacted personally by a member of the research team to discuss the project, determine interest in participation and to ensure that the invited members had time to complete the process. Those interested were emailed individually (Appendix E).

A Delphi method consisting of a series of web-based questionnaires was chosen as the preferred format for the creation of the knowledge assessment tool. These questionnaires were iterations of the same basic theme for the most part, depending on how questions scored. In this particular study separate questionnaires (or 'rounds') were used to gain consensus after feedback was incorporated into each subsequent 'round'. Participants were asked to complete each round within a three-week time frame and an email reminder was sent approximately one to two weeks after each round of the questionnaire was sent (Appendix G). Individuals that did not respond by the deadline were sent a personal reminder via email or text from the study researcher (Appendix H). No incentives of any type were offered to the experts for taking part in the process, and completion of the questionnaires was taken as free and informed consent.

Each questionnaire was programmed into SurveyMonkey, an online survey development software licensed by the University of Saskatchewan and distributed to participants by email. The SurveyMonkey platform allowed researchers to maintain participant confidentiality and minimize costs while ensuring secure and timely responses. The identity of each participant and corresponding responses was known only to the research student and primary supervisor just in case follow up clarification was required, or if a person wished to withdraw their responses from the study. With each round, all responses were amalgamated, and the data were anonymized before sending out in the next iteration of the questionnaire, to help ensure confidentiality. An in-depth explanation of the methods for each round of the Delphi method along with the development of the BI scale and the readability analysis of the questionnaire will be covered in the subsequent sections.

5.1.1. Delphi Method: Round 1

For Round 1, individuals who expressed an interest in participating after speaking to a research team member received a formal email invite to the study (Appendix F). This email provided an overview of the importance of the research project and development of the C-KAT for guiding education programs, along with an overview of the Delphi method. Within the email, there was a link to the first round of the questionnaire.

Eleven open-ended questions were administered during the initial round, focusing on identifying the gaps in knowledge of the general public, the misconceptions of cannabis, and identifying target knowledge topics for students. The questions also explored opinion on the length of the questionnaire and how much time it took to complete.

The questions used for this first iteration were self-created by the research team and were piloted on a graduate student from the College of Pharmacy and Nutrition, the School of Public Health and the College of Nursing at the University of Saskatchewan prior to disbursement to the Delphi participants. During the pilot phase the questions were revised for clarity and wording to avoid miscommunication and confusion, along with ensuring a variety of questions to allow for adequate exploration of the topic.

Once participants completed Round 1 of the Delphi method for questionnaire development, the data were analyzed through qualitative coding and the creation of a codebook, using Microsoft Excel. Emergent coding, in which the code is developed from the data itself, was used to determine broad themes from the answers to the open-ended questions. As the research

student read through the responses from Round 1 of the Delphi method, themes that were emerging in each answer were highlighted and noted in the Microsoft Excel sheet. These themes were broken down into mutually exclusive categories, denoted as *codes*. For each new code that was identified, a definition was written down pertaining to the theme of the code to allow differentiation between codes. It was tallied each time a participant's answer mentioned an existing code, and if a novel theme was mentioned in an answer a new code was created until all themes were covered. The number of times each code was mentioned was summed for each question. All data analysis was performed by the research student and rechecked and verified by the research team.

Since it was challenging to determine and condense the data's major themes simply by looking at the codebook, principal component analysis (PCA) was performed with the codes from Q1, *What essential information should the general public know about cannabis*. Each of the 17 codes from the 24 participants were treated as variables and the PCA helped to clarify what content was important to include on the knowledge assessment questionnaire.

PCA is a dimensionality reduction technique that allows researchers to identify a new component that is a combination of the old, larger set of variables.[61] As a result of the feature extraction abilities of PCA, a large data set, such as our 17 variables, is transformed into a smaller set of variables (principal components) that still contain most of the information from the large set.

A total of three components were deducted from the PCA. For each component, a minimum of two variables were used with the highest correlation. For component 1 and 2 there was a sufficient number of variables with a correlation greater than 0.6 (four variables and three variables, respectively). However, for component 3, the two highest positive correlation variables used were below 0.6. Therefore, the 17 codes from Q1 were reduced to 3 components that encompassed 9 codes with the greatest correlations. The three principal components that were obtained from the PCA for Q1 guided the content for the knowledge questionnaire.

5.1.2. Delphi Method: Round 2, 3 and 4

The experts who completed each round were invited to participate in each subsequent questionnaire (Appendix F). The questions used in each subsequent iteration were modified based on participant feedback and consensus, and the questionnaires became increasingly specific

following each round of collection and analysis to generate and refine the questions to be used in the final version of the C-KAT.

To begin, based on the factors derived from the PCA in Round 1 and guided by participant's answers in Round 1, multiple-choice questions were developed by the research team. These multiple-choice questions were presented back to the expert panel, and participants were asked to comment on whether they believed the question should be included in the final questionnaire, and to provide suggestions for improvement if they saw any. Participants were asked during Round 2, 3 and 4 of the Delphi process if they *strongly agree*, *agree*, felt *neutral*, *disagree* or *strongly disagree* with each question being asked based on a 5-point Likert scale.

Survey responses were collected and recorded following each round in a Microsoft Excel spreadsheet. For each question, the number of participants who answered, *strongly disagree*, *disagree, neutral*, *agree* or *strongly agree* were noted. Comments made by participants were individually addressed and modifications were made to the multiple-choice questions based on expert suggestions. The revised questions were then presented back to the group during each subsequent round in the Delphi method. If a question received a percent agreement of less than 70%, meaning less than 70% of participants selected *strongly agree* or *agree,* the question was removed or reworded. As mentioned previously, 70% agreement for consensus was found to be appropriate by previous studies using the Delphi method. [17,114–117] Round 3 and 4 allowed participants to see the changes made based on the comments from the previous round and make further clarifications. After Round 4, > 70% consensus was achieved on all the questions and no further rounds of changes to the questionnaire were made.

Following each iteration of the Delphi method, the questionnaire format of the C-KAT was determined through pilot work with three students, two in grade 7 and one in high school. These three students helped researchers identify appropriate questionnaire format between true false (TF), multiple choice (MC), multiple-multiple choice (MMC) and multiple true false (MTF). After each iteration of the Delphi method, the updated questionnaire was assessed by the same three students.

5.1.3. BI Scale Development

The BI scale was drafted by the research team based on the codebook from Round 1, question 6, of the Delphi method which asked participants, *what essential information should youth, (in particular, grades 7-12) know about cannabis?* This question and the answers associated with it were chosen as it gave researchers a good starting point for topics to cover in the BI scale based on expert opinion of the Delphi method participants, in order to try and predict future behaviour as it pertains to cannabis use. Based on the answers, the BI scale draft focused on questions regarding the effects of cannabis, the social consequences of cannabis use and test-taker's perceptions of cannabis use prior to the legal age of consumption.

Once the initial version of the BI scale was developed by the student researcher and an expert in questionnaire development, it was distributed to six educators and three students by email for content review and input. Educators included individuals with expertise in assessment, questionnaire development, healthcare and biostatistics. An initial email was sent to the six educators and three students to ask for their assistance in reviewing the BI scale draft, with follow-up emails being sent to clarify their suggestions or ask for further input. After changes were made based on the suggestions, the researcher and the questionnaire development expert met to make final changes to wording and formatting.

Following several discussions between educators based on the number of scale points, the 5-point Likert-based scale was chosen to be able to provide participants with an adequate number of options to state their degree of agreement or disagreement while remaining manageable.[69] The scale has all five points labelled as it was found that end-point labelling may result in avoidance of the extremes and increase likelihood of answers concentrated in the middle of the scale.[69] Next, a *neutral* option was included to avoid a forced choice. As a result, students were given the option to keep their opinion undisclosed should they feel uncomfortable or remain indifferent on certain statements. Double-barrelled questions asking about two variables at one time were avoided to decrease confusion or answers that addressed only one part of the question.[69] Finally, a brief explanation and example section were included prior to the first BI scale question to show students an example of this questionnaire and response style.

5.1.4. Readability Analysis

Following the completion of Round 2, Round 3 and Round 4 and the completion of the BI scale, the questionnaire was tested for readability. In order to attain an 8th grade reading level, the

questionnaire was revised subsequently to the Flesch-Kincaid formula and the SMOG index. The Flesch-Kincaid Grade Level is determined with a formula using the average sentence length and the average syllables per word,[72] while the SMOG index assesses the number of complex words in 30 sentences from the beginning, middle and end of the text.[72] Both the Flesch-Kincaid Grade Level and the SMOG index are the most commonly used readability tests.[73] All readability tests were performed on free online software at www.readabilityformulas.com

5.2. Phase 2: Questionnaire Testing

The third objective of this study was to administer the questionnaire to the same cohort of students before and after their participation in a cannabis education program. For the purposes of this study, seven schools that had recently implemented the REACH program were purposely chosen to test the validity of the questionnaire. These schools represented various school grades, both public and Catholic schools, and geography and demographics. Beginning in February of 2020, nursing students and faculty began delivering the REACH program to select Grade 7 classes at Brunskill Public School, North Park Wilson Public School, St. Lorenzo Ruiz Catholic School, St. Luke Catholic School, and George Vanier Catholic School along with Grade 9 classes at Tommy Douglas Collegiate and Bishop James Mahoney Catholic School. Grades 7 and 9 were chosen because they represented time points in elementary and high school when students are likely to be introduced to cannabis and were the targets of the REACH program. Notably the REACH program is also aligned with the Saskatchewan Ministry of Education's curriculum outcomes for these grades.

In order to participate in the study, written consent had to be provided by the students' parents or legal guardians. Prior to beginning the REACH program, the research student, a faculty member, and the nursing students held a brief introductory session about what the study was, and the consent process. An envelope was handed out to each student in class, which contained all information necessary for the consent process. The package included a consent letter for the parents or legal guardians detailing the research and contact information of the researchers (Appendix A). This was to be signed and sent back to school with the students. Additionally, it contained a watermarked copy of the assent form which the students were given a copy of, so that the parents could see what the students read as well (Appendix B). The assent form allowed students who were under the legal age of consent to be informed about the study and agree to participating. All students received the REACH education program as part of the school

curriculum, however only those students with signed consent forms were allowed to complete the questionnaire and participate in the study. Additionally, even if the parents or legal guardians consented to their children participating in the study, the students were made aware that participation was optional and they could chose to not participate if desired. Prior to taking the pre-and post-test, the students read the assent forms that described the study.

5.2.1. Pre-test and Post-test

A pre-test, post-test design was carried out in which the same participants were tested each time. Scheduling of the pre- and post-test for all schools was determined by the homeroom teacher's schedule, the REACH program coordinators schedule and the researcher's availability. Each pre-test and post-test was administered by the researcher. For Brunskill Public School and Tommy Douglas Collegiate, the pre-test was administered on the same day as the beginning of the REACH program, prior to the first lesson. The pre-test was administered a week and half prior to the first lesson at St. Lorenzo Ruiz Catholic School and one day prior to the first lesson at Bishop James Mahoney Catholic School.

On the morning of the pre-test, the researcher attended the scheduled class time and collected all the consent forms which were returned to the home-room teacher or nursing students. The names of students with signed consent forms were called out and students picked up an envelope which included the assent letter and a watermarked copy of the consent letter, along with the questionnaire (Appendix C, Appendix E). The researcher reviewed the study details to ensure students understood the research, the questionnaire instructions, and ensured the students that anonymity would be maintained during the process. To ensure anonymity, students were instructed to use a unique codename consisting of a word and/or number (or any combination) of their choice that only they would know, so that their pre-test could be matched to their post-test. This explanation of the study took 5 minutes, and completion of the pre-test took approximately 15 to 20 minutes. If students had questions during the completion of the questionnaire, they were instructed to raise their hand and the researcher would then answer their question. The schoolteachers were not involved with the questionnaire process; all questionnaires and consent forms were collected by the researcher.

Once the entire REACH program was delivered, the post-tests could be performed. For Brunskill School Public School and Bishop James Mahoney Catholic School, these post-tests

were performed one week following the completion of their last REACH lesson. The post-test administration process was similar to the pre-test whereby a study description was given by the researcher, and the post-test was handed out to students for whom had completed the pre-test after a consent form was obtained. The students were asked to write the same codename on their questionnaire that they used for their pre-test. This took 20 minutes.

At Tommy Douglas Collegiate, students received their post-test immediately following their last lesson. For St. Lorenzo Ruiz Catholic School, the post-test occurred the day following their last REACH lesson. Unfortunately, the post-test results could not be obtained for the other participating schools, as data collection was interrupted due to COVID-19.

In the case that a student wrote a different codename on their pre-test and post-test, the unmatched questionnaires were removed from the study.

5.2.2. Data Analysis

Immediately after the pre-tests were performed, the researcher scored the C-KAT portion of the questionnaire and each student was given a grade out of 64 (i.e. there were 64 discrete answers). One mark was deducted from the total score for each item that was answered wrong on the C-KAT. The same process occurred following the completion of the post-test by the students. Once the post-tests were scored, the questionnaires were matched to a pre-test based on the codenames, therefore each student had a score for their pre-test and their post-test on the C-KAT. Students who were present for the pre-test but absent for the post-test had their questionnaire removed to ensure each individual had a complete data set.

For scoring of the BI scale, the corresponding numerical response to each Likert scale question was noted in IBM SPSS (version 26). If a student responded that they *strongly agree*, a score of 1 was noted, for *agree* a score of 2 was noted, while *neutral*, *disagree, strongly disagree* received a score of 3, 4 or 5, respectively. Four questions (Q17, Q20, Q26 and Q27 on the full questionnaire, corresponding to Q1, Q4, Q10, Q11 on the BI scale) on the BI scale answers were reverse scored using the recode variable function in SPSS to allow for consistency during reporting. As a result, favourable behaviours were indicated by answers at the higher end of the Likert-based scale while those at the lower end of the scale indicated unfavourable behaviour.

Following the scoring of the questionnaires, the results were entered into and analyzed using IBM SPSS (version 26). The researcher reviewed the score entries twice to ensure all scoring was inputted correctly. Demographics, including school, gender and grade for each data

set were recorded. Match-paired t-tests were performed on SPSS for each dependent data set to test the null hypothesis that the means of the pre- and post- tests are the same against the alternative hypotheses that the post-test scores are greater. For sample sizes < 25, such as Other Genders and Tommy Douglas Collegiate, a p-value was not recorded as this sample size does not satisfy the assumptions for a match paired t-test. A significance level of 0.05 was used as this is a reasonable cut off for statistical significance in this study and indicates that there is a 5% risk of saying a difference exists between the pre and post-test when there is no actual difference.

6. RESULTS

6.1. Phase 1: Questionnaire Development

6.1.1. Delphi Method: Round 1

The first round of the Delphi survey consisted of open-ended questions and was analysed using emergent and open coding. From the 34 experts emailed, 24 participated, resulting in a 70.6% response rate. The 24 participants consisted of six health care professionals, five policymakers, four patients, three academics with an interest in cannabis, and six students.

Following the coding of Round 1, a PCA was completed for the codes in Q1, *What essential information should the general public know about cannabis* (Figure 3). The first principal component was strongly correlated with 4 of the original 17 codes. As shown in Figure 3, *social consequences*, *substance misuse*, *familial support* and *cultural links* all had a correlation of 0.985. These themes revolved around effects on the individual including social exclusion and how to address cannabis use or overuse within a family and the cultural importance of cannabis to some. Therefore, this component can be viewed as *impact of cannabis on the individual*. The second component included 3 of the 17 codes as the variables with the highest correlation: *gaps in scientific evidence*, *different components*, and *contraindications*. This component was grouped as *general information about cannabis* as the themes involved scientific knowledge of cannabis and its side effects. The third component was grouped as *cannabis harm reduction* as the 2 themes, *regulation*, and *harm reduction techniques*, related to regulations and precautions to take to avoid harm when using cannabis.

6.1.1.1. Determining Questionnaire Format

Following the analysis of Round 1, the draft questionnaire was piloted on two grade 7 students and one high school student to check the difficulty of content and determine the format

of the questions, such as single TF, MC, MMC or MTF. The cohort of students indicated that single true and false questions were too easy. However, students were indifferent to whether or not the multiple-choice question had more than one correct answer, as in the MTF format, as long as the format of the questions remained the same throughout the questionnaire. MTF was used for the C-KAT as a result of the students' feedback along with previous work showing that the benefits of the MTF format.

Figure 3. Principal component analysis with 3 component extraction performed based on the qualitative coding of answers from Round 1, Q1. Bolded items represent the variables from the larger set that were incorporated into the new variables of *impact of cannabis on the individual* (component 1), *general information about cannabis* (component 2), and *cannabis harm reduction* (component 3).

	Component		
	1	2	3
Background Information	-0.146	-0.247	0.192
Gaps in Scientific Evidence	-0.230	**0.842**	-0.126
Different Components	-0.192	**0.777**	-0.016
Different Forms/Strains	-0.139	0.180	0.304
Drug-drug interactions	-0.123	0.426	-0.076
Contraindications	-0.225	**0.624**	0.232
Physiological Consequences	-0.417	-0.256	0.335
Social Consequences	**0.958**	0.085	-0.189
Benefits	-0.139	-0.170	-0.400
Medical Use	-0.259	0.492	-0.229
Harm Reduction Techniques	0.613	0.161	**0.568**
Procurement	-0.073	-0.370	-0.357
Regulation	0.464	0.048	**0.378**
Substance Misuse	**0.958**	0.085	-0.189
Familial Support	**0.958**	0.085	-0.189
Cultural Links	**0.958**	0.085	-0.189
Reliable Resources	0.817	0.067	0.252

6.1.2. Delphi Method: Round 2

The second round of the Delphi survey consisted of 20 questions with Likert-based scales and a final question asking for the participant's first name and last initial. The 20 questions addressed the three main factors derived from the Principal Component Analysis: 1) *general information about cannabis*, 2) *impact of cannabis on the individual*, and 3) *cannabis harm*

reduction. There were 7 questions related to factor 1, 8 questions related to factor 2, and 5 questions related to factor 3.

From the 24 experts who responded in Round 1, 21 participated in Round 2 (87.5% participant retention from Round 1). The 21 participants included six health care professionals, four policymakers, three patients, three academics in the field, and five students.

Each of the questions were analyzed to determine agreement amongst the participants. From the 20 questions, four questions had percent agreements lower than 70% (Table 1). The stems of these four questions included: (Q4) *Which of the following statements are TRUE regarding the different forms of cannabis?,* (Q6) *Which of the following are TRUE regarding THC and CBD?,* (Q7) *Which of the following is TRUE regarding the potency of cannabis,* and (Q9) *What are some potential long-term effects of using cannabis?* Q4 and Q6 received the lowest percent agreement (63.64%). The majority of comments for Q4 were in regard to wording, such as the use of the word *effective,* and the difficulty of the content; however, comments also mentioned the importance of such questions regarding the effects of different forms of cannabis. Participants indicated that Q7 may be difficult for younger individuals and the general public and may not give accurate insight into cannabis knowledge levels. Q6 and Q9 both received a 68.18 percent agreement, with comments for Q6 suggesting that the question should address one topic at a time, instead of both the euphoric effects (A and B) and medical uses (C and D) of cannabis. The comments for Q9 suggested removing the word *curing* and replacing it with *treating* along with rewording some of the answers. All other questions received a percent agreement of 70% or greater.

Additional comments from Round 2 on the other questions suggested that participants were in agreement that questions regarding the misconceptions of cannabis (Q1), terpenes and cannabinoids (Q2, Q6), cannabis potencies (Q4), harmful effects of cannabis (Q8, Q9, Q11), cannabis use below the age of 25 (such as Q12), along with cannabis and travel (such as Q18) are necessary topics for the final C-KAT.

Other comments also suggested that wording should be less complex. For instance, the mention of phrases such as *dos*e, *onset of effect*, *harm reduction strategies*, and *adverse consequence* were criticized. Moreover, participants suggested changing vague words, such as *curative* (Q1) and *effective* (Q4). Subsequent comments included changing wording to improve the inclusivity of the C-KAT's language. For instance, it was suggested that Q5. B) *A mother who*

is breastfeeding be changed to *Someone who is breastfeeding*. Uniformity of wording in questions was also mentioned. For example, in Q12 (*It is important to delay cannabis use until after the age of 25 because*) it was proposed that the phrase *age 25* was repeated instead of *this age* in the question answers. Experts also recommended that consistent terminology should be used to refer to cannabis dispensaries. Furthermore, the mention of *eating* was changed to *ingesting* (Q8) to include other oral routes such as oils or capsules, while the term *medical license* was replaced with *medical authorization* (Q13) for accuracy.

Table 1. Percent agreement based on percent of experts who *agree* and *strongly agree* with the inclusion of each round of questions on the C-KAT.

Question number	Percent Agreement (% Strongly Agree + % Agree)		
	Round 2	**Round 3**	**Round 4**
1	86.37	71.43	100
2	72.72	90.48	88.89
3	81.82	90.48	94.45
4	63.64	90.47	88.88
5	81.81	95.24	83.33
6	68.18	90.48	88.89
7	63.64	90.48	88.89
8	72.73	90.48	94.45
9	68.18	95.24	77.77
10	95.45	80.96	83.34
11	86.36	95.24	94.44
12	77.27	80.95	100
13	72.73	90.48	94.44
14	77.27	85.72	88.89
15	72.73	95.24	88.89
16	95.46	85.72	72.22
17	95.46		
18	90.91		
19	72.73		

20	81.82		

6.1.3. Delphi Method: Round 3

Round 3 of the Delphi survey consisted of 16 questions with Likert-based scales. The four questions from Round 2 of the Delphi method that received less than 70% agreement (Q4, Q6, Q7, and Q9) were removed from this questionnaire, and similar themes, such as information about the components of cannabis and long-term effects of cannabis use, were incorporated into other questions. Each of the 16 Likert-scale based questions in Round 3 also allowed comments to be made by participants following their answer. All 21 experts who participated in Round 2 participated in Round 3 (100% participant retention from Round 2, 87.5% participant retention from Round 1).

All 16 questions in Round 3 received a 70% agreement or higher (Table 1), thus each question was further analysed based on comments. Q1, *which statements are TRUE regarding cannabis,* received a much lower approval score (71.43%) than all other questions (80.95-95.24%).

Comments from different participants in Round 3 suggested making each question focused on one concept. For instance, Q1 included answers based on terminology as well as cannabis ingredients. Q2 (*Which statements are TRUE regarding THC (tetrahydrocannabinol) and CBD (cannabidiol*)) assessed various concepts, while Q3 (*Which statements about cannabis are TRUE)* assessed the safety, use and evidence for cannabis. Furthermore, an expert mentioned that cannabis is promoted for use under the age of 25 for individuals suffering from epilepsy and thus Q6, *why is it important to AVOID using cannabis before the age of 25*, was recommended to be rephrased to address such exceptions.

Q13, *which statements are TRUE regarding cannabis laws,* is based on Saskatchewan-specific regulations, and it was recommended to instead address Canada-wide regulations, to decrease the limitations of the C-KAT. Further content-based changes included the range of hours recommended following cannabis use for driving in Q14.A (*Avoid driving for at least eight hours after taking it*), whereby one expert mentioned that literature often mentions a minimum of six hours prior to using a motor vehicle. Other suggestions also included removing questions that may need to be constantly updated due to ongoing research, such as Q8.

In addition to the abovementioned content changes, experts also suggested changes to the wording of some questions and answers. Experts proposed changing vague words such as *works* in Q4.C (*what works for one person may not work for another*) and the vague phrase *potentially effective* in the stem of Q8 (*cannabis has been shown to be potentially effective for treating which medical conditions*). Other wording changes included changing *prescription* for medical cannabis to *medical authorization* in Q12.A (*you need a prescription for medical cannabis but not for recreational cannabis*). Grammatical changes were also suggested to make the terminology of answers more consistent, such as removing the terms *because* in Q6.A and Q6.C.

6.1.4. Delphi Method: Round 4

From the 21 participants in Round 2 and Round 3, 18 experts participated in Round 4 (85.7% participant retention from Round 2 and 3, 75% retention from Round 1). Of these 18 experts there were six health care professionals, three policymakers, three patients, two academics in the field, and four students.

Each question received a 70 percent agreement or higher (Table 1), and all comments/feedback provided were in regard to wording or grammatical changes. Q1 (*which statements are TRUE regarding the compounds (ingredients) in cannabis*) and Q12 (*which statements are TRUE regarding the regulation of cannabis)* received 100% agreement. All other questions received a minimum of 83.33% agreement except for Q9 (*in someone using cannabis, which of the following ways may be harmful to their lungs*) and Q16 (*if you want reliable information about cannabis, where should you seek out information*) which received 77.77% and 72.22%, respectively.

Following a revision of the wording in the C-KAT based on the comments from Round 4, the questionnaire was finalized and received a Flesch-Kincaid Grade Level of 6.3, along with a SMOG index score of 7.6 (Table 2). The final version of the C-KAT (with answers) can be found in Appendix 2 and 3.

Table 2. Flesch-Kincaid Grade Level and SMOG index score for the Cannabis Knowledge Assessment Tool and Behavioural Intention Scale, obtained from www.readabilityformulas.com.

	Flesch-Kincaid Grade Level	SMOG Index Score
C-KAT	6.3	7.6
BI Scale	7.2	8

6.1.5. Behavioural Intention Scale Development

Following the development of the C-KAT through the Delphi method, the researchers consulted educators and students on the development of a behavioural intention (BI) scale. First, the draft questions developed by the research student and expert in questionnaire development were based on the most mentioned codes from Round 1, Q6, *What essential information should youth, (in particular, grades 7-12) know about cannabis?* Codes included *physiological consequences, youth-specific consequences*, *harm reduction techniques*, *regulation and legality*, *dealing with peer pressure* and *social consequences*.

With respect to formatting of the questions, initially the scale was a 7-point Likert scale because of the inclusion of options in between *strongly-* and *somewhat- agree* or *disagree* as well as a *neutral* option. The *neutral* option was kept as some students may have no opinion or be indifferent toward a question and the lack of *neutral* option would force an opinion that may not be genuine. After discussion and debate it was decided that a 5-point Likert-scale with descriptors placed on top, would be most simple and easier for students to understand.

Figure 4. The Behavioural Intention Scale

In the second part of this questionnaire, we have a few statements for you to read and indicate on a scale from 1 to 6 if you agree or disagree.

For example:
If you *strongly agree*, meaning you agree with the statement a lot, circle 1.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(1)	2	3	4	5

If you feel *neutral*, meaning you neither agree nor disagree, circle 3.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	(3)	4	5

If you *strongly disagree*, meaning you disagree with the statement a lot, circle 5.

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	(5)

Please circle the number that best describes your opinion. Please only circle one number for each question.

17. Using cannabis will negatively affect my health

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

18. Using cannabis will give me a fun “high”

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

19. I am curious about what it feels like to try cannabis

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

20. Using cannabis will negatively affect my future (for example, sports, jobs, school)

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

21. Most people who are important to me think using cannabis is okay

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

22. I have friends who use cannabis

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

23. I have family members who use cannabis

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

24. I will consider using cannabis to impress my friend(s)

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

25. I will consider using cannabis to gain a sense of independence from my parents

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

26. My decision to use cannabis is up to me

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

27. I have a trusted adult I can talk to about cannabis

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

28. I will consider using cannabis before the legal age in my province

Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	2	3	4	5

Three of the six educators commented on changes regarding wording of the BI scale. For instance, one expert suggested using direct language, instead of a passive voice as the passive voice suggests thinking about something in the future, and to maintain consistency (e.g. *using cannabis would negatively affect my future* was changed to: *using cannabis will negatively affect my health)*. Wording was also changed from questions which were Saskatchewan-specific to more general in order to be able to be used more broadly. For instance, the question *I would consider using cannabis before the age of 19* was changed to *I will consider using cannabis before the legal age in my province*. Also, it was suggested by two experts that details should be given for the question *using cannabis will negatively affect my future.* As a result, examples were added to the question.

Educators also suggested including questions regarding cannabis use in the student's environment, such as *I have family members who use cannabis* and their social support systems, such as *I have a trusted adult I can talk to about cannabis*. Other aspects that were mentioned by two experts were the aspects of peer pressure or independence-seeking that adolescents may face. Therefore, an expert suggested adding questions such as *I will consider using cannabis to impress my friend(s), I will consider using cannabis to gain a sense of independence from my parents,* and *my decision to use cannabis is up to me.* Along with the themes of environment and peer pressure, the question *most people who are important to me think using cannabis is okay* and *I have friends who use cannabis* were suggested to be included.

The final BI scale (Figure 4) includes brief instructions prior to the start of the survey and 11 questions using a 5-point Likert scale. The BI scale attained a Flesch-Kincaid Grade Level of 7.2, along with a SMOG index score of 8 (Table 2).

6.2. Phase 2: Questionnaire Testing

The pre-test was administered to 413 students in seven schools in Saskatoon, SK (Table 3). The post-test could not be completed in 3 schools due to COVID-19 interruption. Therefore, the post-test was completed by 138 students in 4 classrooms; However, six pre-tests and post-tests had unmatched codenames and were therefore removed resulting in 132 total participants (32% completion rate overall).

Of the 132 students who completed the pre- and post-test, 84 identified as female, 46 identified as male and 2 identified as other. Of these 84 females, 40 were in grade 7 (54.8% of the grade 7 students) and 44 were in grade 9 (74.6% of the grade 9 students). Of the 46 males, 31 were in grade 7 (42.5% of the grade 7 students) and 15 were in grade 9 (25.4% of grade 9 students). Both students who identified as other were in grade 7 (2.7% of the grade 7 students).

Table 3. Demographics of questionnaire respondents.

		Breakdown according to school			
	Total n (%)	Tommy Douglas Collegiate *n*=18 (13.6%)	Bishop James Mahoney Catholic School *n*=41 (31.1%)	Brunskill Public School *n*=29 (22.0%)	St. Lorenzo Ruiz Catholic School *n*=44 (33.3%)
Gender	Female *n*=84 (63.6%)	18 (100%)	26 (63.4%)	14 (48.3%)	26 (59.1%)
	Male *n*=46 (34.8%)	0	15 (36.6%)	14 (48.3%)	17 (38.6%)
	Other *n*=2 (1.5%)	0	0	1 (3.4%)	1 (2.3%)
Grade	7 *n*=73 (55.3%)	0	0	29 (100%)	44 (100%)
	9 *n*=59 (44.7%)	18 (100%)	41 (100%)	0	0

Note: (%) in greyed area represent the percentage of the specific demographic within each school.

6.2.1. Matched-Paired T-Tests: Cannabis Knowledge Assessment Tool

Results comparing the overall C-KAT scores in those students who completed a pre-test and post-test showed that student scores increased from the pre-test (mean=46.17, SD=5.46), to the post-test (mean=50.71, SD=4.58). At the $\alpha=0.05$ level of significance, there was a statistically significant change in knowledge between the pre-test and post-test (p-value <0.05) (Table 4).

6.2.1.1. Comparison Between Grade 7 and 9

C-KAT scores for grade 9 students increased from the pre-test (mean=48.76, SD=4.66), to the post-test (mean=52.51, SD=3.94) (p-value <0.05). For the grade 7 students, pre-test scores for knowledge (mean=44.07, SD=5.17) also increased during the post-test (mean=49.26, SD=4.56) (p-value <0.05). At the α=0.05 level of significance, there was a statistically significant change in knowledge between the pre-test and post-test in grade 7 and grade 9 students (p-value <0.05) (Table 4).

6.2.1.2. Comparison Between Genders

A sub-analysis was performed whereby participants were stratified by gender. The mean scores increased for all gender identifications in the pre- and post-tests [pre-test: female students (mean=45.57, SD=5.54), male students (mean=47.13, SD=5.25) and students identifying as other (mean=49, SD=5.66) ; post-test; female students (mean=50.70, SD=4.51) (p-value <0.05), male students (mean=50.65, SD=4.79)(p-value <0.05) and students identifying as other (mean=52.50, SD=3.54) (Table 4). The increase in scores for both males and females were statistically significant (p-value<0.05). The sample size for students who did not identify as male or female (n=2) was too low for any statistical analysis (Table 4).

6.2.1.3. Comparison Between Schools

An analysis was performed to determine the mean changes in pre and post test scores for each school. Due to a sample size less than 25, statistical analysis could not be completed on the CKAT scores for Tommy Douglas Collegiate students. The scores for students at Bishop James Mahoney Catholic School increased from the pre-test (mean=49.37, SD=4.91) to the post-test (mean=53.17, SD=3.67) (p-value <0.05). The scores for students at Brunskill Public School improved from the pre-test (mean=45.24, SD=5.85) to the post-test (mean=49.48, SD=5.08) (p-value <0.05). The scores for students at St. Lorenzo Ruiz Catholic School improved from the pre-test mean of 43.30 (SD=4.58) to the post-test mean of 49.11 (SD=4.25) (p-value <0.05) (Table 4). The increase in scores were statistically significant for all 4 schools (p-value <0.05) (Table 4).

Table 4. Match-paired t-test for the C-KAT score before and after the REACH program presented according to grade, gender and school.

Knowledge Variable	Mean Pre-test (SD)	Mean Post-test (SD)	Mean Change (SD)	P-value
Grade 7 (n=73)	44.07 (5.17)	49.26 (4.56)	5.19 (4.32)	<0.05

Grade 9 (n=59)	48.76 (4.66)	52.51 (3.94)	3.75 (4.26)	<0.05
Female (n=84)	45.57 (5.54)	50.70 (4.51)	5.13 (4.62)	<0.05
Male (n=46)	47.13 (5.25)	50.65 (4.79)	3.52 (3.67)	<0.05
Other Genders (n=2)	49.00 (5.66)	52.50 (3.54)	3.50 (2.12)	
Tommy Douglas Collegiate (n=18)	47.39 (3.82)	51.00 (4.20)	3.61 (5.57)	
Bishop James Mahoney Catholic School (n=41)	49.37 (4.91)	53.17 (3.67)	3.80 (3.63)	<0.05
Brunskill Public School (n=29)	45.24 (5.85)	49.48 (5.08)	4.24 (3.63)	<0.05
St. Lorenzo Ruiz Catholic School (n=44)	43.30 (4.58)	49.11 (4.25)	5.82 (4.65)	<0.05
Total (n=132)	46.17 (5.46)	50.71 (4.58)	4.55 (4.34)	<0.05

6.2.2. Match-Paired T-Tests: Behavioural Intention Scale

The overall mean pre-test for all 132 participants was 48.90 (SD=7.49) and the mean overall post-test was 48.49 (SD=7.61), indicating that there was no significant change from pre-test to post test. No significant changes were noted for any of the demographics, with the exception of female students (p-value <0.05) (Table 5).

Table 5. Match-paired t-test for the total BI score before and after the REACH education program presented according to grade, gender and school.

BI Scale Variable	Mean Pre-test (SD)	Mean Post-test (SD)	Mean Change (SD)	P-value
Grade 7 (n=73)	51.03 (5.49)	50.62 (5.78)	-0.41 (3.28)	0.144
Grade 9 (n=59)	46.27 (8.74)	45.85 (8.74)	-0.42 (4.19)	0.221
Female (n=84)	48.94 (7.49)	48.18 (7.85)	-0.76 (4.11)	<0.05
Male (n=46)	49.09 (7.59)	49.26 (7.21)	0.17 (2.85)	0.341
Other Genders (n=2)	43.00 (4.24)	43.50 (6.36)	0.50 (2.12)	

Tommy Douglas Collegiate (n=18)	47.06 (8.56)	46.44 (8.87)	-0.61 (4.07)	
Bishop James Mahoney Catholic School (n=41)	45.93 (8.90)	45.59 (8.78)	-0.34 (4.29)	0.307
Brunskill Public School (n=29)	53.00 (4.62)	52.90 (4.86)	-0.10 (2.11)	0.397
St. Lorenzo Ruiz Catholic School (n=44)	49.73 (5.68)	49.11 (5.89)	-0.61 (3.88)	0.150
Total (n=132)	48.90 (7.49)	48.49 (7.61)	0.42 (3.70)	0.099

Matched-paired t-test were performed for each individual question of the BI scale (Table 6) and statistical differences were found only three of the items. The scores for *I am curious about what it feels like to try cannabis* (p-value <0.05) and *I have family members who use cannabis* decreased after the REACH program (p-value <0.05), while the scores for *Using cannabis will negatively affect my future (for example, sports, jobs, school)* increased (p-value <0.05) **(**Table 6).

Table 6. Match-paired t-test for the mean change in score of each BI scale question, for all participants (n=132).

Variable	**Mean Change (SD) (n=132)**	**P-value**
Using cannabis will negatively affect my health	0.03 (1.04)	0.370
Using cannabis will give me a fun “high”	0.01 (1.01)	0.466
I am curious about what it feels like to try cannabis	-0.23 (0.90)	<0.05
Using cannabis will negatively affect my future (for example, sports, jobs, school)	0.21 (1.28)	<0.05
Most people who are important to me think using cannabis is okay	-0.05 (0.81)	0.228
I have friends who use cannabis	-0.09 (1.11)	0.174
I have family members who use cannabis	-0.23 (0.87)	<0.05
I will consider using cannabis to impress my friend(s)	-0.04 (0.71)	0.272

I will consider using cannabis to gain a sense of independence from my parents	-0.07 (0.73)	0.144
My decision to use cannabis is up to me	0.02 (1.05)	0.434
I have a trusted adult I can talk to about cannabis	-0.05 (1.25)	0.314
I will consider using cannabis before the legal age in my province	0.08 (0.88)	0.140

7. DISCUSSION

First, the use of the Delphi method showed to be an appropriate study design for reaching formal consensus and developing a cannabis questionnaire. The use of the cannabis knowledge assessment tool (C-KAT) showed that knowledge about cannabis improved after students participated in the REACH program via a pre-test and post-test study design. The improvement in student knowledge occurred within each demographic of gender, grade and school with a sample size greater than 25. However, the study did not find that the Behavioural Intention (BI) scale was useful in determining the intentions of students towards cannabis use following the REACH program. This chapter presents a discussion of the study results during questionnaire development, questionnaire testing and overall strengths and limitations.

7.1. Questionnaire Development

7.1.1. Development of the Cannabis Knowledge Assessment Tool

To our knowledge, this study was the first to develop a tool to assess cannabis knowledge. Therefore, a method that allowed us to gain expert opinion and reach consensus during the development of the questionnaire was deemed valuable to increase the content validity. The Delphi method was used in the process, as it allowed for a large sample size of experts while maintaining their confidentiality from one another to avoid biases in expert responses. Hence, they could all answer openly and honestly without having to worry about ‘group-think’. In Round 1, we were able to recruit 24/34 invited experts representing all five category of experts that were intended for adequate information retrieval. The ten experts who chose not to complete Round 1 did not disclose the reason for their lack of participation, however it is believed that three of them may have been on holiday due to automated replies that were received from their email accounts and as the data gathering for the Delphi method began in the summer.

Prior to round 2, the format of the C-KAT was piloted with two grade 7 students and one high school student. This pilot work gave researchers insight on the difficulties of different

question formats for this age range of students and helped identify content difficulty or ambiguity. For instance, single true or false (TF) questions were deemed as too easy and students preferred when the question format remained the same throughout the questionnaire. Conversely, multiple-multiple choice (MMC) questions were recognized as too difficult by the students and were identified by questionnaire development experts to be more appropriate for university level students. Compared to multiple choice (MC) questions, multiple true-false (MTF) questions allow for more items to be tested, with a smaller number of questions. Therefore, the questionnaire does not feel daunting for participants and attempts to avoid participant fatigue and skipped questions. Also, MTF questions more accurately identify students with misunderstandings of concepts or incomplete understanding, as compared to MC questions which only capture a student's preferred answer and do not explore students' thinking of the other answer options. Therefore, MC questions may overestimate a student's understanding. Downsides of MTF questions that were discussed include the 50% chance of students guessing the correct answer or correctly indicating an answer as *false* but not knowing what the *true* version would be; However, when compared to MC questions, MTF decrease cluing and ceiling effects. Furthermore, an answer key was created by researchers to address the true answer for each item so students can check their understanding following the post-test (Appendix D). Ultimately, the MTF format allowed researchers in this study to test knowledge of 64 separate items within only 16 questions.

Round 2 of the Delphi method had a loss of 3 participants. Of the three experts who did not participate in Round 2, one was a patient who gave no reason for their discontinuation in the study, one was a policymaker who was 'out-of-office' on their email reply, and one student indicated that they found the instructions and questions in Round 2 complicated and were unable to complete the questionnaire. Although the student expert did not continue participating in the Delphi method, their contribution was valuable in assessing how participants, especially other students, may misunderstand the instructions given for the Delphi method or could find the content too difficult. Based on this feedback, the instructions in subsequent emails were made clearer and more detailed.

Round 2 was the only time that questions had a percent agreement lower than 70% (Q4, Q6, Q7, and Q9). Based on the feedback from the participants, the disagreement with these questions was regarding wording and difficulty of content, but not about the content being covered. The reason for this high percent of disagreement is likely due to Round 2 being the first

round of close-ended questions made by the researchers based on the results of Round 1. Therefore, the wording and difficulty of the questions had not yet been vetted and was far from the expectations of the participants, while the content was based on the results from Round 1.

Next, in Round 3, Q1) *which statements are TRUE regarding cannabis,* received a much lower approval score when compared to all other questions in the round. This is a result of the changes made to the question from Round 2 to Round 3. In Round 2, the answers in Q1 included: *A) Cannabis is natural and therefore completely safe to use, B) Cannabis can be beneficial in certain medical treatments but is not curative, C) Scientists and doctors know all of the adverse consequences of cannabis use* and*, D) Scientists and doctors know all of the benefits that cannabis may have.* These answers address the theme of misunderstandings or gaps in scientific knowledge regarding cannabis. However, in Round 3 the answers were adjusted to: *A) Cannabis is sometimes called marijuana, B) THC (tetrahydrocannabinol) and CBD (cannabidiol) are the only active ingredients in cannabis, C) The major active ingredients in cannabis are terpenes,* and *D) There are more than 400 ingredients found in cannabis.* These answers involve a variety of themes from terminology, the active compounds in cannabis, and the composition of cannabis. In addition to participants suggesting that too many different topics were being approached at once in a question, they also noted that the question was testing trivial knowledge of cannabis instead of knowledge that students should know to make informed decisions about their health and wellness. This was valuable feedback to inform changes to the question necessary to improve the question.

The last round of the Delphi method had 18 participants: three less than the previous round. The three participants, including one academic, one student and one policy maker, did not cite a reason for discontinuing their participation. While the percent agreement for most questions increased, Q9 (*in someone using cannabis, which of the following ways may be harmful to their lungs*) and Q16 (*if you want reliable information about cannabis, where should you seek out information*) received less than 80% agreement. The written feedback for both questions suggested wording changes, so this was addressed in the final version. However, it is important to distinguish consensus and unanimous agreement when performing the Delphi method. As most previous Delphi method literature indicates, 70% is an acceptable percent agreement rate. Therefore, changes were made to some wording in Q9 and Q16, however the content was not

changed as the percent agreement was already above 70% and no participants picked *strongly disagree* for either of these questions while only one picked *disagree* for each.

At this point in time, it was felt that there was enough consensus to make the questionnaire complete without need for further feedback. This decision was based on the literature guiding the appropriate use of the Delphi method, and our comfort with consensus based on responses and open-ended feedback from participants.

7.1.2. Development of the Behavioural Intention Scale

In addition to measuring knowledge change, we wanted to see if taking the REACH program may be able to predict future behaviour with respect to cannabis use. Hence, we developed a Behavioural Intention (BI) scale. As a starting point to inform the BI scale, we used feedback written by experts in the first round of the Delphi method. Particularly, Q6 asked experts to indicate what information they believed was essential for youth to know about cannabis. Using this information, researchers drafted a BI scale which was ultimately reviewed by 6 people with various levels of expertise.

The developed BI scale covered items that may factor into motivation for future behaviours, such as peer perception, peer pressure, perceived personal control, family influences and safe spaces to seek guidance; However, in the case of surveys based on behaviour, it is difficult to determine if the outcome of the survey is a measure of true future behaviour. Further studies can focus on observing actual behaviour of students, reported behaviour in schools while also surveying their knowledge and behavioural intentions in regard to cannabis.

7.2. Questionnaire Testing

The C-KAT post-test results showed that student scores had increased from the pre-test mean in each studied demographic with adequate sample size (grade 7, grade 9, female, male, Bishop James Mahoney Catholic School, Brunskill Public School and St. Lorenzo Ruiz Catholic School). Specifically, the scores of the grade 9 students were higher in the pre-test and the post-test as compared to the grade 7 students. Since the REACH program has different modules for grade 7 and grade 9 students based on the Saskatchewan Ministry of Education's health education curricular for each grade, the content variation of the program may explain this. Also, students in grade 9 may be exposed to more information about cannabis through media, peers and their families as they were older when legalization occurred, and they have additional years of 'real world experience'. No floor or ceiling effects were reported for the C-KAT as no student scored

all questions incorrect or all questions correct. Encouragingly, it appeared as if the REACH program was able to increase some knowledge about cannabis in all groups of participants.

Overall, the BI scale showed no significant changes in behaviour following the REACH program for any demographic other than females. The female scores decreased by 0.76 points, which means the post-test for females had a less favourable behaviour score than the pre-test ($P<0.05$). The lack in statistically significant change and the decrease in female scores may be attributed to several factors. First, the female cohort had the largest sample size in the study with 84 participants (63.6% of all participants) and cohorts such as Tommy Douglas Collegiate and those who identified as "other" had to be removed from statistical analysis due to small sample sized. Therefore, it is possible that small sample size was a limitation for the other demographics and the BI scale should be explored in larger samples.

The tool may also need to be scored differently or have certain items removed as some questions may be considered more important than others depending on the motivation for behaviour that is determined to be the most significant. For example, questions regarding normative beliefs, such as *Most people who are important to me think using cannabis is okay* may be deemed as less important than questions that assess attitude toward the behaviour, such as *Using cannabis will negatively affect my health.*

Furthermore, it is possible that education programs such as REACH should not be expected to change behaviour and are more focused on knowledge improvement. The behavioural impact of such programs may be limited, especially when the program is administered over a short period of time with no supplemental material to prolong learning, such as take-home assignments. Students in grade 7 and 9 may already have set behavioural intentions regarding substance use by this age and therefore the REACH program did not change their perceptions of this behaviour.

Another possible explanation for the lack of meaningful improvement in the BI scale scores is the time between completion of the REACH program and administration of the post-tests. For instance, for Brunskill Public School and Bishop James Mahoney Catholic School, the post tests were performed one week following the completion of REACH while at Tommy Douglas Collegiate, the post-test was administered immediately following their last lesson and for St. Lorenzo Ruiz Catholic School, the post-test occurred the day following their last REACH

lesson. The timeline of post-tests must be considered in future studies to determine if this is an important variable.

A significant change was not observed between the pre-test and post-test scores on the BI scale when broken down to each demographic; however, it was found that the true mean BI score for the questions *I am curious about what it feels like to try cannabis* and *I have family members who use cannabis* after the REACH program was significantly lower than the true mean BI score for the questions before the REACH program ($p < 0.05$). This may indicate that students may be more curious about what it feels like to try cannabis following the REACH program. Also, it is possible that students have a better understanding of what cannabis is and realize that they do have family members who use it. Students may have also spoken with their parents or family members more openly about cannabis use while learning about cannabis at school and learned that their family members do use cannabis for medical or recreational purposes, thus more students answered that they have family members who use cannabis. In theory, the scores for *I have family members who use cannabis* should have remained the same between the pre- and post-test since it is unexpected that a significant number of students would have changed their answer to this question in such a short time frame. Conversely, scores for the question *using cannabis will negatively affect my future (for example, sports, jobs, school)* after the REACH program became more favorable ($p<0.05$). Perhaps after the education the students became aware of the negative consequences of cannabis use. Nevertheless, it is still important to not draw too many inferences from this one response because as a whole, the BI scale did not appear to capture any future changes in participants behavioural intentions.

7.3. Strengths and Limitations

In literature pertaining to the use of the Delphi method, the selection of experts is highlighted as a key step in ensuring success for the study. Some criteria include having a minimum of 10 participants and upward of 50 to 100, with 5 to 10 participants per discipline of expertise. In this study, seven healthcare professionals, six policymakers, eight patients, six academics, and seven students were invited to participate, and in Round 1 six health care professionals, five policymakers, four patients, three academics in the field, and five students participated. This composition of respondents closely follows the criteria set by previous Delphi methods. Furthermore, while the retention rate of the Delphi method can be low, this study retained 78% of participants. These participants all had adequate and equal opportunity for

providing feedback as every question in the Delphi method had a comment box for additional suggestions outside of only choosing on the Likert-scale. Due to the maintenance of confidentiality by researchers, participants were able to freely express their thoughts and no dominating opinions biased the input of others. Therefore, the C-KAT was developed through the appropriate use of a validated method in consensus development.

Limitations to the study must also be considered. First, during the expert selection process for the Delphi method, middle and high school educators were not specifically included in the participant list. Although some experts had a previous background in youth education, there were no current teachers or teaching assistants. Educators from elementary schools, middle schools and high schools would have been beneficial to determine the understandability of the questionnaire for the students and for use in the general public. As teachers have first-hand experience with reading levels and student comprehension, their involvement would increase the accessibility of the questionnaire. The piloting of the questionnaire was also only completed in three students, which may not have allowed for a variety of reading levels to be assessed and adjusted for. Piloting the post-Round 4 questionnaire in a class of students would also have been beneficial for greater feedback on readability prior to finalization of the questionnaire.

Another limitation is the retention rate of participants decreased throughout the Delphi method, other than between Round 2 and Round 3, so a nonresponse bias must be considered. While participants who decided to not respond or to not continue responding to the Delphi method may have missed their email invitation or been on holiday, it is also possible that they had different views compared to the overall study or changes that were being made to the questionnaire. For instance, some chosen experts may not agree with in-school cannabis curriculums and chosen not to participate. Next, some experts may have disagreed with the direction of the questionnaire and discontinued their participation in subsequent rounds. In addition to nonresponse bias, the open-ended style questions of Round 1 in the Delphi method and the iterative multistep approach may have been discouraging, especially for participants who had already busy schedules. Researchers attempted to maximize participant retention through anonymity of answers and other steps that have been proven to effect retention, such as personalized emails and reminder emails.

The study identified areas of improvement in questionnaire development and testing. First, emergent coding was used for the answers to the open-ended questions in Round 1 of the Delphi

method. While emergent coding is appropriate for broad and exploratory questions, such as those in Round 1, it is not as rigorous as established coding. Therefore, emergent coding does not allow researchers to identify frequency of themes or the relationship between them as appropriately as established coding may. Also following Round 1, a principal component analysis (PCA) was performed on the themes noted from *Q 1) What essential information should the general public know about cannabis.* While Q1 offers a summarized insight into what experts expect from a cannabis knowledge assessment tool, a PCA on the other questions of Round 1 could also help researchers encompass other themes that may have been missed during their item reduction.

The rigor of the Delphi method for the development of the C-KAT may also be necessary for the development of the BI scale to improve the quality of the scale. Furthermore, the timing of the pre-test and post-test should be evaluated to better evaluate changes in knowledge and behaviour in cohorts of students. For instance, one week may not be enough time following the REACH program for behavioural changes to occur and effect the answers of the students on the BI scale. Also, it is important to determine if knowledge obtained from cannabis education programs, such as REACH, remains in the months or years following the curriculum.

While public and Catholic schools from different geographical locations in Saskatoon, Saskatchewan were studied, sampling bias may continue to exist. The seven schools were chosen as they were accommodating of the REACH program and had teachers that were willing to have their classes participate in both REACH and the pre- and post-testing. Researchers must consider more vulnerable youth populations who may attend school or classes less often or may not be enrolled in school. While such populations are more at risk for harmful cannabis use and should be addresses, they would unfortunately not be encompassed in the study sample. Also, the presence of volunteer bias must be considered in the student population who completed the questionnaire. This volunteer bias is a result of the consent required from parents for students to participate in the study. Parents who are willing to educate their children on cannabis and have their children be educated in the school system regarding substance use are more likely to consent to the study, while those who are opposed to this form of education are likely to not allow their children to participate. This acceptance by the parents of the participating students may also have effects on the behavioural intention scale and knowledge assessment tool. For instance, these students may have prior knowledge regarding cannabis and health from their families, which may skew the results of the knowledge assessment tool to be higher than it would be in the general

public. This may account for the high overall pre-test scores in the C-KAT and BI scale. Therefore, the sample population in this study may not be generalizable to other youth and adolescents, particularly those who may be more vulnerable.

As a result of the COVID-19 pandemic and school closures, the post-tests were taken by students closely following their completion of the REACH program but due to school closure during the COVID-19 pandemic, a response rate of 32% was recorded. Additionally, the timing of the pre-tests and post-tests varied between classrooms. For Brunskill Public School and Tommy Douglas Collegiate, the pre-test was administered immediately prior to the first REACH lesson while the pre-test was administered a week and half prior to the first lesson at St. Lorenzo Ruiz Catholic School and one day prior to the first lesson at Bishop James Mahoney Catholic School. This approach does not allow researchers to disregard timing of the tests as a variable for the results and must be observed in future studies.

At each school, teachers were present during administration of the pre- and post-test. Some teachers chose to participate by handing out questionnaires or proctoring the assessments while others stepped back while researchers lead the process. Having teachers present during administration of the questionnaire may make students perform differently on the C-KAT and BI scale when their teachers are in the room watching them answer questions as this removes the anonymity from their answers. Also, in some cases when the researcher was busy addressing one student's question, the teacher would approach other students who wanted to ask questions. In these cases, the teacher could see the students answers and could give false information or guide them to the correct answer which would interfere with the study results. In future iterations of the study, it would be useful to ensure that all teaching staff are given instructions to observe the study process without giving their input or discipline to students during the test taking as this may confound the results, or ideally to be removed from the room altogether. Also, as the BI scale is a self-reported measure of behaviour, researchers must consider self-report bias. The responses on the BI scale may be exaggerated, due to aspects of peer pressure or insecurity, or can be downplayed due to respondent's embarrassment to reveal private details. For instance, students may feel reluctant to admit to certain behaviours, such as consuming cannabis before the legal age, or may not remember certain details, such as friends or family members using cannabis. Therefore, what students reported on the BI scale may not truly measure their future actions and a study design including direct observation of future actions would be more appropriate.

Ultimately, this study relied on a questionnaire design which has limitations including sampling bias, volunteer bias, nonresponse bias, self-response bias and more. Other areas of concern with questionnaires include problems with wording (ambiguous questions, complexity, vague words), scale formats, intrusiveness for sensitive questions and response fatigue. As a result of these limitations, capturing concepts accurately in survey-based research poses problems and researchers should aim to minimize these biases as much as possible in future iterations of the study.

7.4. Conclusion

To our knowledge, this was the first time that a tool was developed and tested to assess knowledge about and intentions towards cannabis use. The study aimed to determine if the Cannabis Knowledge Assessment Tool and the Behavioural Intention Scale captured changes in knowledge and behaviour intention in populations undergoing cannabis education. In this convenience sample of grade 7 and 9 students who participated in a cannabis educational program, knowledge about cannabis improved, but no significant change was evident in behaviour intention scores with respect to cannabis use. Future studies are required to test the C-KAT and BI scale to determine its usability in other contexts.

APPENDIX A: PARENT CONSENT FORM

UNIVERSITY OF SASKATCHEWAN
College of Pharmacy and Nutrition
USASK.CA/PHARMACY-NUTRITION

Participant Consent Form

Cannabis Education and Assessment of Knowledge and Behaviour

Dear Parent/Guardian(s),

Thank you for taking the time to read this letter – we know you are busy! Your child will be learning about cannabis in school in the next couple of weeks as part of their health class. This will be taught by nurses and nursing students through the Real Education About Cannabis and Health (REACH) program, which is a program that we developed last year with the help of students from a few different Saskatoon schools.

We would like to know if the REACH program improves knowledge about cannabis, and if the knowledge learned through the program may predict future behaviour. Hence, we are inviting students to participate in a study by filling out two paper questionnaires. The first questionnaire will be completed before the students receive their cannabis education, and the second questionnaire will be completed after the completion of the cannabis education. In short, we want to determine if the REACH program is useful to help kids increase their knowledge about cannabis, so that they are able to make healthy decisions.

There are no known or anticipated risks to students by participating in this research. Although the data from this research project may be published or presented at conferences, the results will only be presented as a summary of all responses, so it will not be possible to identify individual answers. Further, your child will be instructed not to use their names on their answer sheet, so that the answers can remain completely anonymous. The questionnaires will be kept in a locked filing cabinet in the locked office of Dr. Kerry Mansell for a period of 5 years post-publication, after which time they will be destroyed by confidential shredding.

Whether your child participates or not will have no effect on their class standing or how they will be treated. Your child's participation is voluntary, and they do not have to answer any questions they are not comfortable with. They may withdraw from the study for any reason without explanation or penalty of any sort. In addition to your consent for your child to participate, they must also give their assent to participate which is done by filling out the questionnaire (they do not have to sign a form).

Should you or your child wish to withdraw your child from participating at any time, please contact one of the following researchers: **Ava Bayat;** Graduate Student, College of Pharmacy and Nutrition, University of Saskatchewan, email: avb513@mail.usask.ca or **Dr. Kerry Mansell,** Professor, College of Pharmacy and Nutrition, University of Saskatchewan, email: kerry.mansell@usask.ca; phone: (306) 966-5235. If you or your child wish to withdraw their data after the study ends (before March 31st, 2020), or if you would like to see a summary of the findings, please contact Dr. Kerry Mansell (email: kerry.mansell@usask.ca; phone: (306) 966- 5235).

This research project has been approved on ethical grounds by the University of Saskatchewan Behavioural Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office (ethics.office@usask.ca; (306) 966-2975). Out of town participants may call toll free (888) 966-2975.

Thank you for considering!

My child(ren),_____has (have) my permission to

participate in this study assessing cannabis knowledge and predicted behaviour after learing about cannabis in the REACH program.

(Parent's Printed Name)	(Parent's Signature)

Date

APPENDIX B: STUDENT ASSENT FORM

UNIVERSITY OF SASKATCHEWAN
College of Pharmacy and Nutrition
USASK.CA/PHARMACY-NUTRITION

Participant Information

Date:_____ Your Unique Code Name:_____

Grade:_____ Gender: Male / Female / Other

Cannabis Knowledge and Behavioural Intention

Welcome to the Real Education About Cannabis and Health (REACH) program. We hope that you find it interesting and informative!

We hope that you will fill out the questionnaire attached to this letter. It should not take you any more than 15 minutes to complete. The questionnaire will ask you questions about your knowledge and feelings towards cannabis. Please answer the questions honestly and the best that you can.

If you are reading this sheet, your parents have signed a consent form saying that you can participate. The decision to complete this questionnaire is up to you. If you choose not to fill it out, it will not affect your grades or your relationship with the instructors or teachers. You do not have to answer any questions you are not comfortable with, and you may withdraw from the study for any reason without explanation or penalty of any sort.

If you choose to participate, please enter the date, what grade you are in, and your gender identification in the spaces above. Also, please choose a code name that will be unique to you and that nobody else will know. We will provide you tips to ensure that it is unique to you. It is important to remember this code name, and not share it with anyone. None of the researchers will know your code name, and so your answers will be completely anonymous and will not be shared with anyone. All of the responses will be grouped together, and so your individual answers will not be reported – you will remain anonymous. The questionnaires will be kept in a locked filing cabinet in the locked office of Dr. Kerry Mansell for a period of 5 years post- publication, after which time they will be destroyed by confidential shredding.

If you have any questions, please feel free to ask one of the REACH leaders, the study coordinator, or your teacher. By completing and submitting this questionnaire, **YOUR FREE AND INFORMED ASSENT IS IMPLIED**, and indicates that you understand the above conditions of participation in this study. If you would like to withdraw your data after the study ends (before March 31st, 2020), or if you would like to see a summary of the findings, please contact Dr. Kerry Mansell (email: kerry.mansell@usask.ca; phone: (306) 966-5235).

This research project has been approved on ethical grounds by the University of Saskatchewan Behavioural Research Ethics Board. Any questions regarding your rights as a participant may be addressed to that committee through the Research Ethics Office (ethics.office@usask.ca; (306) 966-2975). Out of town participants may call toll free (888) 966-2975.

Thank you for your participation!

APPENDIX C: THE QUESTIONNAIRE, C-KAT PORTION

Questionnaire About Cannabis

√ CHECK ONLY THE CORRECT ANSWERS (YOU MAY CHOOSE MORE THAN ONE ANSWER).

1. Which statements are **TRUE** regarding the compounds (ingredients) in cannabis? (check all of the correct answers)

- ☐ THC (tetrahydrocannabinol) is what causes people to feel "high"
- ☐ CBD (cannabidiol) is what causes people to feel "high"
- ☐ Terpenes are what cause people to feel "high"
- ☐ Cannabis used for medical conditions may contain both THC and CBD

2. Which statements are **TRUE** regarding cannabis terms? (check all of the correct answers)

- ☐ Cannabis is sometimes called "marijuana", "weed", or "pot"
- ☐ The terms "sativa" and "indica" refer to different cannabis plants
- ☐ Cannabis with a high amount of THC is called "hemp"
- ☐ The term "cannabinoids" refers to the compounds in cannabis, such as THC and CBD

3. Which statements about cannabis are **TRUE**? (check all of the correct answers)

- ☐ Cannabis is natural, so that means that it is safe to use
- ☐ Scientists and health care professionals know all of the potential harmful effects of cannabis
- ☐ Scientists and health care professionals know all of the potential benefits of cannabis
- ☐ More research is needed to know all the effects of cannabis

4. Which statements are **TRUE** regarding the effects of cannabis? (check all of the correct answers)

- ☐ Inhaling cannabis provides the fastest effects
- ☐ The effects one person feels may be different than the effects another person feels
- ☐ The time it takes to feel the effects of cannabis can be different for everyone
- ☐ People typically feel the effects of edible cannabis within 10 minutes

5. Based on what is known about potential harms, who should *avoid* using recreational cannabis? (check all of the correct answers)

- ☐ Someone who is pregnant or breastfeeding
- ☐ Someone that is older than 65 years old
- ☐ Someone who has a substance use disorder
- ☐ Someone with a personal or family history of psychosis (for example, schizophrenia)

6. Unless you are being treated for a medical condition by a health care professional, why is it important to *avoid* using cannabis before the age of 25? (check all of the correct answers)

- ☐ Using cannabis is not legal until you are 25
- ☐ Using cannabis before 25 may increase the risk of depression later in life
- ☐ You can become addicted to cannabis if you use it before 25, but not after
- ☐ The human brain does not fully develop until around the age of 25

7. People considering cannabis for a *medical condition* should: (check all of the correct answers)

- ☐ Speak to a health care professional (for example, doctors, pharmacists or nurses)
- ☐ Try cannabis from a licensed retailer
- ☐ Try some cannabis from their friends first to see if it may work
- ☐ Try edibles first

8. What are some of the potential *short-term* negative effects of using cannabis? (check all of the correct answers)

- ☐ Difficulty focusing and confusion
- ☐ Lung cancer
- ☐ Increased heart rate
- ☐ Slower reflexes

9. Which of the following ways of using cannabis may be harmful to someone's lungs? (check all of the correct answers)

- ☐ Smoking cannabis
- ☐ Eating cannabis
- ☐ Vaping cannabis
- ☐ Rubbing cannabis on their skin

10. If someone uses a large amount of cannabis for a long time and then suddenly stops, what are some of the withdrawal symptoms they might experience? (check all of the correct answers)

- ☐ Mood changes, such as increased anxiety
- ☐ Better ability to focus
- ☐ Difficulty sleeping
- ☐ There are no known withdrawal symptoms

11. Which statements are **TRUE** about recreational cannabis use in Canada? (check all of the correct answers)

- ☐ The legal age for using it in all provinces is 18 years old
- ☐ The laws for possession are the same in all Canadian provinces
- ☐ You can buy it from licensed online sellers
- ☐ You can grow as much as you want in your home if it is for personal use

12. Which statements are **TRUE** regarding the regulation of cannabis? (check all of the correct answers)

- ☐ You need medical authorization to purchase cannabis from a licensed retailer
- ☐ You can legally purchase recreational cannabis from anyone
- ☐ Licensed producers have similar rules for making both medical and recreational cannabis
- ☐ Stores that sell cannabis can only sell products that are guaranteed to have the same ingredients in them every time

13. Which statements are **TRUE** regarding Canadian cannabis laws? (check all of the correct answers)

- ☐ The maximum amount of cannabis you can carry in public is 30 grams of dried cannabis
- ☐ Drug-impaired driving is not allowed at any time
- ☐ You can use cannabis in a parked vehicle
- ☐ The laws for consuming cannabis in a public space are the same all across Canada

14. If cannabis is used, which decisions may be helpful for reducing harm? (check all of the correct answers)

- ☐ Avoid driving for at least six hours after using cannabis
- ☐ Buy cannabis from a licensed retailer
- ☐ Do not use cannabis until you are at least 25 years old
- ☐ Use cannabis with a lower THC content

15. Which statements are **TRUE** regarding cannabis and travel? (check all of the correct answers)

- ☐ Bringing cannabis into Canada is illegal
- ☐ Leaving Canada with cannabis is illegal
- ☐ You may not be able to enter the USA if you have used cannabis
- ☐ You can take cannabis to other countries if it is also legal there

16. Where should you seek out *reliable* information about cannabis? (check all of the correct answers)

- ☐ Health care professionals (for example, doctors, pharmacists or nurses)
- ☐ Government of Canada website
- ☐ Retail stores that sell cannabis
- ☐ Your peers who are using cannabis

APPENDIX D: THE QUESTIONNAIRE, C-KAT PORTION WITH ANSWERS

√ CHECK ONLY THE CORRECT ANSWERS (YOU MAY CHOOSE MORE THAN ONE).

1. Which statements are **TRUE** regarding the compounds (ingredients) in cannabis? (check all of the correct answers)

- ☐ **THC (tetrahydrocannabinol) is what causes people to feel "high"**
- ☐ CBD (cannabidiol) is what causes people to feel "high"
- ☐ Terpenes are what cause people to feel "high"
- ☐ **Cannabis used for medical conditions may contain both THC and CBD**

Cannabis contains more than 400 compounds. Some of these compounds are terpenes and cannabinoids. Terpenes are responsible for the smell of cannabis. There are more cannabinoids than just CBD and THC, but these are the most researched. THC is what causes people to feel "high", but CBD does not. Medical cannabis may have both THC and CBD.

2. Which statements are **TRUE** regarding cannabis terms? (check all of the correct answers)

- ☐ **Cannabis is sometimes called "marijuana", "weed", or "pot"**
- ☐ **The terms "sativa" and "indica" refer to different cannabis plants**
- ☐ Cannabis with a high amount of THC is called "hemp"
- ☐ **The term "cannabinoids" refers to the compounds in cannabis, such as THC and CBD**

"Hemp" comes from the sativa cannabis plant and has low levels of THC compared to other forms of cannabis.

3. Which statements about cannabis are **TRUE**? (check all of the correct answers)

- ☐ Cannabis is natural, so that means that it is safe to use
- ☐ Scientists and health care professionals know all of the potential harmful effects of cannabis
- ☐ Scientists and health care professionals know all of the potential benefits of cannabis
- ☐ **More research is needed to know all the effects of cannabis**

Even though cannabis is natural, that does not mean it is safe for use. More research is needed to know about all of the positive and negative effects of cannabis. Scientists and health care professionals are still learning!

4. Which statements are **TRUE** regarding the effects of cannabis? (check all of the correct answers)

- ☐ **Inhaling cannabis provides the fastest effects**
- ☐ **The effects one person feels may be different than the effects another person feels**
- ☐ **The time it takes to feel the effects of cannabis can be different for everyone**
- ☐ People typically feel the effects of edible cannabis within 10 minutes

While the effects one person feels may be different than the effects another person feels, smoking (inhaling) cannabis provides the fastest effects. Edibles are slower acting and start having an effect between 30 minutes to 2 hours after.

5. Based on what is known about potential harms, who should *avoid* using recreational cannabis? (check all of the correct answers)

- ☐ **Someone who is pregnant or breastfeeding**
- ☐ Someone that is older than 65 years old
- ☐ **Someone who has a substance use disorder**
- ☐ **Someone with a personal or family history of psychosis (for example, schizophrenia)**

The Canadian government suggests that people who are pregnant and/or breastfeeding avoid cannabis completely. The Canadian government also suggests that people who are at risk for mental health problems, specifically psychosis and problematic substance use, avoid cannabis completely. Healthy individuals over the age of 65 are able to use cannabis safely but can speak to a health care professional about it!

6. Unless you are being treated for a medical condition by a health care professional, why is it important to *avoid* using cannabis before the age of 25? (check all of the correct answers)

- ☐ Using cannabis is not legal until you are 25
- ☐ **Using cannabis before 25 may increase the risk of depression later in life**
- ☐ You can become addicted to cannabis if you use it before 25, but not after
- ☐ **The human brain does not fully develop until around the age of 25**

Cannabis is legal at 18 in Alberta and Quebec but 19 in all other provinces. There is research that has shown a higher risk of depression when cannabis is used before the age of 25. Since the human brain does not fully develop until around the age of 25, those who use cannabis before 25 may experience more long-term mental health effects. You can become addicted to cannabis at any age.

7. People considering cannabis for a *medical condition* should: (check all of the correct answers)

- ☐ **Speak to a health care professional (for example, doctors, pharmacists or nurses)**
- ☐ Try cannabis from a licensed retailer
- ☐ Try some from their friends first to see if it may work
- ☐ Try edibles first

People who want to try cannabis to help them with a medical condition should always speak to a health care professional first. They should not try cannabis from other people, edibles or buying it from a retailer without getting medical advice from a professional.

8. What are some of the potential *short-term* negative effects of using cannabis? (check all of the correct answers)

- ☐ **Difficulty focusing and confusion**
- ☐ Lung cancer
- ☐ **Increased heart rate**
- ☐ **Slower reflexes**

Some short-term negative effects of cannabis include difficulty focusing, confusion, increased heart rate and slower reflexes. Lung cancer may result from long-term cannabis inhalation.

9. Which of the following ways of using cannabis may be harmful to someone's lungs? (check all of the correct answers)

- ☐ **Smoking cannabis**
- ☐ Eating cannabis
- ☐ **Vaping cannabis**
- ☐ Rubbing cannabis on their skin

Lungs are affected by inhaling cannabis, which includes smoking it and vaping it. Rubbing cannabis on their skin may cause a rash and itching.

10. If someone uses a large amount of cannabis for a long time and then suddenly stops, what are some of the withdrawal symptoms they might experience? (check all of the correct answers)

- ☐ **Mood changes, such as increased anxiety**
- ☐ Better ability to focus
- ☐ **Difficulty sleeping**
- ☐ There are no known withdrawal symptoms

Withdrawal symptoms of cannabis include mood changes, difficulty sleeping, loss of focus, cravings for cannabis, changes in appetite, headaches and more.

11. Which statements are **TRUE** about recreational cannabis use in Canada? (check all of the correct answers)

- ☐ The legal age for using it in all provinces is 18 years old
- ☐ The laws for possession are the same in all Canadian provinces
- ☐ **You can buy it from licensed online sellers**
- ☐ You can grow as much as you want in your home if it is for personal use

The legal age for cannabis use in Alberta and Quebec is 18 but in all other provinces you must be 19 years old to legally use cannabis. The laws for possession of cannabis vary between provinces, including the amount you can have on you. In Manitoba and Quebec, you are not allowed to grow any cannabis in your home. In other provinces, adults can legally grow up to four cannabis plants but must follow the laws for growing cannabis in the home.

12. Which statements are **TRUE** regarding the regulation of cannabis? (check all of the correct answers)

- ☐ You need medical authorization to purchase cannabis from a licensed retailer
- ☐ You can legally purchase recreational cannabis from anyone
- ☐ **Licensed producers have similar rules for making both medical and recreational cannabis**
- ☐ Stores that sell cannabis can only sell products that are guaranteed to have the same ingredients in them every time

Anyone over the legal age limit is able to purchase cannabis from a licensed retailer in Canada. Recreational cannabis can only be purchased legally from a licensed retailer. The amount of ingredients (including THC and CBD) in each batch of product vary, even if it is purchased from the same licensed retailer.

13. Which statements are **TRUE** regarding Canadian cannabis laws? (check all of the correct answers)

- ☐ **The maximum amount of cannabis you can carry in public is 30 grams of dried cannabis**
- ☐ **Drug-impaired driving is not allowed at any time**
- ☐ You can use cannabis in a parked vehicle
- ☐ The laws for consuming cannabis in a public space are the same all across Canada

While some provinces allow drivers to use a small amount of cannabis if they are above the legal age, no province allows driving while impaired. Using cannabis in a parked

vehicle is illegal. If cannabis is being transported in a vehicle, it should not be within reach of the driver or passengers.

14. If cannabis is used, which decisions may be helpful for reducing harm? (check all of the correct answers)

- ☐ **Avoid driving for at least six hours after using cannabis**
- ☐ **Buy cannabis from a licensed retailer**
- ☐ **Do not use cannabis until you are at least 25 years old**
- ☐ **Use cannabis with a lower THC content**

A minimum of six hours after cannabis use is suggested before driving a vehicle to avoid drug-impairment and potential harm to yourself or others.
To make sure the cannabis you are using is regulated and does not contain other harmful drugs, only purchase cannabis from a licensed retailer.
The human brain does not fully develop until around the age of 25. Using cannabis before this age may affect mental development and lead to higher risks of anxiety or depression later on.
THC is what causes people to feel "high." Cannabis with lower amounts of THC is recommended.

15. Which statements are **TRUE** regarding cannabis and travel? (check all of the correct answers)

- ☐ **Bringing cannabis into Canada is illegal**
- ☐ **Leaving Canada with cannabis is illegal**
- ☐ **You may not be able to enter the USA if you have used cannabis**
- ☐ You can take cannabis to other countries if it is also legal there

It is illegal to bring cannabis into Canada and to travel outside of Canada with cannabis. Even if cannabis is legal in other countries, it is illegal to travel to those countries with cannabis. If you have used cannabis before you may not be allowed to enter the USA.

16. Where should you seek out *reliable* information about cannabis? (check all of the correct answers)

- ☐ **Health care professionals (for example, doctors, pharmacists or nurses)**
- ☐ **Government of Canada website**
- ☐ Retail stores that sell cannabis
- ☐ Your peers who are using cannabis

You can get reliable information about cannabis from a health care professional and from the Government of Canada website. Cannabis retail stores and your peers may have misinformation about cannabis.

APPENDIX E: DELPHI METHOD FIRST EMAIL CORRESPONDENCE

Dear Jane Doe,

Greetings. My name is Ava Bayat, and I am a graduate student in the College of Pharmacy and Nutrition at the University of Saskatchewan. The purpose of my master's thesis is to make a tool to assess knowledge about cannabis. You have been identified by our research team as having expertise or an interest in this area. As such, I am hoping that you may be able to help out with our project.

As cannabis is now legal and increasing in popularity, there is a need to understand what our youth knows about cannabis. A knowledge tool will help assess cannabis knowledge and be useful for guiding and evaluating education programs.

To make this tool, we will use the Delphi Method to reach an agreement amongst all of the participants. Participants include health care professionals, policy makers, patients, academics, and students. There will be approximately 25 participants in total.

Participating in this project will involve taking part in three separate questionnaires.

- The first survey (round 1) will involve open-ended questions about what you feel should be included on a cannabis knowledge assessment tool
- The second and third surveys (rounds 2 and 3) will consist of follow up questions that will be developed based on the information gathered from the first survey

We would like to invite you to participate in the first questionnaire.

Your answers to these questions will be kept confidential, and your identity will not be shared with the other participants. Your decision to take part is voluntary. If you choose to participate, we kindly ask that you complete the survey by **July 18th, 2019**. Each survey will take about 15 minutes to complete.

If you have any questions or concerns, please feel free to email me at any time. I am also happy to chat in person if that is easier; my contact information is provided at the end of this email.

This survey is hosted by SurveyMonkey, a USA owned company so the privacy of the information you provide may be subject to USA laws. By participating in this survey, you acknowledge and agree that your answers will be stored in Canada, but they may or may not receive the Canadian law's level of privacy protection. Your responses in the survey will remain anonymous. A copy of the research data will remain on Kerry Mansell's protected computer for a minimum of five years as per University of Saskatchewan Guidelines.

By completing the questionnaire, **YOUR FREE AND INFORMED CONSENT IS IMPLIED,** and indicates that you understand the conditions of participation in this study as mentioned above.

A link to this questionnaire can be found at XXX.

This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. For any questions regarding your rights as a participant please contact the committee through the Research Ethics Office: ethics.office@usask.ca or (306) 966-2975. Out of town participants may call toll free: (888) 966-2975. If you have any questions about the project itself, you may contact myself (Ava Bayat) or Kerry Mansell (principal investigator) at (306) 966-5235 or kerry.mansell@usask.ca. A summary of the research results will be offered through email following the last round of surveys.

Thank you for your time,

Ava Bayat, MSc student
College of Pharmacy and Nutrition, University of Saskatchewan
Phone number
Email

APPENDIX F: SUBSEQUENT ROUND EMAIL

Dear Jane Doe,

Greetings.

Thank you so much for participating in our project to make a tool to assess knowledge about cannabis use. We know that your time is valuable, and we truly appreciate your help! Your opinions are extremely important as they are guiding the tool development process.

Please click on the link below to complete a follow-up survey, which is based on the feedback from Round 1. XXXXX.

Your answers in the survey will be kept confidential, and your identity will not be shared with the other participants. Your decision to take part is voluntary. If you choose to participate, we kindly ask that you complete the survey by **September 16th, 2019**. Each survey will take about 15 minutes to complete.

If you have any questions or concerns, please feel free to email me at any time; my contact information is provided at the end of this email.

This survey is hosted by SurveyMonkey, a USA owned company so the privacy of the information you provide may be subject to USA laws. By participating in this survey, you acknowledge and agree that your answers will be stored in Canada but they may or may not receive the Canadian law's level of privacy protection. Your responses in the survey will remain anonymous. A copy of the research data will remain on Kerry Mansell's protected computer for a minimum of five years as per University of Saskatchewan Guidelines.

By completing the survey, **YOUR FREE AND INFORMED CONSENT IS IMPLIED** and indicates that you understand the conditions of participation in this study as mentioned above.

This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. For any questions regarding your rights as a participant please contact the committee through the Research Ethics Office: ethics.office@usask.ca or (306) 966-2975. Out of town participants may call toll free: (888) 966-2975. If you have any questions about the project itself, you may contact myself (Ava Bayat) or Kerry Mansell (principal investigator) at (306) 966-5235 or kerry.mansell@usask.ca. A summary of the research results will be offered through email following the last round of surveys.

Thank you for your time. We look forward to sharing more results in the next round of the project.
Ava Bayat, MSc student
College of Pharmacy and Nutrition, University of Saskatchewan
Phone number
Email

APPENDIX G: REMINDER EMAIL

Dear Jane Doe,

About two weeks ago, you received an email inviting you to take part in a survey about a tool for assessing cannabis knowledge.

If you have not had a chance to complete the survey yet, we would still love to hear from you! We are asking health care professionals, policy makers, patients, academics, and students to help us identify what topics the knowledge tool should cover.

To complete the survey, please go to the link below: XXXX.

Your answers in the survey will be kept confidential, and your identity will not be shared with the other participants. Your decision to take part is voluntary. If you choose to participate, we kindly ask that you complete the survey by July 26th. Each survey will take about 15 minutes to complete.

If you have any questions or concerns, please feel free to email me at any time. I am also happy to chat in person if that is easier; my contact information is provided at the bottom of this email.

This survey is hosted by SurveyMonkey, a USA owned company so the privacy of the information you provide may be subject to USA laws. By participating in this survey, you acknowledge and agree that your answers will be stored in Canada but they may or may not receive the Canadian law's level of privacy protection. Your responses in the survey will remain anonymous. A copy of the research data will remain on Kerry Mansell's protected computer for a minimum of five years as per University of Saskatchewan Guidelines.

By completing the survey, **YOUR FREE AND INFORMED CONSENT IS IMPLIED** and indicates that you understand the conditions of participation in this study as mentioned above.

This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. For any questions regarding your rights as a participant please contact the committee through the Research Ethics Office: ethics.office@usask.ca or (306) 966-2975. Out of town participants may call toll free: (888) 966-2975. If you have any questions about the project itself, you may contact myself (Ava Bayat) or Kerry Mansell (principal investigator) at (306) 966-5235 or kerry.mansell@usask.ca. A summary of the research results will be offered through email following the last round of surveys.

Thank you for your time,

Ava Bayat, MSc student
College of Pharmacy and Nutrition, University of Saskatchewan
Phone number
Email

APPENDIX H: FINAL REMINDER EMAIL

Final Reminder-Responses due Friday, August 9th

Dear Jane Doe,

About a month ago, you received an email inviting you to take part in a survey about a tool for assessing cannabis knowledge.

If you have not had a chance to complete the survey yet, we would still love to hear from you! We are asking health care professionals, policy makers, patients, academics, and students to help us identify what topics the knowledge tool should cover.

A link to this questionnaire can be found at XXXXX.

Your answers in the survey will be kept confidential, and your identity will not be shared with the other participants. Your decision to take part is voluntary. If you choose to participate, we kindly ask that you complete the survey by this Friday, August 9th. Each survey will take about 15 minutes to complete.

If you have any questions or concerns, please feel free to email me at any time.

This survey is hosted by SurveyMonkey, a USA owned company so the privacy of the information you provide may be subject to USA laws. By participating in this survey, you acknowledge and agree that your answers will be stored in Canada but they may or may not receive the Canadian law's level of privacy protection. Your responses in the survey will remain anonymous. A copy of the research data will remain on Kerry Mansell's protected computer for a minimum of five years as per University of Saskatchewan Guidelines.

By completing the survey, **YOUR FREE AND INFORMED CONSENT IS IMPLIED** and indicates that you understand the conditions of participation in this study as mentioned above.

This research project has been approved on ethical grounds by the University of Saskatchewan Research Ethics Board. For any questions regarding your rights as a participant please contact the committee through the Research Ethics Office: ethics.office@usask.ca or (306) 966-2975. Out of town participants may call toll free: (888) 966-2975. If you have any questions about the project itself, you may contact myself (Ava Bayat) or Kerry Mansell (principal investigator) at (306) 966-5235 or kerry.mansell@usask.ca. A summary of the research results will be offered through email following the last round of surveys.

Thank you for your time,

Ava Bayat, MSc student
College of Pharmacy and Nutrition, University of Saskatchewan
Phone number
Email

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