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# Sex Gender and Cannabis

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## EXECUTIVE SUMMARY

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This report reviews current research and data on cannabis use and its effects in order to highlight sex and gender related factors and issues. It is one of the products of a policy-research partnership project funded by Health Canada and the Canadian Institutes of Health Research Institute of Gender and Health and managed by the Gender Health Unit of the Strategic Policy Branch of Health Canada. The overall goal of applying a sex and gender-based analysis (SGBA+) to cannabis is to integrate sex and gender into cannabis prevention and public education, for all populations: men, women, boys, girls, and gender diverse individuals.

This partnership project has several goals: to support the analysis of available data regarding cannabis use patterns among gender groups; to provide expertise and capacity building on sex and gender-based analysis plus (SGBA+); to support the development of responsive and effective public education and awareness products; to support monitoring and evaluation activities related to the initiative as well as priorities for future initiatives in research, policy and programming for Health Canada.

Assessing the sex and gender related factors affecting cannabis use is important in order to better inform Health Canada, the Controlled Substances and Cannabis Branch and the Communications and Public Affairs Branch on prevention messaging and public information on cannabis. As with many health issues, and like most other substances, cannabis affects female and male bodies differently, and, is used or treated in ways that reflect gendered roles, relations, identity and rules.

Hence, this report assesses recent social and biological research that investigates sex, gender and cannabis; analyses current survey data from Statistics Canada and Health Canada; reviews public opinion research (POR) commissioned by Health Canada; highlights areas requiring more sex and gender focus in the Health Canada Cannabis Indicator Framework; and makes several suggestions for priority actions, research directions, and future prevention messaging. The evidence in the literature related to sex and gender factors and cannabis use and its effects was linked to related survey questions, POR findings, and the Health Canada Cannabis Indicator Framework, in order to map the implications of these findings for Health Canada and to derive recommendations for future initiatives in research, policy and programming for Health Canada.

The evidence reviewed is, in part, derived from a scoping review of both academic and grey literature attached to a Canadian Institutes of Health Research Institute of Gender and Health (CIHR-IGH) Knowledge Translation Team Grant investigating the effect of introducing sex, gender and gender transformative concepts and information into the substance use system in Canada. Much of this evidence was generated prior to cannabis legalization in October 2018. This evidence has been supplemented by several purposive searches on selected topics.

The survey data, public opinion research and the Health Canada Indicators Framework were subjected to a SGBA+ (sex & gender-based analysis plus) analysis. Core to the process is an understanding of sex, gender, diversity and equity, along with gender transformative public health and health promotion solutions. Sex refers to the biologically based factors and

characteristics of individuals such as anatomy, physiology, genetics and hormones that influence the physiological responses of individuals. Gender refers to the ascribed or assumed social, cultural and economic factors that influence individual and group behavior and responses. These two factors interact with a range of diversities such as age, ethnicity, dis/ability and sexual orientation to generate the specific effects of cannabis use, and diverse responses to prevention, treatment and public education. Overarching efforts in health and health promotion are aimed at increasing gender and health equity, by generating gender transformative solutions that do not reinforce negative aspects of gender, but rather improve individuals' status and gender equity, along with health.

The recommendations reflect the need for: a) more research on sex related factors in cannabis research; b) focused attention on inserting SGBA+ and gender transformative approaches into procurement, survey and creative processes; c) generating information on the relative harms of routes of administration of cannabis; d) aligning prevention and public education with normative approaches to alcohol and nicotine; e) enhanced gendered approaches to preventing impaired driving; f) information for higher risk sexual minority groups; g) the development of sex specific lower risk cannabis use guidelines and sex specific information for consumers and clinicians; h) more robust gendered parenting information; and i) harm reduction messaging on multi-substance use involving cannabis. Some ideas for prevention messaging are suggested along with improved development processes that reflect sex, gender, diversity and equity issues. Overall, there is much to be done to fill out the evidence on sex, gender and cannabis, and in applying such knowledge to practice and policy.

## THE SGBA+ CANNABIS POLICY CONTEXT:

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Cannabis was legalized in Canada on October 17, 2018. The intent of the *Cannabis Act* (which received Royal Assent on June 21, 2018) is to regulate and legalize the use and sale of cannabis. Specifically, the aims of the Cannabis Act are: **(a)** protect the health of young persons by restricting their access to cannabis; **(b)** protect young persons and others from inducements to use cannabis; **(c)** provide for the licit production of cannabis to reduce illicit activities in relation to cannabis; **(d)** deter illicit activities in relation to cannabis through appropriate sanctions and enforcement measures; **(e)** reduce the burden on the criminal justice system in relation to cannabis; **(f)** provide access to a quality-controlled supply of cannabis; and **(g)** enhance public awareness of the health risks associated with cannabis use. The issues connected to cannabis legalization span health, research and law enforcement, and benefit from a consistent and comprehensive sex, gender and equity analysis, especially in relation to crafting prevention messages and initiatives regarding use.

### *SGBA+ and Policy-Research Partnership Goals:*

A team of researchers from the Centre of Excellence for Women's Health, led by Dr. Lorraine Greaves, has partnered with policy leads at Health Canada, Cannabis Legalization and Regulation Branch (CLRB), and Communications and Public Affairs Branch (CPAB) to ensure sex and gender related factors are integrated into future research, public health education and prevention initiatives for cannabis, and that these are informed by sex and gender analyses. This research-policy partnership is a collaborative initiative between the Canadian Institutes of Health Research (CIHR) - Institute of Gender and Health (IGH) and Health Canada's Gender Health Unit (GHU) and is one of several projects under this joint program.

### *Why SGBA+?*

Sex- and gender-related factors have an effect on cannabis use, the effects of use, and the response to cannabis use interventions and approaches. Sex related factors include the biological factors and mechanisms that are affected by, or affect, cannabis use in male and female bodies, while gender related factors include the effects on all people of gender norms, relations, identity and gendered institutional factors such as laws, regulations and customs. These concepts are evolving and fluid, and each comprise several elements. For example, sex related factors include elements such as hormones, genetics, metabolic processes, anatomical characteristics and organ function, while *gender* related factors include the effects of roles, relational power differences, perceived identity, processes of discrimination, differential opportunities, and stereotyping affecting individuals in all cultures. *Gender transformative* approaches are an aspirational consequence of SGBA+, and aim to improve gender and health equity *along with* improving health. Gender transformative principles are a guide to creating forward-looking prevention and public education that avoids reinforcing negative gender stereotyping. This report: a) consolidates the currently available evidence on the effects of sex and gender on cannabis use and health effects; b) reflects on available Canadian survey data and public opinion research on cannabis; c) applies an SGBA+ to the evolving Cannabis Indicator Framework; d) offers recommendations for future prevention initiatives, research and messages.

### **Caution Advised: The limitations of existing cannabis research evidence**

There are several limitations of existing cannabis research and evidence that affect our knowledge of sex, gender and patterns of cannabis use and health effects. As a result, evidence must be interpreted with caution. Many of the following weaknesses are evident in academic research, public opinion research and survey research.

*Paucity of research on sex and gender.* Overall, more research and surveillance is needed on cannabis use. While research on cannabis is rapidly expanding in response to a shifting policy landscape, research specifically focussed on the impact of sex and gender on cannabis use is in its infancy. For example, more research is needed on gender and perceived benefits and harms of cannabis use and the role of gender roles and norms on patterns of cannabis use. There is also a need for more research on a range of sex-specific health effects (e.g., cardiovascular, respiratory, reproductive).

*Misuse of sex and gender concepts.* As is common in many fields of study, sex and gender are often misunderstood and misused in both study design, surveys and research reporting. This makes both the location of evidence and the interpretation of research difficult, as studies may collect sex disaggregated data, but provide limited analysis of sex or gender or further interpretation of findings. This detracts from building a more robust evidence base. More disciplined research is needed that includes competent and comprehensive sex and gender-based analysis to build the evidence and address existing gaps, as well as more oversight in requiring such inclusion in research proposals, peer reviews, analyses and reporting before publishing.

*Design limitations.* The currently available research has several methodological limitations. The majority of studies are correlational or cross-sectional; therefore, it is not possible to make causal or temporal conclusions. For example, while some studies have reported an association between cannabis use and violence, this does not infer causality, as it is possible that other factors may mediate this association. Many studies have attempted to limit the degree of confounding by controlling for potentially important confounding variables that are known to exist (e.g. other substance use, social and economic factors).

*Self-reporting.* Studies and surveys also tend to rely on self-reported cannabis use, and therefore the quality of the data may be hindered by socially desirable responses or poor recall. This may particularly affect studies on sensitive cannabis-related topics such as pregnancy, breastfeeding, driving or work. In addition, many studies have been conducted with specific sub-populations of people who use cannabis, or convenience samples, and lack broader generalizability.

*Omission of significant details.* Clearly, more nuanced research on medical/non-medical cannabis use is needed to understand patterns of use and health effects. Existing studies often lack details on the purpose of use, frequency of use, and standard definitions of quantity and method of use, other simultaneous substance use, and the strain of cannabis consumed (including THC and CBD content). Prevalence and patterns of use studies that rely on data from national surveys are limited by the data collected, which often lacks this

level of detail. Improving data collection to capture more nuanced information on cannabis consumption will improve both the accuracy and comparability of findings.

### ***Sources of Evidence***

This report relies on several sources of evidence including grey literature, survey data, public opinion research and selected evidence scoping reviews. The report reflects on all of these sources and synthesizes the key elements of sex, gender and diversity related information into advice on future prevention messaging on cannabis, as well as priorities for future initiatives in research, policy and programming for Health Canada. The primary source of evidence is from the research and grey literature on sex, gender and diversity and cannabis use patterns and perceptions that were identified in a separate project funded by the CIHR Institute of Gender and Health. (See Appendix A: for a description of the methods used in this project to identify academic evidence on sex, gender and cannabis).

## A. FINDINGS FROM THE LITERATURE

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### I. EVIDENCE ON SEX/GENDER RELATED TRENDS, FACTORS, AND INFLUENCES

There is emerging international evidence on sex and gender related trends, factors and influences, but numerous gaps remain. The majority of the evidence describes prevalence and patterns of use, with relatively few studies examining the influence of sex and gender on cannabis use and the health effects of cannabis use. Further, in many of the topic areas, evidence is limited, and a replication of findings is required to indicate the robustness of conclusions. It will be critical to monitor emerging findings on sex and gender related trends, factors and influences to inform nuanced prevention, health literacy, and public education approaches, and to encourage more sex and gender related research, especially in Canada.

#### *i. International trends*

Multiple studies report higher prevalence of cannabis use among boys and men compared to girls and women for past year [1-3], lifetime [4] and past 90 day use [5]. Among adults, an analysis of US cannabis use trends from 2007 to 2014 revealed a greater increase in the prevalence of past year cannabis use for men than women [2]. Legley and colleagues examined cannabis use patterns among adults in the USA, Germany (GER), and France (FR) [6]. In all countries, experimentation with cannabis was higher among men.

**Frequency:** Several studies described sex and gender differences in frequency of cannabis use. Men report using cannabis more frequently than women [5, 7]. Men also report consuming greater quantities of cannabis. In a US study examining cannabis use among young people across the period from early adolescence through adulthood, young men reported greater quantity of cannabis use across time compared to young women [8]. Other studies reported on various factors associated with greater cannabis use frequency in females or males, including: greater reward dependence (increased sensitivity to social situations and reinforcement) in women but not men [9]; sex related drug expectancies for both women and men [10]; expectation of relaxation and tension reduction with cannabis use in women [11]; depressive symptoms for boys [12] ; and early initiation (<13-15 years) in men [13].

#### *ii. Gender gap narrowing*

An analysis of US trends in adolescent cannabis use from 1999 to 2009 revealed higher prevalence of lifetime use for boys in all years [14]. However, this gap has been narrowing over time; in 1999, 51% of boys and 43.4% of girls reported lifetime cannabis use, while in 2013, 42.1% of boys and 39.2% of girls reported lifetime cannabis use [14]. Legley et al report a narrowing in the gender gap in the USA and Germany, while the gender gap is greater and has been more stable over time in France [6]. These authors suggest that the diffusion of cannabis experimentation appears similar to that observed with tobacco, with use beginning among men and the most educated groups first. In all three countries (FR, GER and USA), cannabis experimentation is increasingly common among people with lower levels of education. However, in France, cannabis experimentation continues to be more prevalent among women with higher education.

### **iii. Rates and trends by gender and subgroups**

Sex and gender intersect with numerous other characteristics and factors in determining patterns of cannabis use.

#### ***Race/ ethnicity<sup>1</sup>***

**Adolescents:** In a sample of North American Indigenous adolescents from the US and Canada, female participants reported higher rates of cannabis use (and other substance use) prior to age 15, but cannabis use (and use of other substances) among males exceeded that of females in later adolescence [16].

Multiple studies from the USA have analyzed racial/ ethnic differences in cannabis initiation and use among adolescents. There is some evidence of greater cannabis use initiation in the past year among Black and Hispanic males, compared to White males [17], and greater cannabis use prevalence and intention to use cannabis among Black females compared to White females[18]. In contrast, one study reported higher cannabis use prevalence for White male and female adolescents compared to Black and Hispanic adolescents [19].

Analysis of a US survey conducted with a large sample of adolescents ( $n=115,379$ ), revealed higher current cannabis use among boys for all race/ ethnic groups (Black, White, Hispanic, American Indian/Alaska Native, multi-racial.), except for Asian and Native Hawaiian/ Pacific Islander adolescents who reported no statistically significant gender difference in cannabis use. American Indian/Alaskan Native adolescents (41% boys vs 26.9% girls) and Black adolescents (27.8% boys vs 19.9% girls) reported the largest gender gap in cannabis use [14].

**Adults:** Multiple studies have reported racial/ ethnic differences in cannabis use among adults. In a US correlational study, Black, Hispanic, and “other” males reported higher rates of lifetime cannabis use than non-Hispanic White males [17]. Non-Hispanic “other” females reported higher rates of lifetime cannabis use than non-Hispanic White females. A US study of cannabis use among older adults aged 50-64 reported higher rates of cannabis use among males than females, and higher rates of use among ethnic minority groups [20]. Among females belonging to an ethnic minority, lower income was significantly associated with cannabis use. Among non-minority females, having a lower level of education was significantly associated with cannabis use. Among non-minority males, lack of health insurance, mental health issues and unemployment were associated with cannabis use.

#### ***Income***

**Income and adolescent use:** In general, it is difficult to determine how income affects cannabis use. Several studies have examined how income impacts cannabis use among adolescents. Among a diverse sample of US adolescents, poverty was not significantly associated with cannabis use initiation among males or females [17]. However, a US longitudinal analysis of

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<sup>1</sup> Ethnicity and race are overlapping concepts that are often used interchangeably. Ethnicity “refers to the group to which people belong, and/or are perceived to belong, as a result of certain shared characteristics, including geographical and ancestral origins, but particularly cultural traditions and languages” 15.Bhopal, R., *Glossary of terms relating to ethnicity and race: for reflection and debate*. Journal of Epidemiology and Community Health, 2004. 58(6): p. 441-445. [p.443]. The modern concept of race emphasizes its social construction rather than perceived biological basis, and “provides a way of defining, for social purposes, populations that look different and have different ancestral roots” 15.ibid. [p.443].

## MESSAGING ABOUT DETERMINANTS OF HEALTH

There is not yet definitive evidence on cannabis use rates related to all social characteristics and the social determinants of health. Nevertheless, it is important to show people who use cannabis of various genders, sexual orientations, races, ethnicities, ages, abilities, socioeconomic status (SES), communities, occupations, etc. in images accompanying prevention messages.

substance use among adolescents living in an economically disadvantaged neighbourhood reported a consistent increase in cannabis use (along with heavy drinking and nicotine use) from adolescence to young adulthood among males; in contrast, females maintained low levels of cannabis use [21].

*Income and adult use:* For adults, income does not appear to have a clear correlation with cannabis use especially in times of rapid policy and regulatory change in the USA. Two studies reported on income and cannabis use among adults. Analysis of US survey data from 2007 to 2014 revealed that prevalence of cannabis use increased significantly among women and men in all income levels. While the increased prevalence was similar for women and men living on a higher income, it was greater among men than women living on a lower income [2]. In the second study, conducted with a sample of low-income women aged 18-31 in the USA, being younger, non-Hispanic White and single was associated with increased odds of cannabis use [22].

### **Sexual Orientation**

Sexual orientation is associated with increased use of a range of substances [23]. Patterns of cannabis use appear to reflect these trends of higher use among sexual minority groups and

is consistent across race/ethnic groups and age categories.

*Adolescents:* Several US studies have analyzed patterns of adolescent cannabis use based on sexual orientation. Overall, cannabis use tends to be higher among non-heterosexual youth. Higher rates of cannabis use have also been reported among various sub-groups of non-heterosexual youth (compared to heterosexual youth), including: non heterosexual Asian American and Pacific Islander girls [24]; and gay and bisexual males and bisexual females living with HIV [25]. In contrast, in one study with a sample of incarcerated or detained adolescent girls, prevalence of cannabis use did not differ between bisexual and heterosexual girls [26].

*Adults:* Cannabis use is also higher among non-heterosexual adults. There is evidence from US studies of high rates of cannabis use among: gay men, lesbian women, and bisexual women and men, compared to heterosexual women and men [27, 28]; men who have sex with men (MSM) [29]; bisexual men compared to heterosexual men [30]; and sexual minority women who report post-traumatic stress disorder (PTSD) compared to those without PTSD [31]. In focus groups with a sample of Canadian bisexual women, cannabis use was identified as helpful for coping with anxiety, stress, pain and biphobia [32].

### **Gender Identity**

Similarly, there is evidence that gender identity status is linked to increased substance use in general [33, 34]. There is some evidence from US studies that cannabis use is higher among trans and gender diverse individuals. In a study conducted with Lesbian, Gay, Bisexual and

Transgender (LGBT) individuals, the highest rates of cannabis use were reported by transgender men (12.5%) and sexual minority females (12.1%) [35]. In a sample of transgender women recruited through outreach services, cannabis was commonly used (25.6%) and did not differ by HIV status [36]. Gender minority youth (ages 13-18) have also reported greater odds of past year cannabis use (and other substance use) compared to other youth, particularly for youth who have been victims of bullying and harassment [37]. Gender minority stress has also been associated with alcohol use among transgender men and cannabis use among transgender women [38].

#### ***iv. Factors associated with cannabis initiation and use***

##### ***Age of Initiation and gender:***

There is mixed evidence on the age of initiation into cannabis use. Several studies have reported on both gender and age of cannabis use initiation. A study with college students in two US states did not find any significant difference between age of cannabis use initiation for females and males (mean age of initiation = 17) [39]. Similarly, in a US study with people who used cannabis nonmedically and medically, there was no statistically significant difference in the age of initiation between women and men (the majority of both women (38%) and men (38.3%) reported initiating cannabis use between ages 14 and 16), although women were twice as likely to begin using cannabis after age 30 [5].

However, other evidence suggests that some boys may initiate cannabis use earlier than girls. In a US study among a sample of justice-involved adolescents on probation, male adolescents were significantly younger at age of first use (11.5 years for boys; 13.6 years for girls) [40]. In an Australian study, males and females who used cannabis reported similar age of initiation (women: 16.9 years; men: 17.2 years); however, for both females and males who frequently used cannabis, the initiation of cannabis use occurred at a younger age than that of people reporting occasional use (females: 16.1 years vs 17.1 years; males: 15.9 years vs 17.9 years) [41].

#### ***v. Risk & protective factors associated with cannabis use and gender:***

##### ***Psychosocial protective factors:***

Studies have examined the correlation between cannabis use and various psychosocial factors in girls and boys. There are several studies that report similar findings for girls and boys regarding the association of protective psychosocial factors with cannabis use. For example, lower cannabis use has been associated with having: more schoolmates as friends [42], and higher personal importance of religion and frequency of attendance at religious services [43] for both females and males.

## MOVING PAST SIMPLE SEX DISAGGREGATION AND RISK ORIENTATION

It is important to monitor trends in age of initiation and use by gender, and to tailor prevention messages accordingly. Prevention program planners need data on cannabis use reflecting multiple variables (by gender, age ethnicity, location, etc.) in accessible reports in order to design tailored, sex and gender informed campaigns and interventions.

It is recommended that some prevention messaging emphasize protective factors such as empowering peer connections and gender equitable norms.

Among girls (but not boys), participation in team sports [44] and having a greater proportion of same-gender friends [45] have been associated with lower self-reported cannabis use, while higher social self-control (control of behavior in social situations) has been associated with higher self-reported cannabis use [42].

### ***Psychosocial risk factors:***

On the other hand, peer pressure, and a history of alcohol and tobacco use were risk factors for cannabis use uptake in both boys and girls, and attending bars and discos was a risk factor for initiation among Spanish boys in their third year of high school, and girls in their first year [46]. In a US study with Hispanic adolescents, peer cannabis use was not significantly related to an increase in the odds of cannabis use initiation for males or females [47]. Factors that have been associated with cannabis use in males (but not females) include: greater public body consciousness (an awareness of external bodily appearance) [48]; and sleep problems during childhood [49].

The evidence on the relationship of cannabis use with academic achievement is mixed. In a US study, greater academic achievement was associated with lower odds of experimentation and frequent use among boys only [50], while findings from a Spanish study suggest that low academic performance is a risk factor for cannabis use in girls only [46].

### ***Parental monitoring and gender:***

There is evidence that parental monitoring and knowledge of adolescents' activities may be protective of cannabis use, and that there may be gender differences in this effect. In a meta-analysis, parental monitoring was identified as a protective factor against cannabis use among females [51]. Similarly, among a sample of US urban adolescents, higher levels of perceived parental monitoring were associated with lower odds of cannabis use by females, while higher perceived levels of family conflict were associated with higher odds of cannabis use by females [52].

In contrast, a longitudinal study that examined the effects of perceived peer cannabis use and parental support on cannabis use patterns among males and females from ages 15 to 33 reported an association between parental support and lower use of cannabis among males only [53]. However, by young adulthood, parental support was not associated with cannabis use in either males or females.

The gender of the parent also makes a difference. A US study compared fathers and mothers regarding knowledge of adolescent activities and association with cannabis use. Fathers' knowledge of adolescent activities was associated with lower odds of current and former use for girls and boys, except for experimental use in boys [50]. Mothers' knowledge of adolescents' activities was associated with lower likelihood of current frequent use for boys and girls, current occasional use for boys, and former experimentation for girls.

Some research has looked at gender of parent and ethnicity. Several studies have examined the role of parenting on cannabis use among samples of Mexican American and Latino adolescents in the USA. Similar to other studies on parental monitoring, the results are mixed. Greater parental monitoring has been associated with lower cannabis use [54], and greater parental permissiveness (allowing the adolescent to go out when they want) with higher rates of cannabis use [55] in girls, but not boys. However, other research found that greater parental

## CANNABIS AND MENTAL HEALTH/WELLNESS PROMOTION

Canadian agencies working on mental health promotion could address how cannabis use may affect mental health from a sex and gender informed and gender transformative perspective.

It is important in prevention messaging to identify how cannabis - like other legal substances - may be used "to cope" with the effects of trauma and violence, rather than for social/recreational or medicinal purposes. Such use increases the likelihood of developing dependence or addiction.

communication was associated with lower levels of cannabis use among boys only [56], and that parental monitoring and anti-drug parental norms were more strongly associated with lower cannabis use for boys [57].

### ***Gender norms and cannabis use:***

Conformity to masculine and feminine gender norms impact cannabis use patterns. For those boys and young men who behave and think in alignment with stereotyped masculine norms, there is a higher rate of cannabis use and binge drinking. For example, in a study with adolescents, male-typical males were most at risk for both alcohol and cannabis use [58]. Similarly, a US study found males who were more adherent to gender typical behavior were more likely to engage in binge drinking and use cannabis [59]. However, in contrast to alcohol and other substances, which tend to be associated with dominant masculine values such as "risk taking" and "playboy", Haines and colleagues suggest that cannabis use may be associated with more androgynous values, and represent an alternative and gentler way of "doing masculinity" [60].

There is a lack of research examining the association of conformity to dominant feminine norms with cannabis use among girls and women. However, qualitative research reveals that young women who use cannabis often frame their use as a form of rebellion against traditional gender roles. Studies from Canada [61] and Norway [62] both reveal how females who used cannabis resisted dominant feminine ideals, positioning themselves as "one of the boys", by engaging in cannabis use activities traditionally identified as masculine such as: using cannabis habitually, rolling joints,

buying cannabis, and being able to handle the high.

### ***Violence, trauma, gender and cannabis use:***

Multiple US studies have reported on the relationship between violence, victimization and cannabis use among youth and young adults. The research has looked at both perpetration of violence, victims of violence, and the experience of witnessing trauma.

A US study found that for both girls and boys, being a perpetrator of bullying was associated with higher experimental use, while being a victim of bullying was associated with lower odds of current occasional use [50]. Dating violence victimization during adolescence has been associated with: cannabis use among female adolescents [63] and cannabis use during young adulthood among males only [64]. Among a sample of young adults entering substance use treatment, both females and males who had been victimized were more likely to report cannabis use; however, males who were victimized reported earlier initiation of cannabis use [65].

Some US studies examined the association between violence perpetration and adolescent cannabis use. One study reported that among females, both victims and perpetrators of verbal dating violence, or of verbal and physical dating violence, were more likely to report cannabis use; this effect was not found for males [66]. Similarly, another study found that adolescent girls who reported higher levels of cannabis use also reported higher levels of engaging in dating aggression; this association was not found for boys [67]. However, the authors emphasize that the link reported between dating violence/ aggression and cannabis use among adolescents is not causal, and that other distal or proximal factors likely mediate these associations.

#### ***Witnessing trauma and adverse child experiences:***

There is also evidence for an association between witnessing violence and trauma and cannabis use among adults and adolescents. In an Australian a sample of females and males who had experienced the arrest or incarceration of a mother's partner during childhood (before age 14), males (16.2%) were more likely to report frequent cannabis user than females (7.4%) [68]. And in a study with a sample of urban US students, both girls and boys who had witnessed a violent death were more likely to report cannabis use [69].

#### ***vi. Access and methods of cannabis use***

##### ***Access:***

Two studies examined gender differences in access to cannabis. A Danish study reported no significant gender differences in the number of joints purchased, the proportion of females and males who purchased resin, or in the quantity of cannabis bought in cannabis retail purchases in Christiania, Copenhagen in 2004, although cannabis use has been normalized in this particular community since the early 1970s [70].

A study from Norway examined the individual and environmental risk factors associated with being offered cannabis. High school students were more likely to receive offers than middle school students, and delinquent students and students with a cannabis using best friend were more likely to be offered cannabis. Current tobacco use, past year alcohol intoxication and any past cannabis use were significantly associated with being offered cannabis use. They do not indicate if the relationship between these variables and cannabis offers differed for boys and girls. But they do report that girls (48%) and boys (52%) reported similar rates of being offered cannabis in the past year [71].

##### ***Context of Use:***

Several studies described gender differences in the context of cannabis use. A US survey conducted with a large sample of students aged 10-19 years (n=20,055 students) found that: males were more likely to report using cannabis at school and on weeknights compared to females; in contrast, females were more likely to report cannabis use on the weekends [72]. In a German study, males who used cannabis reported more frequently using cannabis with friends, strangers or alone compared to females. Females who used cannabis were more likely to use cannabis before sleep or when they woke up at night [73].

A US study reported significant differences in the prevalence of cannabis use for nonmedical purposes (73.4% men; 65.5% women) and for medicinal purposes (54.3% men; 64.1% women) [5]. Men reported using cannabis both more frequently and in greater quantities. Men were more likely to report experiencing: enhanced memory, increased appetite, enthusiasm, an altered

sense of time, and increased musicality; women were more likely to report experiencing a loss of appetite and a desire to clean [5].

#### ***Method of Use:***

In a US study with people who used cannabis both nonmedically and medically, men reported greater use of joints, blunts, vaporizers and concentrates; women were more likely to report using oral methods (e.g. edibles, sprays) and pipes [5]. In a German study, males who used cannabis reported more frequently using cannabis in a water pipe, while females who used cannabis more frequently reported smoking joints [73]. Among a sample of people who used medical cannabis in the USA, males were slightly more likely (41% vs 35%) to vaporize cannabis; females and males who were younger and more educated were also more likely to vaporize cannabis [74]. Similarly, a US survey with 2,910 people who used cannabis found that vaping was more common among males and younger respondents [75].

### ***vii. Physical and mental health consequences***

#### ***Cognition:***

In a US study with young adults (ages 18-30), both women and men who reported regular cannabis use and completed a self-report survey reported problems with cognition related to daily time spent smoking cannabis. There were no differences between women and men [76].

A US study conducted with adolescent girls found that they experienced more attention problems during years when they used cannabis, compared to pre-use levels, even after controlling for other substance use; this was not found for boys [77]. Girls who used cannabis monthly or less than monthly also reported more academic problems. Boys who used cannabis monthly reported more academic problems, but there was no significant difference in academic problems for boys who used less than monthly compared to non-users [77].

#### ***Sexual health:***

Several studies have examined the association of cannabis use with sexual health risks and sexually transmitted infections (STI). Analyses of US national longitudinal data found that adolescent cannabis use predicted adulthood sexually transmitted infection (STI) risk for all ethnoracial groups except for Black females; peer cannabis use predicted risk for STI among Black males only [78]. Finally, a US study with adolescents involved in the juvenile justice system reported no significant association between gender and cannabis use for predicting condom use during sex [79].

#### ***Risk behaviours:***

In a US study that examined the impact of cannabis use on “risky partying” behaviours and health related harms among college students [80], people who used cannabis were more likely than those who did not to drink alcohol excessively, use other substances, and experience health related harms including: injury from accidents or fights, blackouts from alcohol and substance use, and illness. The authors note that the main contributor to those harms is the heavy and frequent alcohol use reported by people who used cannabis. The students who used cannabis, alcohol and other substances reported the greatest harms, and women in this group reported significantly greater harms than men. The only harm that men were more vulnerable to

was injury from fighting. The authors suggest that women are more vulnerable to the negative effects of cannabis and alcohol use with similar or lesser use; although not specifically investigated, this finding may reflect sex differences in alcohol metabolism, resulting in greater intoxication among females at lower levels of use.

### **viii. Mental Health:**

Some US studies have examined gender differences in the impact of cannabis use on aspects of mental health.

#### ***Anxiety & depression, cannabis use and gender:***

Multiple studies have examined the relationship between mental health, gender and cannabis use, with very mixed results. Evidence from US studies reveals an association between depressive symptoms and: cannabis use for girls [81]; and frequency of cannabis use among males [82] and young males [83]. However, other studies have reported no association between depressive symptoms and cannabis use in sub-groups of girls. A US study with sexual minority adolescent girls found that cannabis use and depression symptoms were not significantly associated [84].

In addition, a US longitudinal study examined gender differences in changes in cannabis use and depressive symptoms over time in a sample of African American adolescents [85]. Males who reported higher depressive symptoms reported greater increases in cannabis use over time compared to males who reported lower depressive symptoms. In contrast, females who reported lower depressive symptoms reported more cannabis use over time compared to females who reported more depressive symptoms.

Women who experience social anxiety may be more vulnerable to cannabis use. In a US study, women reported a desire to use cannabis during a social anxiety provoking scenario in a laboratory; they did not report wanting to use cannabis before or after the situation [86]. These findings were not found for men.

Among a sample of girls with depressive symptoms followed from ages 5-8 for 6 years, cannabis use was associated with further increases in depressive symptoms [87]. In a study by Aspis et al (2015), women who used cannabis compared to women who did not use cannabis, regularly reported higher odds of experiencing emotional or physical problems that interfered with social activities, and were more likely to report that they accomplished less due to emotional problems [88]. Among men, no differences were found between those who used cannabis regularly or occasionally and those who did not use cannabis.

## MESSAGING ABOUT EFFECTS OF CANNABIS ON PHYSICAL AND MENTAL HEALTH

Highlighting sex and gender related physical health effects is important in order to improve health literacy and to prompt all girls, women, boys and men to engage in critical thinking about the effects of their use.

This will guide Canadians in making decisions about frequency and amount of use, and preferred routes of administration.

For most other substances the adverse physical health effects are higher for girls and women, and concrete information about these sex specific health effects have been foundational to sex specific messaging in lower risk guidelines.

There is limited evidence that the initiation of cannabis use during adolescence may increase the risk of depression in men, although other substance use is a contributing factor. A study conducted with men only found that initiation of cannabis use during early adolescence (ages 13-15) was associated with later depression, although this effect was reduced after adjusting for later substance abuse; alcohol and nicotine dependence and illicit drug use was higher among those who reported being younger at first age of cannabis use [13].

#### ***Other mental health diagnoses:***

Several studies have reported on gender, cannabis use and mental health diagnoses and illness. In a US study, having a psychiatric illness during late adolescence was more strongly associated with cannabis use in males than in females [89]. In a UK sample of men and women with schizophrenia or schizoaffective disorder, those who used cannabis reported an earlier age of psychotic symptom onset (age 26 for females who used cannabis, compared to 30.7 for females who did not use cannabis; 25.5 for males who used cannabis versus 27 for those who did not) [90]. Similarly, a Dutch study reported that among males and females with a psychotic illness, a history of cannabis use was associated with lower age at onset of first psychosis for both males and females; males reported an earlier age of first onset regardless of cannabis use [91]. In an Australian study with females and males with bipolar spectrum disorder, cannabis use was associated with lower total remission and depression symptom remission rates in females, and lower remission rates of manic symptoms in males [92].

#### ***Suicidal ideation:***

Two studies reported on an association between cannabis use and suicidal ideation. One study examined the association between age of cannabis initiation and suicidal behavior in a sample of French ( $n=13,187$ ) and US ( $n=15,136$ ) youth; early cannabis use initiation was associated with suicide ideation and suicide attempts for both girls and boys in France and for girls only in the USA [93]. Analysis of Youth Risk Behavior Survey data revealed that for a sample of American Indian boys in Montana, cannabis use (and other substance use) was significantly associated with suicidal ideation/ attempts; this effect was not reported for girls [94].

### ***ix. Cannabis use dependence/ disorder***

The evidence on sex, gender and cannabis use disorder (CUD) is mixed. There is some evidence that men are more likely to be diagnosed with CUD [4], and other evidence of no sex/gender differences in prevalence of past year CUD among women and men [17].

#### ***Rates:***

In a study with adolescents and young adults, gender was not significantly associated with the age of initial CUD onset [4]. In contrast, in a US study with women and men aged 18-50 meeting the DSM-5<sup>2</sup> criteria for CUD, men reported an earlier age of CUD onset and frequency of

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<sup>2</sup> The DSM-5 differs from the earlier DSM-IV by adding details on cannabis withdrawal syndrome. In the DSM-5, cannabis withdrawal syndrome is defined by the presence of three or more of the following symptoms post-cessation of cannabis use: 1) irritability, anger, or depression; 2) nervousness or anxiety; 3) sleep difficulties; 4) decreased appetite or weight loss; 5) restlessness; 6) depressed mood; and 7) at least one physical symptom that causes significant discomfort.

cannabis use [7]. However, CUD symptoms, urine tests for cannabinoids, cannabis cravings, and severity of cannabis related problems were similar for women and men.

A US study reported age and sex differences in cannabis abuse/dependence based on the DSM-IV criteria [95]. Both younger females and males who used cannabis reported higher prevalence rates of cannabis abuse/dependence than older males and females who used cannabis. Among young adults aged 18-24, males were more likely to report cannabis dependence than females (17.8% vs 11.5%). However, among adults 25 years and older, rates of cannabis dependence were slightly higher among females (6.2%) than males (5.2%).

In a US national sample, among both women and men the prevalence of CUD was greater among young adults, Blacks, and those with lower income [96]. Among women in the sample, CUD was greater among Native American women compared to White women [96].

### ***Telescoping:***

Similar to other substance use, there is some evidence that females transition more quickly to cannabis use dependence compared to males. In their analysis of US national data, Khan and colleagues reported no gender differences in the age at first or heavy cannabis use, age at onset of CUD, total number of episodes of cannabis abuse or dependence, or in the number of criteria met for cannabis dependence [97]. However, the time from age at first use of cannabis to the age at onset of the CUD was longer among men (mean = 2.64 years vs 2.24 years,  $F = 5.20$ ,  $p < 0.05$ ), providing support for telescoping among women who use cannabis. Another study analyzing US national data found that prevalence of CUD was greater among men than women, but women reported a shorter duration from onset of cannabis use to onset of CUD compared to men (mean of 4.7 vs. 5.8 years) [96].

### ***Risk factors:***

Multiple factors have been associated with CUD in women and men. Specifically, the frequency of use and form of cannabis used have been associated with CUD. In a German study, among both males and females, frequency of cannabis use, using cannabis “upon rising” and “at midday” and using cannabis alone were most strongly associated with CUD. Among females, cannabis use with strangers was more strongly related to DSM-IV for cannabis dependence than in males [73]. In a US study with Black males and females, females who used blunts (cannabis rolled in tobacco leaf) (23.8%) reported greater past year cannabis abuse or dependence than females who used other forms of cannabis (11.3%) [98]. Among males, past year cannabis abuse and dependence were similar for those who used blunts (23.5%) and those who used other forms of cannabis (23.5%).

Polysubstance use and trauma and violence may also be risk factors for CUD. In a US study, sexual abuse and history of alcohol use disorder were more strongly associated with 12-month CUD among females, compared to males [89]. In a US study with adult women and men who identified as lesbian, gay or bisexual revealed that sexual minority men who experienced discrimination reported higher odds of cannabis use disorder compared with sexual minority men who never experienced discrimination; this effect was not reported for sexual minority women [99]. In a US study, psychiatric interviews with women revealed that African American women were approximately three times more likely to initiate cannabis use before alcohol use; initiating cannabis use before alcohol use was associated with onset of CUD symptoms [100].

### ***Differences in symptoms:***

Women and men may report different CUD symptoms. A US study analyzing sex/gender differences in CUD diagnostic criteria found that men were more likely than women to report hazardous use (44.9% vs 19%), social consequences (9.6% vs 3.8%), physiological and psychological consequences (11% vs 5%), tolerance (18.5% vs 10.6%), withdrawal symptoms (10.7% vs 4.6%), and an inability to stop or reduce use (11.6% vs 4.8%) [101]. In contrast, Foster et al (2016) reported no sex/gender differences in CUD symptoms. However, women who met criteria for CUD in late adolescence (age 18-22) and middle adulthood (age 41 and over) reported a greater risk for concurrent suicide risk and anxiety, compared to men in the same developmental stages. CUD has lower prevalence during late adolescence and middle adulthood; therefore, the authors suggest that women meeting criteria for CUD during these stages may have a more severe CUD compared to those who develop it during early adulthood [7].

### ***Effects:***

Some evidence suggests that women who use cannabis and have CUD may experience a lower quality of life. Analysis of the US National Epidemiological Survey of Alcohol and Related Conditions (n = 43,093) found that males and females who used cannabis reported a lower quality of life compared to those who did not use cannabis, and females and males with CUD reported a lower quality of life compared to those without CUD [102]. However, the effect of cannabis use on mental quality of life scores was more pronounced for women. Each daily joint smoked was associated with a greater decrease in mental quality of life summary scores in females compared to males [102]. Another study reported greater CUD severity in women. In a sample of treatment-seeking adults with cannabis use disorder, women reported greater withdrawal intensity, more co-occurring mental health issues (including lifetime panic disorder and current agoraphobia), and more days of poor physical health [103].

Among a US sample of women and men meeting the DSM-5 criteria for CUD, there were no gender differences in severity of cannabis related problems or number of psychiatric diagnoses. However, men reported a younger age of onset of CUD compared to women (18.8 vs 20.7 years) [7].

Research on recovery from CUD and cannabis withdrawal reveals some sex/gender differences. While Farmer and colleagues (2015) reported no significant sex/gender difference in CUD recovery rates, time to CUD recovery was more rapid for women compared to men. In a US study with people who used cannabis both nonmedically and medically, there were no sex/gender differences in challenges in reducing or stopping cannabis use [5]. Men were more likely to report insomnia and vivid dreams as withdrawal symptoms while women more often reported nausea and anxiety; however, 36.7% of men and 44.9% of women reported no withdrawal symptoms. In a study conducted with young adults between the ages of 16 and 30 years, men were more likely to be diagnosed with CUD; but of those diagnosed with CUD, women recovered more quickly than men [4].

## x. Medical Cannabis Use

Although many cannabis use studies unfortunately conflate evidence (or do not specify or ask) on both medical and non-medical use, there are some studies specifically on medical use of cannabis. Several studies report on gender differences in medical use of cannabis. Analysis of medical cannabis programs in 13 US States revealed that men are more likely to use medical cannabis. Oregon and Alaska reported the narrowest gender gap; however, in Colorado and Arizona, the gender gap appears to be narrowing [104]. In a US study, among people who used medical cannabis, women were more likely to use cannabis to treat anxiety, nausea, anorexia, irritable bowel syndrome, and headaches/ migraines. However, men reported greater headache/ migraine relief from medical use of cannabis compared to women [5]. Among a US sample of females and males using prescription painkillers, both females and males who used medical cannabis were more likely to self-report using cannabis as a substitute for prescription medication, compared to those who used cannabis for non-medical purposes, but substitution rates were slightly higher among females [105].

## xi. Polysubstance Use

*Patterns:* Mixing cannabis use with other substances is a key area of concern for health and other harms. Several studies examined the relationship between cannabis use and other substance use. Some studies have reported higher rates of polysubstance use in men. In a sample of women and men (ages 18-50) with cannabis use disorder (CUD), polysubstance use was higher among adult men [7].

There is also evidence that simultaneous use of alcohol and cannabis tends to be higher in young males compared to young females [39, 106, 107], and is associated with substantial risks, including: greater impairment, heavier alcohol use, negative social consequences including driving while impaired, and greater likelihood of comorbid substance use and mental health issues. In a US study that examined the impact of cannabis use on “risky partying” behaviours and health related harms among college students [80], men and women who used cannabis were more likely than those who did not to drink alcohol excessively and use other substances.

*A risk factor:* Other substance use may be a risk factor for cannabis use. In a US study, alcohol use disorder in adulthood and past year marital problems were more strongly associated with cannabis use in males than in females [89]. In addition, nicotine dependence and stressful life events were associated with a greater lifetime risk of cannabis use for women compared to men. In a Spanish study with adolescents, having a history of alcohol and tobacco use was a predictor of cannabis initiation for boys and girls, except for girls in the

### MESSAGING ABOUT POLYSUBSTANCE USE

Gendered prevention messages about polysubstance use are needed to inform Canadians about the enhanced risks to health and wellbeing.

Cannabis use in pregnancy is one example of where advice about the risks of polysubstance use can be positioned. The CanFASD Research Network database shows that many of the mothers of children diagnosed with Fetal Alcohol Spectrum Disorder also used tobacco and cannabis when pregnant.

first year of their secondary education [46]. One Australian study reported an association between lifetime use of cannabis and stimulant use and stimulant abuse/ dependence among both females and males [108].

Age at initiation of cannabis use may be a risk factor for other substance use in men. In one study with men, alcohol and nicotine dependence and illicit drug use were higher among those who reported being younger at first age of cannabis use [13].

*Effects:* A US cross-sectional study compared the association of cannabis use with behavioral health disorders in females and males using cannabis for non-medical, medical, or both purposes [109]. They found that those who reported medical-only use had decreased odds of alcohol or drug use disorders, and unmet need for alcohol or drug treatment among males and females. Additionally, females who reported medical-only use had decreased odds of opioid use disorder. Males who reported using cannabis both non-medically and medically had increased odds of major depressive episode, hallucinogen use disorder, and unmet need for mental health services; females who reported using cannabis both non-medically and medically had increased odds of cocaine use disorder.

*Cannabis and opioids:* Two studies examined the relationship between cannabis and opioid use. Among a Canadian sample of methadone maintenance therapy (MMT) patients, cannabis use was significantly associated with illicit opioid use among women, but not among men [110]. The authors suggest that women may show improved treatment outcomes if cannabis use is addressed during MMT. However, evidence from a US cross-sectional study suggests that females who use prescription painkillers may be slightly more likely to substitute with cannabis (48.3% females reported ever substitution, compared to 43.6% of males) [105].

*Cannabis and nicotine:* Three studies examined the relationship between cannabis and tobacco or nicotine use or cessation. A US study with adolescent smokers found that high frequency cannabis use (more than 6 times in the past month) was associated with decreased odds of having a past cigarette quit attempt among boys, but not girls [111]. A Canadian study examined the association between e-cigarette use with other substance use in a sample of n=39, 837 grade 9-12 students; they found that those who reported current and non-current cannabis use were more likely to report using e-cigarettes than those who did not use cannabis, and this effect was greater for females compared to males [112]. A US longitudinal study following adolescents into young adulthood found that cannabis use frequency was associated with increased cigarette use frequency, particularly among males with depressive symptoms; this effect was not reported for females [83].

## ***xii. Other harms- Impaired driving***

There is some evidence that the rate of driving after cannabis use is higher among men, and mixed evidence on the impact on riding as a passenger after using cannabis. In a Swedish study, Jones and colleagues (2008) examined the age, sex and THC blood concentrations among women and men apprehended for driving under the influence of drugs [113]. A greater proportion of men than women were apprehended with THC concentrations detected in their blood (94% vs 6%). Among those with detected THC, blood concentrations were higher in men than in women (mean 2.1 ng/ml vs mean 1.4 ng/ml) when cannabis was the only substance

detected. In a US study among college students who reported past month cannabis use, 43.9% of males and 8.7% of females reported driving after cannabis use [39]. More males also reported riding as a passenger with someone who had used cannabis (51.2% vs 34.8%).

Some studies examined the impact of cannabis use on both driving and riding. O'Malley and colleagues' analysis of US high school seniors also found that male students were more likely to report driving after smoking cannabis; however, there was no gender difference in riding as a passenger after cannabis use [114]. Finally, in surveys conducted with youth ages 16-20 recruited from an emergency department, past year cannabis use was associated with increased odds of driving after drinking, and riding with a driver who had been drinking, for both males and females [115].

### ***xiii. Perceptions of peer use, risk, benefit and gender***

#### ***Perceived peer use***

Several US studies have examined gender differences in the association of perceived peer use with self-reported cannabis use. Perceived peer use has been associated with personal use among: female and male adolescents, particularly during younger adolescence [53]; young adult men [116]; male, but not female, college athletes [117]; and Mexican-American girls and boys [57]. In contrast, in a study with emerging adults, perceived peer use was not associated with intention to use cannabis; conversely, among males, perception of higher peer use was associated with lower intention to use cannabis [118]. In a Canadian qualitative study, adolescents described gendered perceptions of peer cannabis use. Habitual use by girls was described as inappropriate, and girls who did smoke cannabis were often perceived as acting too "silly" and "giggly" when high, while boys who used cannabis regularly were seen as cool and relaxed [61].

#### ***Beliefs and Perceptions***

There is some evidence on gender differences in attitudes regarding cannabis use, and the impact of attitudes on patterns of cannabis use. Among a pan-European sample of adolescents (n=6,359), boys were significantly more likely than girls to endorse positive attitudes, including that cannabis would make them: "feel relaxed" (21.2% vs 18.5%) or "become more popular" (17.3% vs 14.7%) [119]. A US study examined factors associated with cannabis use in a sample of emerging adults. Both females and males reporting high levels of cannabis use were more likely to have positive attitudes regarding cannabis use, lower confidence in their capacity to refuse cannabis use, higher intentions to use cannabis, and higher intention to be with other people using cannabis [118]. In a US study, higher measures on the sex related drug expectancies (SRDE) survey were associated with greater frequency of cannabis use for both women and men [10].

## MESSAGING ABOUT DRIVING AND RIDING

Decisions about driving while impaired and being a passenger can often reflect assumptions about gender roles and stereotypes. It is important to create gender informed messaging that assists both drivers and passengers with safer decision making. Such messaging needs to address power imbalances in gender relations between men and women, as well as the impact of masculinities on men's driving and riding decisions.

Two US studies examined the association between substance use expectancies and cannabis use among young adult women. Hayaki et al found that cannabis use frequency was positively associated with expectations regarding relaxation and tension reduction; there was an inverse association with expectations regarding cognitive and behavioural impairment and global negative effects [11]. In a study by de Dios and colleagues, females who expected that cannabis use would support relaxation and relieve tension were more likely to report using cannabis use to relieve anxiety [120].

Impulsivity and disinhibition have been associated with cannabis use, particularly among boys and men. A US study with adolescents found that boys who self-reported greater disinhibition reported greater increases in cannabis use from early to late adolescence [3]. Analysis of US survey data from 2000 found that sensation seeking/ impulsivity was significantly associated with greater use of cannabis by all groups of women and men (including heterosexual and non-heterosexual women and men) [28]. However, in another US study impulsivity was more strongly associated with cannabis use in males than in females [89].

Two studies reported gender differences in perceptions of risk related to cannabis use. In a study with people who used medical and non-medical cannabis, there were no gender differences in perceptions that cannabis is addictive or not [5]. However, women were more likely to report not knowing if cannabis is addictive. In a survey completed by women and men in Sweden, participants were asked to rate the addictive potential and severity to society of psychoactive substances; women perceived cannabis use as more dangerous than men [121].

## **II. EVIDENCE ON BIOLOGICAL MECHANISMS**

There is emerging evidence about sex differences in cannabis use and its effects from both animal and human studies. This body of evidence is growing, but there are numerous gaps yet to be filled. Nevertheless, several sex differences are present in both human and animal studies, although most of them will require much more validation and replication. There are also areas where no sex differences are reported, and those are also reviewed here. Overall, sex differences in human studies are more variable and less robust than those found in animals, but this may be due to more control over experimental conditions in animal model research. Nonetheless, some of these early findings from both human and animal research could have implications for prevention, health literacy, public education and future campaigns.

While there is increasing evidence of sex differences in cannabis use and its effects, there is limited knowledge regarding the mechanisms underlying these sex differences [122]. Drawing upon results from the review done by Craft et al., (2013) gonadal hormones appear to have an important role among the factors that could be involved in sex differences in the effects of cannabis [122]. Based on both clinical and laboratory-based research evidence Fattore et al. (2010) suggest that in addition to estradiol, cannabis pharmacodynamic and pharmacokinetic may also be important due, at least in part, to sex differences in muscle mass and fat tissue distribution between males and females [123].

### ***i. Human studies on sex differences and cannabis:***

Most studies in humans focused on cannabis dependence, subjective ratings, or the effect of cannabis on cognition. The majority of papers reported on long-term chronic effects by

comparing people who used cannabis and those who did not without giving any cannabis during testing. The following table provides an overview of studies reporting the presence, or not, of sex differences in the human studies on biological mechanisms:

<b>Effects</b>	<b>Sex differences</b>	<b>No sex differences</b>
Dependence	<ul style="list-style-type: none"> <li>- greater decrease in cannabis smoking compulsivity in women who received active THC [124]</li> <li>- sex difference in neural regions activated with cravings [125]</li> </ul>	<ul style="list-style-type: none"> <li>- majority of studies did not find sex differences in dependence responses [124, 126-129]</li> </ul>
Subjective Effects	<ul style="list-style-type: none"> <li>- inconsistent sex differences: greater subjective effects for females [126, 130, 131] or males [124, 126, 132, 133]</li> </ul>	<ul style="list-style-type: none"> <li>- some studies report no sex differences [131, 132]</li> </ul>
Anxiety	<ul style="list-style-type: none"> <li>- inconsistent sex differences: greater anxiety response in females [134]; and adult males compared to boys [133]</li> </ul>	<ul style="list-style-type: none"> <li>- negative emotional temperament [135]</li> <li>- reduced anxiety [124]</li> </ul>
Physiological Effects	<ul style="list-style-type: none"> <li>- men trended to exhibiting greater increases in heart rate after smoking [131]</li> </ul>	<ul style="list-style-type: none"> <li>- increased heart rate [124, 126-128, 130-132, 136]</li> </ul>
Brain Structures	<ul style="list-style-type: none"> <li>- females who used cannabis: greater brain glucose metabolism [135]</li> <li>- some sex differences in reduced size and region of the brain [137, 138]</li> <li>- sex differences in brain size or neural activation in response to cannabis cues [4]</li> </ul>	<ul style="list-style-type: none"> <li>- no sex differences observed in brain size or neural activation in response to cannabis cues [137]</li> <li>- decreased size of various regions for males and females [139, 140]</li> </ul>
Cognition & Memory	<ul style="list-style-type: none"> <li>- no cannabis before testing: inconsistent sex differences [141-143]</li> <li>- cannabis before testing: more pronounced negative impact on psychomotor speed/sequencing ability in males [144]</li> </ul>	<ul style="list-style-type: none"> <li>- cannabis before testing: Impaired cognition measures, but no sex differences [130, 133]</li> </ul>
Cognitive Effects- Cannabis & Opioids		<ul style="list-style-type: none"> <li>- impaired cognition measures [132]</li> </ul>
Attention, learning & driving	<ul style="list-style-type: none"> <li>- decrease in response time and increase in motor control impairment with increasing THC doses in sample of males [145]</li> </ul>	<ul style="list-style-type: none"> <li>- reduced attention and learning [128, 130, 136]</li> </ul>
Sleep		<ul style="list-style-type: none"> <li>- no sex differences in sleep quality or patterns [130, 136, 146]</li> <li>- heavy use may be correlated with insomnia [146]</li> </ul>

Effects	Sex differences	No sex differences
Pain tolerance	- reduced pain sensitivity (time to report pain) in men following THC consumption [147]	- no sex differences in pain tolerance (time to withdraw the hand) or ratings following THC consumption [147]

**Dependence**

Most studies did not find sex differences in dependence responses [126]. Both females and males exposed to cannabis cues, relative to neutral cues, reported an increased desire to use cannabis [127]. Women and men dependent on cannabis also appraised cannabis related images as more pleasant, and demonstrated a delayed response to emotional images, regardless of whether they received a placebo or active THC [128]. Following THC exposure, females and males reported reduced dependence or craving ratings [124]. In a sample of young males, adolescents reported increased cannabis cravings, and adults reported decreased cravings, following use [129].

In a meta-analysis on studies comparing impulsivity traits in people who used cannabis and those who did not and negative drug consequences (e.g. dependence; trouble at home or school due to cannabis use) in people who used cannabis, they found a medium effect size between negative drug consequences and sensation seeking, lack of planning, and positive urgency [148]. Sex and gender were not significant moderators of any relationships.

However, some sex differences were reported, including: a greater decrease in cannabis smoking compulsivity in females who received active THC compared to males and those who received a placebo [124]; and a correlation of cannabis craving with neural activation in the bilateral anterior insula and inverse correlation to left orbitofrontal cortex in women, and a positive correlation with the cluster spanning the striatum in men [125].

**Subjective effects**

Studies on the sex-specific subjective effects of cannabis use are mixed. Two studies reported higher sensitivity to cannabis in females compared to males, especially at low doses. Studies have found that after inhaling THC, women rated themselves as "higher" than men [130]; and reported higher ratings of cannabis as "good" and desire to "take again" than men [131]. However, a follow up study with a larger sample reported no differences between women and men in subjective ratings [131]. One study reported greater subjective effects for women at lower doses of oral THC, but greater subjective effects for men at higher doses [126].

However, several studies reported greater subjective effects for men, or sub-samples of men. Lundahl and Greenwald (2015) found that males felt more "down" than females during cannabis-cue exposure compared to neutral cues, regardless of cannabis given before cue exposure [124]. A study with males who used cannabis found that adults felt more stoned and had more dry mouth, felt the effects of cannabis effects, felt less alert, and felt more anxious than adolescents following cannabis use [133]. Both women and men who combined naltrexone and THC reported significantly increased ratings of 'high' (following a low THC dose) and 'tired' (at all doses), and decreased ratings of 'on edge' when combined with a high THC dose [132]. However, with THC alone, men were more likely to rate themselves as 'high' over time than women.

## **Anxiety**

People who use cannabis tend to report greater anxiety and negative affect, and anxiety ratings in people who use cannabis are dependent on age and quantity and frequency of use. Some studies report no sex differences such as Wiers et al., in which people who used cannabis reported lower positive and higher negative emotional temperament scores, regardless of sex [135]. Lundahl and Greenwald (2015) found that, in people who used cannabis heavily (females and males who smoked an average of 5.4 blunts per day), active THC before cue exposure reduced anxiety ratings induced by cannabis cues [124]. Two studies reported differences in anxiety response based on sex and age. In adolescents with Anxiety Sensitivity (AS-the extent to which an individual is frightened of anxiety symptoms), young females who met criteria for cannabis use disorder (CUD) had increased anxiety responses [149]. No relationship was found between AS, cannabis frequency, and outcome measures in men. In contrast, Mokrysz et al. (2016) found that adult males felt more anxious than adolescent males following cannabis use [133].

## **Physiological effects**

Acute cannabis increased heart rate in both sexes with the majority of studies reporting no sex differences. Several studies found that cannabis use or THC exposure increased heart rate (HR) in both women and men [126, 128, 130-132, 136], although in one study men trended to exhibiting greater increases in heart rate after smoking active cannabis relative to women [131].

Lundahl and Greenwald (2015) found that active THC lowered diastolic blood pressure and elevated heart rate relative to placebo, regardless of cue or sex [124]. Lundahl and Johanson (2011) found no significant differences in heart rate, skin temperature, or systolic or diastolic blood pressure (BP) as a function of group, sex, or cue condition [127].

## **Brain structures**

Brain differences were seen between people who used cannabis and those who did not; cannabis use generally resulted in decreased size for both males and females [139, 140], regardless of region of interest. Some sex differences were reported including: significantly smaller lateral orbitofrontal cortex among cannabis dependent females [139]; and a decrease in cortical thickness associated with higher schizophrenia risk and cannabis use in European males but not females [138]. Females who used cannabis had larger and males, smaller prefrontal cortex volumes compared to their same-sex controls [137]. In the same study, the authors examined the executive functioning between those who used cannabis and the control group. Among those who used cannabis, smaller prefrontal cortex was associated with better executive functioning while the opposite was found among the control group. Although the sample was small, these results suggest that women may be at higher risk for neurocognitive consequences. There were no sex differences observed in brain size or neural activation in response to cannabis cues compared to neutral cues.

However, women showed greater responses to cannabis cues compared to neutral cues in a cluster spanning the striatum, left hippocampus/amygdala, and left lateral orbitofrontal cortex, while men showed greater responses to cannabis cues than neutral in the left striatum and left lateral orbitofrontal cortex [4]. Sex differences in brain glucose metabolism among heavy users suggest that females are more sensitive than males to the adverse effects of cannabis on the brain [135]. Female cannabis users had lower baseline metabolism in left superior frontal gyrus,

right occipital cortex, and right anterior cingulate cortex than female controls; this was not observed in males. Following dopamine challenge (Ritalin), metabolism increased in female controls but not users; no differences were observed in males.

### ***Cognition and Memory***

Cannabis was given before testing cognition/ memory in three studies. In two studies, cannabis did not appear to substantially impair cognition, and no sex differences were observed. Anderson et al found that inhaled THC in people who used cannabis occasionally (using at least once per month, but no more than 10 times per month) had no significant effects on visuospatial processing or cognitive flexibility, with no sex differences [130]. Mokrysz et al. (2016) compared cognition in adolescent (16-17 years) and young adult (24-28 years) males who used cannabis regularly (using cannabis between 1 and 3 times per week) who received vaporized THC before testing [133]. Acute THC appears to affect cognition more in adults than adolescents when comparing males only; cannabis decreased the number of immediate and delayed items recalled in both ages, but adults had twice as large a reduction in delayed items recalled. In contrast, in a study with young adults, increased cannabis use was associated with impaired psychomotor speed/sequencing ability and sustained attention, and more cognitive inhibition errors; further, males had a more pronounced negative effect in regards to psychomotor speed/sequencing ability[150]

In the remaining studies on cognition and memory, cannabis was not given prior to testing. In these studies, people who used cannabis reported impaired executive control [151], decision making [141, 143], processing speed [152], recall [141], and working memory [141], particularly in those with greater past use or earlier age at first use. In some of these studies, sex differences were present but inconsistent. For example, females who reported regular cannabis use (using at least once per week in the past 3 months) demonstrated; greater recall deficits, particularly among those who initiated cannabis use earlier [142]; and greater reward sensitivity on decision making tasks [143]; but reduced impulsivity [141], when compared to males. However, one study reported that earlier age of initiated use was associated with better decision making in females but not males [142].

Males who regularly used cannabis (using at least once per week in the past 3 months) reported: greater delayed decision making [141]; and greater uncertainty and sensitivity to changes in reward value on decision making tasks [143], when compared to females. Using control groups, one study reported poor verbal fluency among men, but better episodic learning, memory, visuospatial processing and attention tasks among women who regularly used cannabis (participants were using cannabis an average of 6 times per week) and who were exposed to an article on the negative cognitive health effects of cannabis [144].

### ***Cognitive Effects- Cannabis and Opioids***

Haney (2007) studied the modifying effect of the opioid naltrexone on cognition during cannabis use [132]. They gave a short test battery to people who used cannabis and those who did not, who were given naltrexone (or placebo) followed by oral THC, methadone, or placebo. Among people who used cannabis, men smoked over twice as many cannabis cigarettes per day than women. THC alone did not affect task performance in either group. Naltrexone with the highest dose of THC worsened visuospatial, attention, and working memory measures in people who

used cannabis, with no sex differences. In people who did not use cannabis, naltrexone pretreatment worsened performance on visuospatial, attention, working memory, and multi-tasking measures following the lowest dose of THC, compared to placebo. None of the substances caused impairment to word recall or recognition in either group and no sex differences were observed.

### ***Attention, learning and driving***

Four studies reported on cannabis-impaired attention and learning, especially in nuanced or divided attention circumstances. THC reduces reaction time and as such, participants made accommodations where applicable. Anderson et al. (2010) studied the effects of inhaled THC on attention impairment among people who used cannabis occasionally (using cannabis at least once per month, but no more than 10 times per month), while driving in a simulator [136]; participants reduced their overall driving speed and performed more poorly on a neuropsychological test following the driving simulation, but no sex differences were observed [130]. A study conducted with males only observed a decrease in response time and increase in motor control impairment with increasing THC doses [145].

Metrik et al. (2015) reported no sex differences in appraised pleasantness in response to neutral, negative, positive, and cannabis related images, or emotional attention measures in people who used cannabis regularly (using cannabis at least 2 days a week in the past month and at least weekly in the past 6 months) after smoking a THC cigarette [128]. However, THC slowed responses in general, especially to negative images, and all women (in both the control and treatment groups) rated negative images as more negative and were slower to colour-name positive images.

### ***Sleep***

Acute THC increased sleepiness among both women and men who received active THC [130, 136]. Chronic heavy cannabis use (both women and men reported using cannabis an average of 28 days in the past month) may be correlated with clinical insomnia in both women and men [146]. Men who used cannabis demonstrated less sleep time than women, and women reported higher dysfunctional beliefs and attitudes about sleep, but there were no sex differences in measured sleep quality or patterns [146].

### ***Pain tolerance***

One study found no sex differences in pain tolerance or ratings, but acute THC reduced pain sensitivity in men. Cooper and Haney (2016) gave inhaled THC or placebo to people who used cannabis frequently (smoked >3 cannabis cigarettes at least four times a week in the past four weeks) and who were not seeking treatment and then tested pain tolerance using the cold pressure test at different time points post-smoking. In men but not women, active THC decreased pain sensitivity, particularly early in the session [147]. No sex differences in pain tolerance or subjective pain reports were found.

## ***ii. Animal Research on Sex Differences and Cannabis***

There is emerging evidence about sex differences in animal models (most often rats). Several studies have investigated sex differences in experimental situations in the impact of cannabis

(THC and/or CBD) on animal behaviours, pain responses, brain function, body temperature, anxiety, withdrawal symptoms, etc. and reported differences.

### ***Motor activity***

Male animals experience greater decrease in motor activity linked to THC while females are more sensitive to motor depression. Both acute and chronic THC tend to decrease motor activity to a greater extent in males than females, but general motor depression appeared at a lower dose in females. Britch et al. (2017) found that THC induced greater hypo locomotion in adult Sprague-Dawley male rats compared to females at the same dose, and CBD did not alter this difference [153]. Craft et al (2012) found that acute THC produced hypo locomotion in both sexes of Sprague-Dawley adult rats but was more potent in females [154]. The long-term effects of chronic CP55,940 treatment reduced the baseline locomotor activity in males but not in female Wistar rats [155].

### ***Metabolism of THC***

Female animals metabolize THC alone more quickly than males, but not when CBD is also present. Wiley et al. (2014) found that in adult Long-Evans hooded rats, whole brain levels of THC and active metabolite 11-OH-THC were higher in females than males 2 hours after injection with THC [156]. Britch et al. (2017) found that blood levels of 11-OH-THC and inactive metabolite THC-COOH were higher in female than male Sprague-Dawley adult rats, and that CBD shortly before THC injection reduced levels of both metabolites especially in females [157]. Thus, females appear to metabolize THC more quickly than males, although this is reversed in the presence of CBD.

### ***Reduced Pain Sensitivity (antinociception)***

THC is linked to greater reductions in pain sensitivity in female rats. In animal models THC was generally more potent in females. Britch et al. (2017) studied the effect of cannabidiol (CBD) with acute THC on antinociception in rats and found that females on THC had greater antinociception compared to males, and CBD did not alter this difference [153]. Craft et al (2012) also found that acute THC produced antinociception in both sexes of adult Sprague-Dawley rats but was more potent in females [154].

### ***Anxiety***

THC increases anxiety in female rats more than male rats. THC increased anxiety response, and this was greater in females than males during sub-chronic drug exposure and subsequent abstinence. Harte-Hargrove et al. (2012) studied anxiety during 7 days of THC and 15 days abstinence in adult Sprague-Dawley rats [158]. On the first drug day, low-dose males showed less anxiety than females. In the middle of drug treatment, high-dose rats of both sexes trended towards more anxiety. With the elevated plus maze, females on THC showed more anxiety compared to controls during abstinence, while males showed less. However, Keeley et al. (2015) found that THC decreased anxiety behaviour in female Wistar rats [159]. Among the factors they suggest why their results were different compared to those found by other studies, the dose and timing of the injection (they injected the rats following puberty onset) might have contributed. The findings of the study done by Llorente-Berzal et al. (2013) also suggest that female Wistar rats were more susceptible to behavioural effects of THC including decreased anxiety/increased risk-

taking [160]. In Wistar male rats both maternal separation and CP55,940 treatment reduced time spent on the open arms of the plus maze or centre time in the open field [155].

### **Brain differences**

Cannabinoid receptors appear to function differently in female and male rats affecting pain sensitivity, locomotion and desensitization. Craft et al. (2012) studied whether sex differences in THC effects on antinociception and hypo locomotion were mediated by cannabinoid receptor (CB-R) type in adult Sprague-Dawley rats [154]. CB1R antagonism blocked THC antinociception more potently in females and prevented hypo locomotion only in females. Burston et al. (2010) examined whether adolescent and adult Long-Evans hooded rats exhibit differential adaptation of brain CB1 receptors after chronic THC for 9.5 days [161]. Less desensitization was seen in adolescent rats than adult rats, and in male rats than female rats; female adolescents showed the greatest desensitization in all brain areas except cerebellum.

Studying the long-term consequences of adolescent THC exposure in two different strains of rats, Keeley et al. (2015) found that THC decreased the hippocampal volume in Long-Evans hooded (LER) females and increased the amygdala volume in males [159]. Adolescent CB1R activation suppressed hippocampal neurogenesis and increased stress responsivity in adult male Sprague-Dawley rats, but not females [162]. When studying the effect of antipsychotics on cannabinoid (CB) receptors in the brain juvenile rats, Lian & Deng (2018) found that risperidone treatment increased CB1R and CB2R combined binding in male Sprague Dawley rats in all brain regions, while CB1R-specific binding was upregulated in females more than males following all antipsychotic treatments, with variations between region based on drug [163]. Llorente et al. (2008) examined the effects of maternal separation (MS) on hippocampal levels of endocannabinoids (ECs) in Wistar albino rats, and their modulation by two inhibitors of endocannabinoids inactivation and found sex differences in the inhibition of EC inactivation altered hippocampal endocannabinoid levels and reversed MS-induced cellular and endocrine effects [164]. Llorente-Berzal et al. (2013) found that female Wistar rats had reduced levels of activity-dependent Arc protein (a biomarker involved in plasticity) in the prefrontal cortex and hippocampus while males had reduced prepro-orexin mRNA (modulated by feeding) in the prefrontal cortex after THC [160].

Silva et al examined sex differences in the effects of THC on the endocannabinoid system. Specifically, they measured hippocampal cannabinoid receptor 1 (CB1R) expression following THC treatment in male and female adolescent rats. There was CB1R downregulation 24 hours post-treatment in both sexes [165]. At two weeks post-treatment, downregulation persisted in the CA1 and CA3 areas of the hippocampus in females; CB1R expression normalized in the dentate gyrus and CA2 in both sexes. Their findings reveal sex differences in effects of THC on the endocannabinoid system; however, the researchers did not assess associated changes in behavior or functionality in the rats [165].

### **Body temperature**

THC reduces body temperature, but females adjust to this more quickly. THC reduces body temperature in both sexes but tolerance to this effect develops more quickly in females than males. Although acute THC produced hypothermia in both sexes of Sprague-Dawley adult rats fairly equally, after 6.5 days of THC, females developed greater tolerance to this effect compared

to males [166]. Wiley (2014) found that acute THC reduced body temperature in both sexes of adult Long-Evans hooded rats, but complete tolerance to this effect was produced in both sexes after 9 days of THC injections [156]. Llorente-Berzal et al. (2011) investigated the long-term effects of early maternal deprivation (MD) and/or an adolescent chronic treatment with the cannabinoid agonist CP-55,940 and found that at adulthood, CP treatment decreased body weight gain only in non-MD Wistar rats; no sex differences were found [167]. Llorente-Berzal et al (2013) found that male Wistar rats had decreased weight gain which persisted for longer after THC [160].

### ***Learning and memory***

Male rats have better spatial memory than females and THC impairs spatial learning more potently in females. Cha et al. (2007) used the Morris water maze to study sex and age differences in sub-chronic THC effects on spatial memory in Sprague-Dawley rats [168] and found that THC impaired learning acquisition in adolescents more than adults, and in females more than males – adolescents were impaired on all 5 training days while adults were impaired on day 1 and 2 only, with females driving this difference in adults (adult males showed no THC impairment on any day). Using the Y-maze, a measure of short-term spatial memory and the novel object recognition test, a measure of non-spatial recognition memory, Klug et al. (2012) found that there were no sex differences, nor these tasks were affected by the chronic CP55,940 treatment in Wistar rats [155]. However, Llorente-Berzal et al. (2013) found that female Wistar rats were more susceptible to behavioural effects of THC including reduced novel object memory [160].

### ***Drug seeking***

Female rats exhibit greater drug seeking behaviour following cue exposure than males. Fattore et al. (2010) trained Lister hooded rats to self-administer the CB1R agonist WIN 55,212-2 for 15-20 days with conditioned cues, then examined reinstatement with priming after a month of abstinence [123]. Females exhibited higher baseline cannabis intake during training, and more active presses with shorter response latency than males after drug priming, cue priming, and combined priming; low-dose combined priming was more effective than drug alone in females but not in males.

### ***Withdrawal from THC***

Female rats have greater withdrawal symptoms than males. Animals received THC daily for a week followed by 15 days without drug, or acute CB1R inverse agonist (IA) to induce withdrawal. Females showed slightly greater withdrawal symptoms than males. Marusich et al. (2014) found that in Sprague-Dawley rats, females but not males in IA- induced withdrawal showed an increase in retropulsion behaviour [169]. (Retropulsion is one sign of precipitated cannabis withdrawal in rats). Harte-Hargrove et al. (2012) observed Sprague-Dawley rats for 15 days after 1 week of daily THC treatment; locomotor depression was seen in females but not males during this abstinence period [158].

### ***Body weight***

In a study by Ho et al (2012), THC resulted in decreased body weight in female Siberian hamsters, but they regained weight during abstinence. THC as well as CB1R antagonism caused decreases in body mass, while sub-chronic CB1R agonism caused brief early weight increase in Siberian hamsters. Marusich et al. (2014) conducted research on Sprague-Dawley

rats and Keeley et al. (2015) on Long-Evans hooded rats and Wistar albino rats; both gave THC over a number of days and observed weight loss during all drug exposure days, but weight was regained during abstinence [169]. Minney et al. (2013) found that synthetic THC for 11 days reduced weight gain in females relative to vehicle [170]. Marusich et al. also observed estrous cycle disruption during drug exposure period [169], but Keeley et al. did not [171].

### ***Impact of reproductive hormones***

The THC effect appears to be enhanced by estradiol. Gonadectomized females without hormone replacement had similar behaviour to intact males, and most THC effects in females were restored by estradiol. Craft et al (2012) found that THC alone was more potent in Sprague-Dawley adult female rats than males for tail withdrawal antinociception, especially those in estrous [154]. Fattore et al. (2010) found that in Lister hooded rats, intact females exhibited higher baseline cannabis intake during training and more active presses after priming than gonadectomized females and intact males [123].

*Anhedonia-like state* - Investigating male and female rats, exposed to maternal separation or control, and CBR agonist or placebo, Klug et al. (2012) found that only in Wistar male rats, repeated maternal separation and CP55,940 treatment induced anhedonia-like behaviour in sucrose preference test [155].

*Sensorimotor gating* - In a study by Llorente-Berzal (2011), the results showed that adolescent cannabinoid treatment increased exploration and reduced prepulse inhibition (PPI) only in Wistar female rats [160]. The prepulse inhibition was reduced by maternal separation in both sexes but there was no additional effect of CP55,940 treatment in the Wistar rats. No sex differences were found [155].

### ***Summary***

In conclusion, there is emerging evidence from both animal and human studies on sex differences in cannabis use and its effects. The majority of human studies have focused on cannabis dependence or the subjective effects of cannabis use. Most studies have not found sex differences in dependence responses. Overall, the sex differences that have been reported in human studies are more inconsistent and less robust than those found in animal studies.

Current evidence on physiological effects, cognition, memory, learning, attention, and sleep suggests similar effects for males and females. There is some evidence that females may experience greater subjective effects at lower doses, and a greater anxiety response, although these findings need validation. Research on the impact of cannabis on brain structures generally reports decreases in the size of various brain regions for both males and females, with some studies reporting sex differences. The evidence on pain response is mixed, with some studies reporting no sex differences in pain tolerance, and other studies reporting greater effects for either males or females. In sum, the findings from human studies highlight the need for more robust studies to validate all of these findings. Specifically, nuanced data collection and analysis on the form, strain, routes of administration (ROAs), quantity and frequency of cannabis use is required to investigate sex differences in the effects of cannabis use.

Animal studies have also investigated sex differences of the impact of cannabis (of isolated THC or CBD) on pain responses, motor activity, body temperature, anxiety, withdrawal symptoms, and spatial memory. The majority of studies on these topics have reported greater effects for females. For example, in female rats exposed to THC, there is evidence for greater reductions in pain sensitivity, increased anxiety responses, greater impairments in spatial memory, reduced body weight during abstinence, and greater withdrawal symptoms, compared to male rats. There is also evidence that THC may be enhanced by estradiol, and that female animals metabolize THC alone (but not in combination with CBD) more quickly than males. In other areas, there is some evidence of similar or greater effects for male animals. For example, in animals exposed to THC, males display a greater decrease in motor activity, and both male and female animals exposed to THC demonstrate a reduction in body temperature in response to THC.

Together, these findings provide evidence on sex differences in response to cannabis, but further research is required to understand if and how findings from animal studies translate to humans. For example, the ROAs used (e.g. intravenous) and isolation of cannabinoids (e.g. isolated THC or CBD) in animal studies may not be comparable to patterns of cannabis consumption by humans. In addition, preclinical cannabis research has often included only male animals. Therefore, further research that includes female animals is needed across all topic areas to strengthen this evidence base.

## B. STATISTICS CANADA HUB

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The Cannabis Statistics Hub (CSH) is a Statistics Canada website that provides overall statistics related to the use, production and distribution of cannabis in Canada. The information provided includes topics such as health, justice, the economy and prices for both medical and non-medical cannabis. The statistics provided here on cannabis use in the 12 months prior to interview or in their lifetime were collected in the Canadian Community Health Survey (2012).<sup>3</sup>

Statistics Canada also developed the National Cannabis Survey (NCS). This survey was created to analyze the changes in the use of cannabis for non-medical purposes before and after the legalization of cannabis for non-medical purposes on October 17, 2018. Data from each province were collected in February and March 2018 from people 15 and older. The second quarter includes data for the provinces, and the territorial capitals. Data were collected from mid-May to mid-June of 2018. The third quarter was collected from mid-August to mid-September 2018 and includes results for the 10 provinces. Questions included frequency of cannabis use in the last three months, source of cannabis products, motivations to purchase cannabis legally, price, quantity of cannabis products, consumption changes when cannabis becomes legal, driving behaviours, health and mental health perceptions.

### SEX, GENDER AND SUBSTANCE USE

It is important to improve health literacy by presenting information on how substance use aligns with sex, gender, age and other relevant factors, so that people can improve their perceptions of risks.

#### *i. Key usage trends by sex/gender*

There are trends and patterns in cannabis use that are distinguishable by sex/gender. Better and more comprehensive research in the future will hopefully broaden our understanding of these two variables. Currently there are several differences in trends, but, as can be seen from the scoping review [6], the gender gap in prevalence appears to be narrowing among adolescents who use cannabis.

#### *ii. More men than women use cannabis*

According to the Cannabis Stats Hub, more men than women reported lifetime cannabis use (49.4% and 35.8% respectively). By age, the highest prevalence is among those between 25 and 44 years old (60.5% of men and 46.5% of women) and the lowest, among those over 65 years old (18.9% of men and 8.3% of women).

According to the 2018 NCS results, men were more likely to currently use cannabis, compared to women. In the first quarter of 2018, 16% of men (compared to 12% of women) reported having used cannabis in the past three months. In the second and third quarter, 12% of women said they used cannabis in the past three months, while the rates for men were 19% and 18% respectively.

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<sup>3</sup> More information on these results can be found at <https://www150.statcan.gc.ca/n1/pub/13-610-x/13-610-x2018001-eng.htm>

### ***iii. Type of cannabis consumed***

More men than women consumed dried flower or leaf (90% of men and 81% of women) while more women than men reported having consumed edibles (41% of women and 26% of men). However, the use of other cannabis products did not differ by sex. In the NCS, data disaggregated by sex for this variable are not provided in the first and third quarters.

### ***iv. Frequency of use***

Men are almost twice as likely as women to report daily or almost daily use (7% of men vs. 4% of women) (data provided only in the third quarter).

## C. OTHER SOURCES

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This is a summary of sex and gender disaggregated results of the Canadian Cannabis Survey (CCS), Canadian Student Tobacco, Alcohol and Drug Survey (CSTADS) and Canadian Tobacco, Alcohol and Drug Survey (CTADS).

### I. CANADIAN CANNABIS SURVEY (CCS) 2018

The CCS collects detailed information regarding the use of cannabis in Canada, methods of use and perceptions of use. It uses a 2-step recruitment process, and accesses information from across Canada from both males and females who used cannabis, as well as those who did not. The 2018 CCS results for females and males presented here use data from the detailed tables and the differences have not been tested for statistical significance.<sup>4</sup> The same thematic areas as in the survey are used below to report the findings.<sup>5</sup> Evidence or lack of evidence from the scoping review is mentioned to supplement these results.

#### i. Theme 1: Knowledge, attitudes and behaviours

This theme included questions regarding participants' opinions and knowledge related to cannabis.

*Social acceptability* The CCS results were not disaggregated by sex.

*However, according to one of the studies located in the scoping review, both males and females who reported higher cannabis use had more positive attitudes toward cannabis, and were more likely to report that their peers approved of cannabis use [118].*

*Willingness to disclose cannabis use* According to CCS data, more males than females reported they would be more willing to publicly disclose whether they use cannabis if it is legal (34.1% of males and 28.7% of females, respectively). More males than females said they are already willing to disclose whether they use cannabis and more females than males said they would not be more willing to say if they use cannabis (26.9% of females and 23.8% of males).

*No relevant studies were found in the scoping review.*

*Opinions on the effects of cannabis use* CCS data show that more females than males reported cannabis had no effect on work or studies (78.1% of females and 75.2% of males), friendship or social life (59.7% of females and 54.1% of males). More females reported positive effects for mental health (52.6% of females and 49.0% of males). More males reported positive effects for quality of life (53.9% of males and 47.3% of females) and friendships or social life (44.3% of males and 38% of females).

*Evidence from the scoping review on the perceived effects of cannabis use is mixed with one study reporting more negative impacts for women, including: emotional, physical, social and work related issues [88], and one study reporting reduced cognition for both men and women [76].*

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<sup>4</sup> The detailed results tables can be consulted at <http://epe.lac-bac.gc.ca/100/200/301/pwgsc-tpsdc/por-ef/health/2018/006-18-e/index.html>

<sup>5</sup> <https://www.canada.ca/en/services/health/publications/drugs-health-products/canadian-cannabis-survey-2018-summary.html>.

*Opinions on whether cannabis use can be habit forming* Among all respondents, more females than males said that using cannabis could be habit forming (84.6% of females vs 79.4% of males). The same pattern was found for those who reported using cannabis in the past 12 months (74.5% of females vs. 69% of males) and those who did not (86.9% of females vs 83.4% of males).

*No relevant studies were found in the scoping review.*

*Observation of use in public places* Among people who had not used cannabis in the past 12-months (35.9% of females vs. 45.9% of males) and those who had (73.9% of males vs. 64.6% of females), more males than females observed smoking of cannabis in public places. Conversely, more females than males responded they did not notice anyone using cannabis in public (29.1% of females vs. 24.7% of males among all respondents).

*No studies reported on this issue in the scoping review.*

*Cannabis use inside the home* All respondents were asked about cannabis consumption methods in their home over the past 12 months. Among all respondents, more women than men reported that no one used cannabis in the home (74.3% of women vs. 67.3% of men). However, among those that used cannabis in the past 12 months for non-medical purposes, data from the CCS show that smoking was the most common method of cannabis consumption in their home (72.8% of males vs. 70.7% of females). Eating or drinking cannabis was the second most used method for cannabis consumption for both females (39.5%) and males (39.4%), followed by vaporizing cannabis (more males than females, 33.7% of males vs. 27.1% of females).

*No studies were found on this issue in the scoping review.*

## ***ii. Theme 2: Cannabis use and products used (for non-medical purposes)***

Questions included frequency of cannabis use, age of initiation of use, number of hours spent "stoned" or "high" in a typical use day, methods of consumption, types of cannabis products used, average amount spent on these products, and where people store cannabis inside the home.

*Cannabis use* 26.5% of males and 17.6% of females reported having used cannabis for non-medical purposes in the past 12 months.

*Similarly, there is evidence from multiple scoping review studies that boys and men report higher prevalence of cannabis use compared to girls and women [1-5]. But, there is also evidence from the US that the gender gap is narrowing between boys and girls [14], and widening among adult men and women [172].*

*Past 12-month use in respondents of various demographic groups* Males who worked full time were more likely to report using cannabis products during the past 12 months compared to females (e.g., 30.1% of males vs. 21.3% of females who worked full-time). The same pattern was

## GENDER GAP NARROWING

Men use cannabis at higher rates, more frequently and in greater amounts than women but there is evidence that the gender gap is narrowing between boys and girls.

This is consistent with past developments in tobacco and binge alcohol use and will influence prevention messaging.

found for those who were working part-time (32.2% of males vs. 21.5% of females), self-employed (24.2% of males vs. 17.8% of females), unemployed (34.4% of males vs. 21.7% of females) and not in the work force (24.3% of males vs. 14.6% of females). Males who were full-time students were more likely to report having consumed cannabis in the past 12 months (36% of males vs. 30.1% of females). Past 12-month cannabis use was higher among males independent of their education: 29% of males vs. 28.3% of females who have less than high school, 34.9% of males vs. 22.7% of females who have high school, 28.8% of males vs. 22.4% of females who have a trade diploma/certificate, 27.1% of males vs. 16.7% of females who went to college, CEGEP, 25.4% of males vs. 14.7% of females who went to University below Bachelor's level, 21.7% of males vs. 15.7% of females who have a Bachelor's degree, 17.1% of males vs. 11% of females with a post-graduate degree.

*There is evidence from the scoping review that cannabis use tends to be higher among more educated women and men, although this pattern appears to be reversing in some countries [6]. In the CCS results there is evidence of higher rates of cannabis use among: unemployed males [20] and males with lower levels of education [89, 173], and lower use among males with higher levels of workforce participation and females with a university education [173].*

## ROUTES OF ADMINISTRATION

It is important to closely monitor emerging evidence on the impacts of methods of consumption and to clarify the sex and gender effects of differing routes of administration for both non-medical and medical use of cannabis

Regarding income, data from the CCS show that people who reported a higher household income were less likely to report the use of cannabis in the past 12 months (e.g., 24% of males vs. 14.9% of females for respondents with a household income higher than \$150,000 and 35.2% of males vs. 31.7% of females among those respondents with a lower household income-under \$10,000).

*Studies from the scoping review corroborate this relationship between low income and cannabis use among ethnic minority females since lower family income was associated with cannabis use in the last year [20]. There were no gender differences in cannabis use prevalence among the highest income levels; however, in households with the lowest income levels (\$0-19,999; \$20,000-49,999), the increased prevalence of cannabis use was greater among men than women [172].*

**Cannabis use during last pregnancy and while breastfeeding** 96.3% of females aged 16 to 44 who had given birth in the past 5 years did not use cannabis once they learned they were pregnant. Further details regarding the females who used cannabis after they learned they were pregnant were not reported. 95.6% of females did not use cannabis while breastfeeding their last child while 4.4% of females did use cannabis while breastfeeding.

*Studies on cannabis use during pregnancy were not included in the scoping review.*

**Age of initiation** Average age of initiation is higher among females (19.2 years) than among males (18.5 years).

*Some studies from the scoping review report a significant difference between age of cannabis use initiation for women and men [40, 41, 173], with either women [41] or men [40] reporting earlier uptake.*

*Frequency of cannabis use* According to CCS data, fewer females (16.3%) than males (20.2%) reported having used cannabis daily. On the contrary, females were more represented among those who consumed less than one day per month (42.9% vs. 29.8%).

*These results are corroborated in the scientific literature with men reporting using cannabis more frequently than women [5, 41].*

*Number of hours "stoned" or "high" on a typical use day* Males reported that they would be stoned for longer periods, compared to females. More females than males reported they would be "stoned" or "high" on a typical use day for less than 1 hour (23.9% of females vs. 15.8% of males). More males than females reported they would be "stoned" or "high" for 1 or 2 hours (40.6% of males vs. 38.1% of females), 3 or 4 hours (28.5% of males vs. 25.9% of females), 5 or 6 hours (8.1% of males vs. 6.8% of females); 7 or more hours (7% of males vs. 5.4% of females).

*No evidence on this issue was found in the scoping review.*

*Methods of consumption* The most common method of consumption (or route of administration) for both males and females is smoking (90.1% of males vs. 86.4% of females). The second most common method for both males and females is eating cannabis in food. However, females are more likely than males to use this latter method (44.1% of females vs. 40.1% of males). The third most common method is vaporizing using a vape pen or e-cigarette (portable) (27.8% of males vs. 22.4% of females). 16.3% of males vs. 11.8% of females use cannabis using a vaporizer (non-portable). Dabbing is used by 13.3% of the males and 10.2% of females, while 6.2% of males and 4.8% of females drank cannabis (e.g., tea, cola, alcohol, other drinks). Other methods such as using a tincture applied directly to skin is the least common method for both males and females (3.0% of males vs. 4.2% of females).

*Several studies from the scoping review reported: similar [70] or different [73] methods of cannabis use by males and females. In a Danish study, there was no significant difference in the number of joints purchased by women, when compared with men [70]. In a German study, the male cannabis users more frequently reported cannabis use via a 'water pipe' while female cannabis users more frequently reported cannabis use by smoking a 'joint' [73].*

*Types of cannabis products used and frequency* CCS data regarding the frequency of use of cannabis products were not disaggregated by sex.

*Evidence from the scoping review suggests gender differences in when cannabis is used [174] and the types of cannabis products used, with men more often using flower, oil, concentrates and vaporizers, and women more often using edibles [5, 174].*

*Average amount used on a typical use day* Males who smoked or vaporized dried flower/leaf used more cannabis than females (1.2 g per male and 0.9 g per female) as did males who used edibles (1.2 servings per male and 0.9 serving per female), men who used hashish/kief (0.5 g per male and 0.3 g per female), males who used liquid concentrate (1 ml per male and 0.9 ml per female) and those who used liquids (e.g., cola, tea) (334.1 ml per male and 221.9 ml per female). The same average amount was used by females and males for cannabis oil cartridges or disposable vape pens (0.1 cartridge/pen) and solid concentrate (0.2 g).

*Evidence from the scoping review suggests a greater quantity of cannabis use over time among men compared to women [5, 8].*

*Sources used to obtain the cannabis product* According to CCS data, more females (58.8%) than males (52.1%) reported that they obtained cannabis from just one source. More males than females reported that they obtained cannabis from 2 or 3 sources (34.9% of males vs. 33.9% of females) and 4 or 5 sources (4.7% of males vs. 3.4% of females). The percentage of females who

## GENDER AND PARENTING

Currently mothers are assuming more responsibility for conversations with children about cannabis, for safe storage, and health literacy overall but fathers could be encouraged to share these roles.

grew their own cannabis and those who obtained it from 6 sources was not reported. While more females obtained their cannabis from a group of friends (14.3% of females vs. 12.4% of males), family member (8.1% of females vs 4% of males), compassion club/dispensary (15.9% of females vs. 14.8% of males), an acquaintance (7.0% of females and 6.3% of males), and Health Canada licensed producer (4% of females and 3.7% of males), more males obtained their cannabis from a friend (36.1% of males and 31.5% of females), and a dealer (8.2% of males and 6.2% of females). Regarding the main location for accessing cannabis, slightly more females than males reported that it was at someone else's home (57.7% of females vs. 57% of males).

*No studies in the scoping review dealt with this issue.*

*Average amount spent on cannabis each month* CCS data show that females reported spending less money on cannabis

than males among people who both used cannabis in the past 12-months and in the past 30 days. *No studies in the scoping review reported on this issue.*

*Cannabis products bought or received, and at what frequency* Among both females and males, the most frequent response was buying or receiving dried flower/leaf. However, more males than females selected this option (87.6% of males vs. 86.8% of females). More females than males reported buying or receiving edibles (25.8% of females vs. 20.1% of males). The average amount purchased by males was higher for dried flower/leaf (17 g per male and 12 g per female) and edibles (e.g., prepared food products) (6.1 servings per male and 5 servings per female).

*Evidence from one scoping review study found no significant gender differences in the purchase of joints or resin, or quantity of cannabis bought [70].*

*Average price per unit of purchases, by product type* CCS data indicate that female paid more than male for dried flower/leaf (\$9.15 per gram for females vs. \$8.37 per gram for males), edibles (e.g., prepared food products) (\$9.09 per serving for females vs. \$8.84 per serving for males) and solid concentrate (e.g., shatter, budder, etc.) (\$38.60 per gram for females vs. \$35.39 per gram for males). Males paid more than women for cannabis oil cartridges or disposable vape pens (\$48.06 per cartridge/pen for males and \$42.71 per cartridge/pen for females).

*There were no studies that reported on this issue in the scoping review.*

*Proportion of people who used cannabis receiving cannabis products for free* More females reported obtaining dried flower/leaf and edibles (17% and 12.1%, respectively) for free compared to males (29% and 21.1%, respectively).

*Again, there were no studies in the scoping review on this issue.*

*Frequency of cannabis use to get "high" before work* Among those who reported past 12-month use, more males than females get "high" before or at work. Females are more likely to have *not* done this in the past 12 months (67.4% of females vs. 62.3% of males). Of these respondents, 11.8% of females and 8.3% of males had not been employed in the past 12 months.

*There were no studies in the scoping review reporting on this issue.*

*Professional help for non-medical cannabis use* Among those that reported "yes, but *not* in the past 12 months", more males reported they felt they needed professional help for cannabis use (3.1% of males and 1.9% of females). Among those that reported "yes, in the past 12 months", 1.2% of the males reported they felt they needed professional help for cannabis use, but data for females were not provided due to the high sampling variability. More females reported that they never felt they needed professional help (e.g., treatment or counselling).

*There were no studies in the scoping review reporting on this issue.*

*Where cannabis is stored inside the home* More females than males reported storing cannabis in child proof containers (23.9% of females and 23.5% of males), unlocked cabinet or drawer (34.6% and 28.7%, respectively), locked container (26.2% of females and 25.6% of males) and on open shelf or table (15.9% of females and 13.7% of males). More males reported storing cannabis in locked room (10% and 5.5% respectively) or in an outdoor building (16.1% of males and 6.7% of females).

*There were no studies in the scoping review on this issue.*

*With whom respondents used cannabis* Among those who reported past 12-month use, females were more likely than males to report using cannabis with a spouse/partner (59.7% of females vs. 48.2% of males). More males than females reported using cannabis with a friend (92.3% of males vs. 85.2% of females), while alone (75.2% of males vs. 60.1% of females), with a family member or relative (53.8% of males vs. 49.1% of females), with a co-worker (37.5% of males vs. 19% of females), with a stranger (26.7% of males vs. 14.5% of females), and with a dealer (24% of males vs. 14.1% of females).

*In one scoping review study, males who used cannabis more frequently reported cannabis use with 'friends', with 'strangers' and 'alone' compared to female users [174].*

### **iii. Theme 3: Driving and cannabis**

The questions covered driving behaviours, cannabis use, and cannabis use in combination with alcohol/other drugs, being a passenger in a vehicle driven by someone who had smoked cannabis and their opinions on cannabis and driving.

*Respondents who operated a vehicle within two hours of using cannabis, and at what frequency* According to the CCS results, more males than females reported that they have driven within two hours of using cannabis in their lifetime (47.9% of males and 25.5% of females, respectively).

*Similarly, evidence from the scoping review found higher rates of cannabis impaired driving among men [39, 113].*

*Respondents who operated a vehicle within two hours of using cannabis in combination with alcohol or other drugs* Among those who reported ever driving within 2 hours of using cannabis,

more males than females reported that they had driven a vehicle within two hours of using cannabis in combination with alcohol (27.1% and 18.8%, respectively). Data for females who drove a vehicle within two hours of using cannabis in combination with alcohol within the past 30 days, within the past 12 months and more than 12 months ago were not reported and data for females who drove a vehicle within two hours of using cannabis in combination with other drugs were not reported.

*Similarly, evidence from the scoping review suggests higher rates of simultaneous cannabis and alcohol use among men [39, 175].*

*Respondents who were passengers in a vehicle driven by someone within two hours of using cannabis* According to CCS data, more males than females have been a passenger in a vehicle driven by someone within 2 hours of using cannabis.

*These findings are corroborated by one scoping review study [39].*

*Interaction with law enforcement related to driving* In the CCS survey, 4.2% of males reported they had an interaction with law enforcement related to driving. Data for females are not provided. *In one scoping review study, cannabis impaired driving arrests were higher among men [113].*

*Opinions on cannabis use and driving* Approximately 83.3% of females and 78.6% of males reported that they think that cannabis use affects driving.

*There were no studies in the scoping review on this issue.*

*Opinions on likelihood of being caught driving under the influence* This was not disaggregated by sex in the CCS survey results, and there were no studies in the scoping review on this issue.

#### ***iv. Theme 4: Cannabis for medical purposes***

This theme included questions such as the source of the product, type of product, frequency of use, type of strain, how much was used in a typical day, diseases and symptoms addressed by cannabis use, and changes in respondents' use of other medications as a result of cannabis use.

*Medical use* According to CCS data, more males than females reported having used cannabis for medical purposes in the last 12 months (13.7% and 12.2%, respectively).

*Several scoping review studies on gender differences on medical use of cannabis corroborate these results [93][105].*

*Possession of medical documents* More males (35.2%) than females (32.5%) reported having a medical document from a healthcare professional for their use of cannabis for medical purposes while most of them did not have such a document (67.5% of females and 64.8% of males).

*No studies were found in the scoping review on this issue.*

*Changes in use of other medications* According to CCS data, 69.6% of males and 67.5% of females answered that cannabis use decreased other medications while 14.9% of females and 9.9% of males reported that there were no changes in other medications.

*One scoping review study found that females report more often substituting cannabis for prescription drugs than males [105].*

*Proportion and frequency of cannabis use for medical purposes* 83.3% of males and 74.2% of females who used cannabis for medical purposes in the past 12 months reported past 30-day use of cannabis for medical purposes. More males than females reported they used cannabis for medical purposes daily (38.4% of males and 36.1% of females). More females than males reported having used cannabis for medical purposes less than 1 day per month (17.6% of females and 13.1% of males). Regarding the frequency of use per day of cannabis use for medical purposes in the past 30 days, the most common answer for both females and males was 1 time (40% of females vs. 34.5% of males). Males answered 3, 4 and 5 times or more per use day while females more often reported 1 and 2 times use per day.

*There were no studies in the scoping review on this issue.*

*Types of cannabis products used for medical purposes* More males than females used dried flower/leaf (smoked or vaporized) (81% of males and 63.5% of females); liquid concentrate (e.g., hash oil, butane honey oil, etc.) (19.5% of males and 12.3% of females); solid concentrate (e.g., shatter, budder, etc.) (17.1% of males and 12.6% of females); and hashish/kief (14.9% of males and 7.3% of females). More females than males used edibles (e.g., prepared food products) (34.7% of females and 32.4% of males) and cannabis oil from Health Canada licensed producers (21.5% of females and 20% of females). Data for cannabis used as liquid was not disaggregated by sex.

*There were no studies in the scoping review on this issue.*

*Average amount used on a typical use day for medical purposes* Males who used dried flower/leaf used higher quantities, compared to females (1.7 g for per male and 1.5 g per female) as well as males who used edibles (1.4 servings per male and 1.1 servings per female).

*Evidence from the scoping review suggests that males report use of greater quantities of cannabis for medical purposes compared to females [5, 104].*

*Sources used to obtain cannabis products for medical purposes* More males obtained their cannabis by: growing it themselves (12.2% of males and 6.3% of females), from a Health Canada licensed producer (24% of males and 23% of females), a friend (31.8% of males vs. 28.3% of females), and a dealer (16.2% of males vs. 9.6% of females). More females obtained their cannabis from a compassion club/dispensary (29.2% of females and 26.6% of males), a family member (13.4% of females vs. 8.5% of males), and an acquaintance (9.3% of females vs. 7.6% of males). Data from the category “shared among a group of friends” were not disaggregated by sex.

*There is some evidence from the scoping review that suggests that women are more likely to be introduced to cannabis by their partners and less likely to engage with dealers and cultivators [62]. In contrast, men are more likely to be engaged with dealers and cultivators.*

*Average amount spent on cannabis for medical purposes in a typical month* Females who used cannabis for medical purposes in the last 12 months spent less than males. The same pattern was found among females who used cannabis for medical purposes in the last 30 days.

*There were no studies in the scoping review on this issue.*

*Cannabis products for medical purposes bought or received, and at what frequency* Among both females and males, the most frequent response was buying or receiving dried flower/leaf.

However, more males than females selected this option (79.9% of males vs. 64.7% of females). More females than males reported buying or receiving edibles (25.1% of females vs. 17.1% males) and tinctures (e.g., concentrated amounts ingested orally or taken under the tongue (15.2% of females and 7.7% of males). The frequency of obtaining cannabis products bought or received among people who reported past 30-day medical use was not disaggregated by sex. *There were no studies in the scoping review on this issue.*

*Average amount bought or received among people reporting medical use, by product type* Among people who reported using cannabis in the past 30-day for medical purposes, males reported purchasing or receiving more quantity of dried flower/leaf than females (20.2 g per male vs. 13.5 g per female) and solid concentrate (e.g., shatter, budder, etc.) (3.9 g per male vs. 2.4 g per female) while females reported buying or receiving more quantity of edibles (e.g., prepared food products) than males (7.1 servings per female vs. 6.7 servings per male) and cannabis oil from a Health Canada licensed producer (96.6 milliliters per female vs. 93.4 milliliters per male). *There were no studies in the scoping review on this issue.*

*Average price per unit of cannabis purchases for medical purposes, by product type* CCS data indicate that males paid more than females for edibles (e.g., prepared food products) (\$9.96/serving per male vs. \$7.87/serving per female) and cannabis oil from a Health Canada licensed producer (\$1.96/millilitre per male and \$1.72/millilitre per female). Females reported paying more than males for dried flower/leaf (\$13.16/g per female and \$10.89/g per male). *There were no studies in the scoping review on this issue.*

*Cannabis products for medical purposes received for free* Data were not disaggregated by sex and there were no studies in the scoping review on this issue.

*Opinions on cannabis use for medical purposes and driving* More males who used cannabis for medical purposes responded that they believed that cannabis use for medical purposes impairs one's ability to drive. The same participants were also asked for their opinion on the time until it was safe to drive after using cannabis and males were more represented in the following categories: immediately, 30-60 minutes, one to three hours, three to five hours. More women than men answered that 'it depended'. *There were no studies in the scoping review on this issue.*

*Driving a vehicle after using cannabis for medical purposes, and at which frequency* Males (47%) were more likely to report driving within 2 hours of using cannabis for medical purposes compared to females (33.7%). *There were no studies in the scoping review on medical use and driving*

## **II. CANADIAN STUDENT TOBACCO, ALCOHOL AND DRUGS SURVEY (CSTADS)**

The prevalence of cannabis use in the general population is estimated by Health Canada through two surveys: the Canadian Tobacco, Alcohol and Drugs Survey (CTADS) and the Canadian Student Tobacco, Alcohol and Drugs Survey (CSTADS). The 2016-17 CSTADS is the ninth cycle of data collection on student tobacco, alcohol, and drug use as well as information on bullying, mental health, and school connectedness. The data were collected between

October 2016 and June 2017 in nine Canadian provinces using a total sample of 52,103 students in grades 7 to 12 (secondary I through V in Quebec). The description of the results comparing females and males are presented. Evidence or lack of evidence from the scoping review is mentioned as well to supplement these descriptions.

#### ***i. Prevalence cannabis use and age of initiation***

According to the results of CSTADS 2016-2017, 17.6% of males and 15.8% of females used cannabis in the past 12 months. The mean age of males at first use was 14.1 years and of females, 14.4 years respectively. Prior to 2014-15, the prevalence of use by males was higher than that of females.

*Scoping review studies have reported greater cannabis use among boys [3] although the gender gap in prevalence of cannabis use appears to be narrowing [176]. Boys have reported earlier uptake [40], but gendered variations in age of initiation have been related to the frequency of cannabis use [41].*

#### ***ii. Prevalence of cannabis use in combination with alcohol use***

Data from the CSTADS 2016-2017 show that 16.7% of males and 15.1% of females used both cannabis and alcohol.

*Some scoping review studies have reported greater prevalence of cannabis use in combination with alcohol among boys and young men [58, 177], although qualitative research suggests some boys who use cannabis prefer cannabis to alcohol use [60]. Use of alcohol and tobacco have been identified as predictors of cannabis use [46].*

***Past twelve-month methods of cannabis consumption*** According to CSTADS 2016-2017 results, among those who used cannabis in the past 12 months, 80.6% of males and 79% of females smoked (a joint, bong, pipe or blunt) in the past 12 months; 36.5% of males and 31.7% of females used edibles; 17.7% of males and 9.6 % of females drank a cannabis product; 34% of males and 24.7% of males vaped cannabis; 27.7% of males and 15% of females dabbed; 28.6% of males and 19.8% of females used in some other way.

*No studies in the scoping review.*

### **III. CANADIAN TOBACCO, ALCOHOL AND DRUGS SURVEY (CTADS)**

The Canadian Tobacco, Alcohol and Drugs Survey (CTADS) is conducted by Statistics Canada on behalf of Health Canada. It is a biennial general population survey of tobacco, alcohol and drug use among Canadians aged 15 years and older. The results for the third biennial CTADS data collection started in February 2017 and ended in December 2017. The results are based on telephone interviews with 16,349 respondents across all 10 provinces, representing a weighted total of 30.3 million Canadian residents aged 15 years and older. The description of the results comparing women and men is included. Evidence or lack of evidence from the scoping review is mentioned as well to supplement these descriptions.

#### ***i. Prevalence of lifetime cannabis use***

According to the CTADS 2017, 52.4% of men and 40.9% of women reported lifetime cannabis use.

*There is evidence from multiple scoping review studies that men and boys have higher cannabis prevalence than women and girls [4, 14], particularly frequent cannabis use [68], although the gender gap appears to be narrowing among adolescents [14].*

**ii. Past year cannabis use**

18.7% of men and 11.1% of women reported they consumed cannabis during the past year. The prevalence of past-year cannabis use among males increased from 2015 (15%), whereas for past-year cannabis use there was no change among females.

*Similarly, scoping review studies reported higher past year cannabis use among boys and men [20, 172].*

**iii. Mean age of initiation**

The mean age of initiating use of cannabis was 18.3 years old for males, unchanged from 2015; and 19.1 years old for females, compared to 18.4 years old in 2015.

*Some scoping review studies reported no difference between males and females in age of first use [14, 39], although women are more likely to initiate cannabis use after age 30 [14].*

## D. RECOMMENDATIONS FOR IMPROVING SURVEY QUESTIONS

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Based on the description of the results of the Canadian Cannabis Survey, the Canadian Student Tobacco, Alcohol and Drugs Survey, the Canadian Tobacco, Alcohol and Drugs Survey we make several recommendations related to the inclusion of new variables and questions to better understand cannabis use among gender groups and diverse individuals; and an SGBA+ analysis of the collected data. We also recommend needed improvements in the approach to contracting public opinion research.

We based the recommendations on the scoping review results included to supplement the results and the sex- and gender-based analysis of the survey data. In this report, we do not consider issues related to the process and practicalities of survey design and implementation. However, there are some limitations regarding the sample size that may be addressed by over-sampling for specific sub-groups of respondents or include data from different waves of the survey to increase the total numbers in those sub-groups, when possible.

### I. SURVEYS: THE INCLUSION OF NEW VARIABLES AND QUESTIONS:

- i. The addition of sociodemographic variables such as sexual orientation, cultural background or immigration status, and time spent in Canada to *all* Health Canada surveys when possible (and to commit to analysis). There is clear evidence that men, women and gender diverse individuals have different cannabis use patterns aligned with their sexual orientation, and some indication that new Canadians may have different patterns of substance use.
- ii. The introduction of questions related to general health, mental health, depression, anxiety, etc. (The evidence found in the scoping review articles is synthesized in the section on factors associated with cannabis initiation: Risk & Protective Factors Associated with Cannabis Use, Anxiety & Depression).
- iii. The addition of questions regarding characteristics that have been linked with cannabis use such as use among family and friends. Specifically, the Canadian Student Tobacco, Alcohol and Drugs Survey could provide a better understanding of the relationship between cannabis use and parental knowledge of use, familial factors, and perceived peer use if these questions were included. (For more information on the support for this recommendation, see Factors Associated with Cannabis Initiation, Risk & Protective Factors Associated with Cannabis Use.)

## II. SURVEY ANALYSES

- i. Report the results for the “other” (gender identity) category, when included, even if cell sizes are small, unless data suppression rules prevent this.
- ii. Report sex-disaggregated data for all questions. CCS data are not sex-disaggregated for all variables. For example, in some cases the results for women are not reported and the following message can be read: "High sampling variability - although an estimate may be

determined from the table, data should be suppressed. " There are approximately 84 cells that do not report data for women compared to approximately 62, for men. CSTADS data by age groups are not sex-disaggregated as well as past 12-month use of cannabis by province, perceptions of risk and difficulty in accessing. Although questions on polysubstance are included, data were not sex disaggregated. Questions such as method of consumption and cannabis use for medical purposes (from CTADS) were not sex disaggregated. Where cell sizes are too small, alternative research methods could be proposed to generate data on women or sub-groups.

### III. PUBLIC OPINION RESEARCH

Health Canada commissioned two pieces of public opinion research (POR) in 2016, in order to gauge attitudes regarding cannabis in Canada. One report was commissioned from EKOS, reporting on a survey to establish a baseline of the knowledge, attitudes and behaviour toward nonmedical 'marijuana' use among Canadians 13+. The second one was commissioned from the Earncliffe Strategy Group, reporting on qualitative research on the issues connected to the legalization of cannabis in Canada and on channels for communicating about cannabis. Reporting their disaggregated findings, and applying a SGBA+ lens to these highlights a few issues for current and future prevention efforts, as well as some future questions that could be resolved or pursued in future POR.

EKOS: The report is entitled: "Baseline Survey on Awareness, Knowledge and Behaviour Associated with Recreational Use of Marijuana"

The report is based on a randomized phone/online survey (pan Canadian) of 2201 individuals 13+ probing issues surrounding health and impairment due to recreational cannabis use. The sample included targeted sampling of youth (13-18, n=287), young adults (18-24, n=372) and parents of youth (n=532). To test the differences, EKOS applied Chi-square and standard t-tests as applicable. Differences noted were significant at the 95 per cent level. The statistically significant differences were marked with an asterisk (\*) in this report.

The majority of the respondents had tried cannabis, especially males, those under 65, and those in BC. Most perceived and reported smoking as the key mode of use. A substantial minority of respondents had either driven after using cannabis or been passengers of someone under its influence. In general, men are more likely to use cannabis, more likely to have driven while impaired or with a cannabis -impaired driver, and more likely to have purchased cannabis from a seller. Women were much more likely to perceive health risks attached to its use, including the possibility of addiction, memory issues and attention. Among the parents who have used cannabis, the messages to their children or teens were more likely about risks and benefits and rules, while those who do not use cannabis were more likely to suggest abstinence. Overall, the majority of respondents wanted more information on risks for health, risks for youth, multi-substance use, impaired driving, and routes of administration. Their preferred sources of information were medical personnel and law enforcement. For respondents who were born outside of Canada, the need for information was even more desired and needed.

## Reported behavior of respondents

*Personal use of cannabis* Taking all three groups of respondents together, men were more likely than women to say that they have used cannabis at some point (62% of men\* vs. 54% of women\*). Moreover, among those who reported ever using cannabis, men were more likely to report cannabis use in the past 12 months (41% of men vs. 35% of women\*). Regarding the age of initiation, most of those who used cannabis started between 13 and 18 years old (60% of the women vs. 58% of the men) followed by 19 and 24 years old (23% of men and 23% of women). Women were less likely than men to initiate cannabis use between 35 and 44 years old (1% of the women\* vs. 4% of the men\*).

*Frequency of use* Among those who answered they used cannabis in the last 12 months, fewer women (20%) than men (24%) reported daily cannabis use. The same pattern was found for those who answered a few times a month (17% of women vs. 18% of men), a few times a year (26% of women vs. 27% of men). Women (19%) were more likely than men (13%) to answer they used cannabis less often than a few times a year. 18% of women and men answered they used cannabis a few times a week.

Among the youth and young adults who reported cannabis use less than weekly during the last 12 months, women were more likely to have said they used cannabis once (14% of the women vs. 10% of men), 2-4 times (44% of women vs. 37% of men) while men were more likely to have reported they used cannabis between 5 and 10 times (26% of men vs. 22% of women) and more than 10 times (28% of men vs. 19% of women).

*Reasons for use* Among those who have tried cannabis, men (37%) were more likely than women (35%) to report they used it nonmedically, for pleasure. 25% of men and women said curiosity was their reason. Women were more likely than men to report reasons such as relaxation (25% of women\* vs. 19% of men\*), desire of inclusion (12% of women\* vs. 8% of men\*). Men\* (11%) were more likely than women (8%) to report they used cannabis because they liked the feeling.

*Methods of use* The most common method of cannabis use for both men and women was smoking it (general mention) (43% of the men vs. 42% of the women) followed by smoking in a joint/cigarette (29% of women vs. 26% of men), smoking through a pipe or a water pipe/Bong (11% of men vs. 10% of women), eating it (9% of men and 9% of women), vaporizing by using a vaporizer (7% of men vs. 5% of women).

*Sources of cannabis* More women (80%) than men (77%) reported that they obtained cannabis from a friend(s). More men\* (22%) than women\* (16%) reported they obtained it from someone who sells it (who isn't a friend). 11% of the women and 9% of the men reported they obtained the cannabis from family. Stores that sell cannabis were cited infrequently (6% of the men vs. 5% of the women); likewise for growing a personal supply (5% of the men vs. 4% of the women).

*Reported interest once legal* Among those with no prior use and those who have not used cannabis in the past 12 months, 66% of the women and 61% of the men reported they would be not at all likely to use/try cannabis once legalized. Only 5% of the men and 3% of the women anticipated using cannabis once legalized.

*Operation of vehicle while impaired* Among those who have ever used cannabis, men\* (38%) were more likely than women\* (15%) to report they drove or operated a vehicle while impaired. When asked if they were a passenger in a vehicle where the driver was under the influence of cannabis, men (39%) were more likely than women (31%) to report they have been the passenger. When asked about the likelihood of accepting a ride from someone who they knew was under the influence of cannabis, more women (61%) than men (48%) answered not at all likely. Men were more likely to answer not very likely (26% of men vs. 20% of women), moderately likely (11% of men vs. 10% of women), likely (8% of the men vs. 4% of the women) and very likely (6% of the men vs. 4% of the women).

*Use of cannabis in social networks* Women were less likely than men to know people in their own network of family and/or friends who have used cannabis (83% of women\* vs. 86% of men).

*Attitudes and social acceptability* Despite understanding that it was illegal at the time, the social acceptability of using cannabis was high. More men\* (52%) than women\* (44%) agreed that using cannabis was socially acceptable. More men than women somewhat agreed (36% of men vs. 33% of men) or strongly agreed (16% of men vs. 10% of women). 20% of women and 18% of men neither agree nor disagree. On the other hand, more women\* (35%) than men\* (28%) disagreed that using cannabis was socially acceptable. More women than men reported they somewhat disagreed (22% of women vs. 16% of men) or strongly disagreed (14% of women vs. 12% of men). 20% of women and 18% of men neither agreed nor disagreed with the statement.

*Social Expectations* More men\* (71%) than women\* (67%) agreed that it is expected that teenagers and young adults will try cannabis. More men (44%) than women (41%) reported they somewhat agreed or strongly agreed (27% of men vs. 25% of women). More women than men disagreed with the statement (19% of women vs. 16% of men). This was similar for other options such as neither agreed nor disagreed (13% of women vs. 12% of men), somewhat disagreed (11% of women vs. 9% of men), strongly disagreed (8% of women vs. 7% of men).

**Perceptions of Health Risks** Using cannabis was considered less risky than using alcohol or tobacco. Even so, the notion that it was harmful to teens was almost universally understood. For example, while more women\* (45%) than men\* (36%) rated the health risk of frequent use (daily or more often) of nonmedical cannabis as high, more men\* (29%) than women\* (21%) rated it as low. 32% of men and women rated it as moderate.

*Perceived harm for different age groups* There were differences when considering the risks for different age groups. 50% of the women and 46% of the men reported considering cannabis harmful for adults over the age of 24 years old; 32% of the men and 30% of the women reported no impact; and 19% of men and 17% of women reported a beneficial effect in the same age group. More women\* (67%) than men\* (60%) thought that taking cannabis occasionally (less than weekly) was harmful for young adults between 19 and 24 years old. Fewer women\* (9%) than men (11%) reported they thought cannabis was beneficial for the same age group. More men\* (27%) than women\* (23%) reported they thought that cannabis use (less than weekly) had no impact. Most women\* (91%) and men\* (87%) answered they thought cannabis was harmful for

teens between 13 and 18 years old while only 2% of women and 3% of men reported a beneficial effect. More men\* (9%) than women\* (5%) reported no impact for the same age group. When asked about their own group, more women\* (50%) than men\* (43%) perceived it as harmful while more men\* (29%) than women\* (22%) perceived it as having no impact. 25% of men and women considered occasional cannabis use was beneficial for their own age group.

*Perceived impact of use* Men and women perceived the effects of occasional use of cannabis differently for the attention and memory area. More women than men answered the effects are harmful (64% of women\* vs. 55% of men\*) while more men than women considered the effects as beneficial (8% of the men\* vs. 5% of the women\*) or without impacts (33% of the men\* vs. 27% of the women\*). More women\* (49%) than men (45%) perceive the harmful effects of occasional cannabis use for physical health while more men\* (41%) than women\* (36%) consider there is no impact on this area.

The results are similar for both men (13%) and women (12%) when the effects are rated as beneficial. More women\* (46%) than men\* (40%) rated the effects of occasional cannabis use as harmful on relationships with family and friends while more men\* (44%) than women\* (39%) considered the effects had no impact. Similar results for men (14%) and women (12%) were found when they rated it as beneficial. The impact of occasional use of cannabis on performance at work or school was rated as harmful by more women\* (62%) than men\* (57%) while more men\* (34%) than women\* (29%) perceived it as with no impact. 7% of the men and 6% of the women rated the effects as being beneficial on performance at work or school.

*Impact on addiction* When asked about the likelihood of less than weekly cannabis use leading to addiction or dependence to cannabis, women are more likely to rate it as high (22% of women\* vs. 18% of men\*) or moderate (21% of women\* vs. 17% of men\*) than men while men are more likely to rate it as low (61% of men\* vs. 52% of women\*). Women were more likely than men to rate the likelihood of addiction or dependence when the use of cannabis was daily or almost daily as high (65% of the women\* vs. 52% of the men\*). Men are more likely than women to rate the risk of addiction or dependence as low (23% of men\* vs. 14% of women\*) or moderate (24% of men\* vs. 19% of women\*).

## Knowledge

The majority of respondents desired more information on health effects, impaired driving, combined use with other substances, different effects of routes of administration, and risks of addiction.

*Information seeking* Men\* (54%) were more likely than women\* (48%) to report that they have looked for information on the effects of using cannabis. When asked about the access to enough trustworthy information about the health risks of cannabis use to make informed decisions, women and men report similar results: 68% of women and 69% of men agree, 31% of women and 37% of men strongly agree, 37% of women and 33% of men somewhat disagree, 17% of women and 18% of men disagree, 4% of women and 6% of men strongly disagree, 12% of women and 12% of men somewhat disagree, and 13% of women and 11% of men neither agree nor disagree.

When asked about their preferred sources of information about health risks of cannabis, 53% of women and 53% of men would speak to health professionals; women are more likely to report internet and google searches (16% of women vs. 14% of men), teachers/counsellors/social workers (9% of women vs. 7% of men), and pharmacist (3% of women\* vs. 1% of men\*). In terms of sources of information regarding safety in driving a vehicle, women are more likely to rely on law enforcement (31% of women vs. 30% of men), health professionals (25% of women vs. 24% of men), internet and google searches (10% of women\* vs. 7% of men\*), provincial/regional health authorities (1% of women\* and 1% of men\*), government of Canada sources (1% of women\* vs. 0% of men\*) and pharmacist (1% of women and 0% of men). Men are more likely to report they would rely on a friend (5% of men and 4% of women) and research professionals (5% of men\* vs. 3% of women\*).

*Information Needs:* 60% of men and women would be interested in knowing more information about the health risks, 57% of men and women would like to know more about the effects of cannabis on driving, and 50% of men and women about the risks of different types of products and ways to consume. More women than men are likely more interested in learning more about the effects of combining cannabis with alcohol or other drugs (56% of women vs. 53% of men), the risks for youth and young adults (55% of women vs. 54% of men), risk of addiction (49% of women vs. 47% of men), the law and penalties (48% of men vs. 47% of men). Regarding the topics of discussion, women were more likely than men to report the health and safety and social risks (29% of women vs. 28% of men), usage, if/who they know takes it, if they have tried it, when (18% of women vs. 9% of men), self/peers/family cannabis use (17% of women vs. 10% of men), effects of cannabis use (12% of women vs. 6% of men). Men were more likely to report discussing legalization, changes to legalization (11% of men vs. 6% of women).

## Parents and cannabis

*Use of cannabis* Among parents of youth and/or young adults, mothers are more likely to report that their child has used cannabis at some point (35% of mothers vs. 32% of fathers).

*Impaired driving* Only 2% of the mothers and 1% of the fathers report that their teenager has driven a vehicle while under the influence of cannabis. When asked if their children accepted a ride with a driver who was under the influence of cannabis, 8% of fathers and 7% of mothers answered yes.

### *Discussions between young people and their parents*

*Reported incidence of discussions with youth/parents* Among teenagers, males (60%) were more likely than females (55%) to report discussing cannabis use with their parents. Among parents, mothers\* (92%) were more likely than fathers\* (80%) to report discussing cannabis use with their children.

## Impact of the Public Opinion Research: Areas for messaging

The EKOS study provides useful information about the state of attitudes, knowledge and behaviour in 2016 among Canadians, and could be helpful in assisting with the targeting of prevention messages. The sex and gender disaggregated results offer some important

directions such as: worries about risks, usage, driving, and roles in parenting regarding cannabis use. These differentiated results can be built upon in messaging.

1. Recognize male usage rates and higher impaired driving and riding rates, but focus on gendered behaviours surrounding masculinities, perceptions of risk and generating skills among men to refuse, to seek alternate transport, and to call out impaired male friends. At the same time, focus on gender relational power differences to increase skills in women in addressing men who might be using cannabis, driving while impaired or riding with someone impaired.
2. Recognize the interest, concern, action and knowledge among women and mothers about health risks, risks of impaired driving and effects of cannabis, and their primary role in speaking with their children about these issues. At the same time, focus on improving gendered parenting roles in encouraging men and fathers to develop skills in parenting, communication and increased knowledge of risks.
3. Recognize the initiatives that men had taken to acquire information about cannabis use, and the relatively high proportion of both men and women who wanted more information on a range of topics.
4. Recognize the apparent gender differential in perceiving risks associated with cannabis use. Women appear to perceive higher risks in several domains, when compared to men. This information gap might be filled using gender-sensitive messaging.
5. Continue to consider sex differences in usage and focus on generating biologically based prevention messaging.
6. Continue to consider gender issues in parenting roles, roles in impaired driving, roles in managing family health, and ability to find and use information about cannabis.

#### Earncliffe Strategy Group: Exploratory Focus Groups on Marijuana Research Report<sup>6</sup>

This report details the results of 24 focus groups in four cities (Vancouver, Toronto, Halifax and Montreal) across Canada undertaken in 2016. The groups comprised youth (13-15); (16-18); (19-24); adults (25+) and parents of youth who are 13-15. While the recruiters screened and noted the sex of respondents according to their appended tool, they did not report on this aspect of their findings. The topics explored were similar to the EKOS survey including use, effects of use on young people, information held, impaired driving, and preferred sources of information. The focus group participants were also asked to react to various messages, scenarios, testimonials and advertisements, in order to assess some fruitful potential messaging. The methodology offered a clear opportunity to delve into knowledge and practices that are influenced by sex and gender, but this opportunity was not realized as this report is gender blind.

First there is no reportage or analysis of responses by sex, so we do not learn about how girls, boys, women and men may have responded differently, or not, to these messages or how any of these groups may have related to the information or had differential experiences. Second, even when materials, such as statements or videos were presented that included sex or gender specific information or players (such as death of a mother by an impaired driver), there was no analysis of this aspect. In statements about tolerance, for example, age was mentioned as a factor, but not sex, as a point of consideration.

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<sup>6</sup> <http://epe.lac-bac.gc.ca/100/200/301/pwgsc-tpsgc/por-ef/health/2016/049-15-e/report-rapport-eng.html>

Nonetheless, the report's main results are: that most participants supported the legalization of cannabis, felt that there were risks to cannabis use, that impairment was a possible result, that driving while impaired could have dire consequences, that enforcement could not detect cannabis impairment, that social media platforms were effective means of communication, and that credibility of messaging was key to its impact. Although there were aspects of content that might be perceived or related to differentially based on sex or gender, it is impossible to comment on those elements, as they are not reported or addressed.

### Public Opinion Research: Requirements for SGBA+

- i. Specific integration of SGBA+ requirements into procurement for public opinion research and communications messaging and content commissioned from creative agencies is urgently required in order to garner or generate needed sex and gender-based information and analysis from these efforts.
- ii. Repeated POR in 2019 on more detailed aspects of gender roles and parenting, usage, health literacy and driving/riding is warranted in order to form the basis for further development of prevention messaging.

### THE NEED FOR ACCESSIBLE ANALYSIS TO SUPPORT PREVENTION PLANNING

## IV. GREY LITERATURE

The grey literature provides some accessible summaries of selected survey data and academic literature, but does not, in general, add to public knowledge by critically discussing the evidence on sex and gender and cannabis use, or the implications for practice and policy.

### i. Prevalence

Grey literature sources often mention data on prevalence of use. Usually this involves one point of data where use is disaggregated by sex. For example the Centre for Addiction and Mental Health's Cannabis Policy Framework document offers a table showing percentage of men and women who used cannabis in 2013 and then makes no further mention of sex/gender [178]. However, the Canadian Centre on Substance Use and Addiction's report on *Cross Canada Student Alcohol and Drug Use* offers data on prevalence of student cannabis use by sex, province and age [179]. While there is a table describing use by sex and province, showing girls using less than boys, there is no comparable breakdown by age and sex. It does cover DUI by sex, showing males more likely to drive impaired; and covers being a passenger with someone driving while impaired, showing females to have a higher rate.

There are few relevant grey literature reports, web page summaries and infographics, and in these, the level of sex and gender analysis is low to nonexistent. There is considerable room for contributing to sex and gender sensitive prevention messaging on cannabis using these formats. The grey literature can play a key role in increasing awareness and promoting safer or reduced use, in ways that are tailored to subgroups and that promote gender equity while promoting health.

## **ii. Reproductive health**

There are a number of grey literature documents describing risks of cannabis use in pregnancy, for example CCSA's *Clearing the Smoke, Maternal Cannabis Use in Pregnancy* [180], Best Start's *Risks of Cannabis on Fertility, Pregnancy, Breastfeeding and Parenting* [181], and the Colorado Department of Public Health & Environment's *Marijuana and Your Baby* [182]. Such documents warn parents about the risks of use, tend not to emphasize the lack of evidence, and sometimes overstate the evidence regarding adverse effects on birthweight and child development. An exception is the CanFASD Research Network's Issue Paper on Cannabis and Pregnancy which describes the literature as mixed and inconclusive. All grey literature recommends no use during pregnancy and breastfeeding [183]. Unlike the coverage of alcohol and pregnancy, the grey literature on cannabis and reproductive health does bring attention to the possible adverse effects on parental-child relational development when new parents use cannabis.

Policy related documents such as the final report of Canada's Task Force on Cannabis Legalization and Regulation make passing reference to pregnancy in a paragraph about risks of cannabis use for vulnerable populations [184]. Similarly, Canada's Lower Risk Cannabis Use Guidelines make brief mention of pregnant women as a special risk population [185].

## **iii. Physical and mental health**

Some reports such as CCSA's *The effects of Cannabis Use During Adolescence* cover studies comparing risks for dependence on cannabis, and vulnerability for PTSD and eating disorders for people who used cannabis by sex, yet go on to make no gender specific treatment recommendations [186]. CCSA's report on the effects of cannabis on cognitive functioning and mental health mentions that sex and gender have largely not been attended to in the studies described. For the most part when health effects are mentioned in the grey literature, they are described for whole age groups (adolescents, adults) and not by sex/gender.

## **iv. Overall perspective on sex, gender and substance use**

The National Institute on Drug Abuse (NIDA) in the US offers an infographic on *Substance Use in Men and Women* with a section on Differences in Marijuana Use Disorder which notes that women develop the disorder more quickly and have more anxiety disorders and panic attacks, in comparison to men who have more severe disorders, more antisocial personality disorders and more of other kinds of substance use problems [187]. NIDA also offers a Drug Facts webpage on women and substance use, revised in 2018, which contains a brief listing of sex and gender differences in substance use by women as well as issues related to pregnancy [188].

At a more general level, the United Nations Office on Drugs and Crime (UNODC) offers a compelling statement on overall gender equity issues in the report entitled *A gender perspective on the impact of drug use, the drug trade, and drug control regimes*: "Women's rights or gender equality rarely feature in discussions about the world drug problem. Men are, after all, a large majority of those using or trafficking drugs. Women's roles, both as participants and victims, are underestimated and understudied. However, it is clear that the world drug problem is undermining gender equality, and that a gender perspective is needed in all efforts to prevent and respond to this issue" [189].

## E. SGBA OF CANNABIS INDICATOR FRAMEWORK

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### I. SGBA+ STEPS AND PROCESSES

SGBA+ (sex and gender-based analysis plus) is a term linked to the Government of Canada's approach to gender-based analysis (GBA+) developed by Status of Women Canada. It has robust training resources and forms the basis of the Sex and gender-based Analysis Action plans at Health Canada and elsewhere in the federal government.<sup>7</sup> Additional training resources are available at the CIHR<sup>8</sup> and at various external sites.

In understanding substance use, both sex and gender are of critical importance. Sex refers to the biological characteristics of people (males and females) and urges consideration of bodily characteristics and how they affect or are affected by cannabis. These components include anatomy, physiology, genetics and other bodily characteristics. Gender refers to the social and cultural milieu affecting humans of any gender and any sexual orientation, and urges consideration of numerous aspects such as roles, norms, laws, relations, power and identity to understand how these are affected by, or affect, cannabis issues. The + (plus) aspect of SGBA+ refers to the potential mediating or determining effects of factors such as age, ethno/racial identity, income, education, etc. as they affect health equity.

### II. APPLICATION OF SGBA+ TO THE FOLLOWING GROUPS OF INDICATORS

There are 5 categories of cannabis indicators in the Health Canada Cannabis Indicators Framework, and several subcategories within each. This is an evergreen document, intended to serve as a compilation of indicators for measuring effects of cannabis use and legalization on Canadian society. In this section, we provide a brief overview of how SGBA+ relates to each category. This is supplemented by a more detailed table illustrating some selected evidence-based examples under some of the sub indicators, and selected and illustrative identified data gaps, especially those that reflect diverse identities and situations. The table is not a complete picture of all data gaps or sex and gender specific research issues, and as an evergreen document, should be reviewed periodically with a SGBA+ lens.

What follows is a summary identifying gaps and questions on a range of issues of interest across government, and, in some cases, requiring targeted research or longitudinal studies in addition to survey data.

Overview of the Categories:

1. **Health:** In this category, the inclusion of *both* sex and gender measures into *all* indicators is essential. Our review of these indicators illustrates the central importance of understanding differences as well as similarities between male and female bodily responses to cannabis, as well as the impact of a range of gender related factors affecting the mental and physical health of the whole population. In particular, more detailed research on reproductive health and cannabis use on both males and females is

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<sup>7</sup> <https://www.swc-cfc.gc.ca/gba-acsc/approach-proche-en.html>

<sup>8</sup> <http://www.cihr-irsc.gc.ca/e/49347.html>

urgently required, including fertility and parenting. Research on the impact of cannabis use on pregnancy and breastfeeding needs more longitudinal research and depth, as does sex and gender specific research on the effects of cannabis on mental health, by condition. Polysubstance use is another key area for more research to underpin policy and programming in Canada. For example, sex and gender sensitive research on the co-use of alcohol and cannabis, nicotine and cannabis, opioids and cannabis and/or multi use of these and other drugs is critically important to inform programs and policies. Finally, more sex specific research on the impacts of cannabis use on cardiovascular and respiratory health, specific to the routes of administration, is urgently required in order to inform both health promotion and harm reduction initiatives. Sex specific information on all of these indicators is required to inform practical initiatives such as amending Low Risk Cannabis Use Guidelines, developing prevention campaigns, or health promotion interventions, for example.

2. **Road Safety:** In this category, the main concerns are with impaired driving and riding with a driver who has used cannabis and might be impaired. General issues about how to measure impairment due to cannabis that require more research, but they must be sex specific. As well, more research in animals and humans analysing sex differences in mechanisms of impairment due to cannabis is required. Additionally, the sex and gender specific effects (both subjective and objective, of cannabis use and impairment) need more study. Gender related factors affecting decisions to drive after cannabis use, as well as decisions or experiences in riding after cannabis use of the driver or passenger, need to be documented. Specific gender related factors affecting use of cannabis and transport of children include caregiving and parenting patterns and need documentation. These are all rich sources of information to inform prevention messaging, safety campaigns, and measurement of impairment.
3. **Market:** In this category, there are numerous questions about the role of gender in determining involvement in the production and marketing of cannabis. In addition, gender and equity related questions exist about access to both medical and nonmedical cannabis, modes of supply and purchase, product preference and other features of engagement with both legal and illegal markets for cannabis. The effects of marketing, pricing, mode of sale, and location of dispensaries and other access points for cannabis purchases all have an effect on access. These are all rich sources of information to inform regulations and legislation regarding sales, marketing and advertising, as well as the effects of legalizing cannabis.
4. **Knowledge, Attitudes and Behaviours:** In this category, there are numerous indicators of interest to health promotion, public education and prevention campaigns. All of these indicators require sex and gender sensitive research and evaluation. For example, an assessment of what Canadians know about the sex specific effects of cannabis, and/or what they need to know to make informed decisions is essential to understand and to inform messaging, policy and programming. The impact of gender on knowledge about the effects on child and adolescent health and how to approach parenting in the context of cannabis legalization is an important dimension to understanding how to pitch information and encourage useful and positive child parent interactions. The impact of

gender on risk perceptions, expectations related to using cannabis, context of use, and related usage issues is important to determine in the Canadian context. Equally important is applying a sub-population lens on these questions, to determine how subcultures, age groups, geographic location, ethno/racial groups, and sexual orientation and gender identity affect KAB, in order to develop a Canada specific profile of the populations using, or considering using, cannabis. This information will be essential to determining messaging, developing health literacy concerning cannabis, and designing advice to parents and young people.

5. **Crime and Law Enforcement:** In this category, the main issues connected to cannabis are impaired driving and other crimes such as property crime related to ongoing illegal markets or to legalization. The main issue is to further sharpen measures of impairment due to cannabis and to determine what sex specific issues affect this measure in order to increase accuracy and relevance of measures and techniques. Related to this are gender related issues about riding with impaired drivers and how refusal skills, techniques for intervention and increasing personal and road safety could be enhanced. Both these approaches could decrease crime related to cannabis use if incorporated into prevention messaging and campaigning.

## **F. RECOMMENDATIONS FOR FUTURE INITIATIVES IN RESEARCH, PUBLIC EDUCATION, CANNABIS AWARENESS AND PREVENTION**

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The policy and programming strategies known to be helpful in substance use prevention can be brought to bear on cannabis prevention and education. Topics such as denormalization, naming and supporting resistance to media pressures, supporting critical thinking and dialogue on benefits and drawbacks to use, offering cautionary information regarding polysubstance use, increasing health literacy on effects, generating awareness about negative health and legal impacts, and providing information about reproduction and parenting, are all key areas needing ongoing attention. In addition, there is a need to educate on harm reduction associated with routes of administration of cannabis, and to align such education with prevailing norms, attitudes, policies and regulations on nicotine and alcohol. What follows are some general points about future directions, the incorporation of sex and gender related factors, and some specific ideas for prevention and awareness messaging and campaigns.

- I. General directions in research, policy and communications
  - i. Introduce SGBA+ considerations into all research and policy and communications regarding cannabis
  - ii. Insert procurement requirements on SGBA+ into all POR and other commissioned research and creative content development such as video, advertising, messaging and campaigns
  - iii. Introduce gender transformative principles that include improving gender equity as well as health, into all communications, prevention messaging, campaigns and advertising
  - iv. Support and generate more studies on sex differences on the effects of cannabis use to build on the limited animal and human biological research. In light of other substance use patterns, it may be especially important to focus on tolerance, telescoping, metabolism of cannabinoids, effects on impairment, pain management, and the effects of medical use on sex linked conditions and diseases etc.
  
- II. Some high priority issues regarding sex, gender and cannabis policy and health
  - i. Generate immediate harm reduction information regarding the impacts of route of administration of cannabis so both males and females are informed about relative health impacts of use according to mode of ingestion
  - ii. Align existing cannabis information, education and policy direction with alcohol, nicotine and other drugs, acknowledging sex specific and age specific impacts and multi-use
  - iii. Utilize existing social and biological research to generate tailored and gendered prevention messaging for all age groups and subgroups
  - iv. Respond to the high priority gendered issue of higher male use, higher male driving while impaired, and higher rates of males riding with impaired drivers
  - v. Respond to high risk of problematic use among gendered sexual minority populations

## I. EDUCATION, PREVENTION AND AWARENESS MESSAGES REFLECTING GENDER-RELATED FACTORS

In general, the gender influences on cannabis use are multiple. However, there is scant mention of gender-related influences on cannabis use in the grey literature in reports, educational materials and web-based summaries. It is usually only when reporting on the **prevalence** of cannabis use where sex/gender is reported, by disaggregating rates of use by sex categories.

Prevention messaging directed to girls and boys often refers only to “youth” as a whole; and for adults, the risks of cannabis use in pregnancy forms the primary sex and gender-based example of prevention messaging.

In light of this lack of coverage of sex/gender factors in use, health effects, addiction, help seeking etc. it is important to consider a suite of messages and products that acknowledge the growing literature on gender influences, and infers gender issues from literatures on other drugs, such as nicotine and alcohol use.

## II. EDUCATION, PREVENTION AND AWARENESS MESSAGES REFLECTING SEX-RELATED FACTORS

In general, the sex related factors affecting cannabis use and its effects have not been sufficiently addressed in research. This poses a challenge for cannabis education and messaging. But even where sex differences are well established, such as in nicotine, opioids and alcohol, there has been scant prevention education outside of pregnancy related concerns. This sex and gender blindness is also an issue for current and future cannabis materials and initiatives. One common area of focus in cannabis (and other substance use) is on pregnancy, often to the exclusion of other sex-based factors.

*For example, the Centre of Excellence for Women’s Health has created information sheets on cannabis for service providers that include the overall health effects of cannabis and other substance use for women, followed by the effects during pregnancy for the woman and fetus, and then followed by the effects on breastfeeding and parenting. This prioritizes women’s health by not focussing exclusively on reproduction when considering sex related effects.*

## III. EDUCATION, PREVENTION AND AWARENESS FOR SUB-GROUPS

Clearly, there is a significant lack of attention to the intersections of gender, social characteristics, and other determinants of health, and the implications for messaging. There are some organizations who have attempted to address these intersections in a gender transformative manner. Messages developed for education, prevention or awareness of cannabis use aimed at gender groups need to take a clear and principled gender transformative approach that does not contribute to ongoing gender inequities.

*For example, True Child, a US based group has explicitly used gender transformative approaches to their work. Their documents - for example those on young black men (<https://www.truechild.org/young-black-men>) –link messaging on health with addressing rigid or unhealthy gender norms in the context of diversities.*

### ***Messages about youth prevention for girls and boys***

- Invite critical thinking by girls and boys on the gendered influences of their use (for relaxation, stress reduction, to challenge norms, medical use)
- Address the development of refusal skills by gender groups regarding usage, driving or riding, or multi-substance use

### ***Messages about LGBTQ2 youth prevention***

- Recognize that sexual minority youth are particularly vulnerable to use and problematic use of substances, including cannabis, and generate specific gender-specific messaging for these groups

### ***Messages regarding gender and impaired driving or riding***

- Share information on the higher rates of driving and riding while impaired by boys and men and encourage changes in responsibility for driving while impaired to be shared by all
- Develop messaging that improves skills specific to drivers, riders, peers and bystanders that recognize the influence of masculinities and femininities, as well as power imbalances in gender relations

### ***Messaging regarding multi-substance use and sex, gender and health risks***

- Generate messaging about health risks of women's and men's multi-use and problematic use of cannabis with tobacco, cannabis with opioids, and cannabis with alcohol.

### ***Messages about sex differences and health risks***

- There *may* be emerging evidence about sex differences in tolerance, brain effects, health effects and usage that will have a direct effect on lower risk cannabis use guidelines, sex specific health information and prevention messages regarding driving. These aspects have emerged with respect to alcohol, nicotine and other drugs

### ***Messages about sex differences and mental health***

- Acknowledge and raise awareness about the impact of sex and gender differences in the impact of cannabis use on mental health and mental illness

### ***Messages about cannabis, reproduction and sex and gender***

- Generate awareness of how everyone can contribute to promoting reproductive health by sharing information on the effects of cannabis on fertility, pregnancy and reproductive health, and supporting shared responsibilities for healthy choices
- Take a preconception care approach that encourages long term planning about fertility and pregnancy for males and females and notes the effects of substance use on those plans

- Generate gendered prevention messaging about the impact of cannabis use on parenting roles and responsibilities, including child access to cannabis and conversations with children by both mothers and fathers
- Generate parenting skills among fathers regarding conversing with children and youth, and increase health information to men about risks of cannabis use

In conclusion, there is much that we do not yet know about sex, gender and cannabis. In the context of legalization, this void needs to be filled as rapidly as possible. Generating both animal and human research, with requisite sex specific and sex related and gender related questions is of utmost importance in order to determine the effects of cannabis on both sexes and all genders. This bedrock of knowledge is required to determine the actual detailed effects of cannabis on bodies and on people, and to serve as a foundation for accurate assessments of harms and benefits of both medical and nonmedical uses. While this evidence is being built, it is important to generate prevention, education and treatment from best practices in other substance use domains, and to look to other jurisdictions for experiences with policy and regulation regimes. Ultimately, it must be a goal to generate and evaluate both research and practice with a clear sex, gender and diversity based analysis, in order to better serve all Canadians.

## GLOSSARY

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Sex refers to a set of biological attributes in humans and animals. It is primarily associated with physical and physiological features including chromosomes, gene expression, hormone levels and function, and reproductive/sexual anatomy.

Gender refers to the socially constructed roles, behaviours, expressions and identities of girls, women, boys, men, and gender diverse people. It influences how people perceive themselves and each other, how they act and interact, and the distribution of power and resources in society.

- a) Gender Relations refers to differential power imbalances and engrained assumptions affecting interactions between genders
- b) Institutional Gender refers to regulated and legislated discrimination that is based on sex or gender, affecting access to resources or roles
- c) Gender roles refer to the assumed and often stereotyped opportunities and occupations accessible to individuals based on their gender
- d) Gender Identity is a person's felt sense of gender independent of their assigned sex or ascribed gender.

Transgender individuals experience a gender identity different from the sex observed, and gender assigned at birth.

Gender-diverse people may identify as both male and female, neither male nor female, no fixed gender, or as another gender recognized by Indigenous or other cultural groups.

Sexual orientation refers to a person's sexual and/or emotional attraction to another person such as heterosexual, gay, lesbian, bisexual.

Gender Transformative approaches aim to advance gender equity as well as improved health by simultaneously changing gender stereotypes and norms and health practices.

Sex and Gender-Based Analysis is a process aimed at analysing how evidence, policies, programs, or communications may differentially affect men, women, boys and girls. SGBA+ includes an assessment of how sex and gender interact with a range of diverse characteristics.

## APPENDIX A: REVIEW METHODS & SEARCH STRATEGY

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### *Overview of Literature Review Methods*

The project, *Integrating and measuring the effect of sex, gender and gender transformative approaches to substance use response in Canada*, aims to develop and test sex- and gender-informed approaches to alcohol, nicotine, opioids and cannabis. *One part* of this project includes a scoping and systematic review to answer the following questions:

Scoping review question:

Q1) *How* do sex and gender related factors impact:

- a) patterns of use;
- b) health effects of;
- c) and prevention/ treatment/ or harm reduction outcomes for opioid, alcohol, tobacco and cannabis use?

Systematic review question:

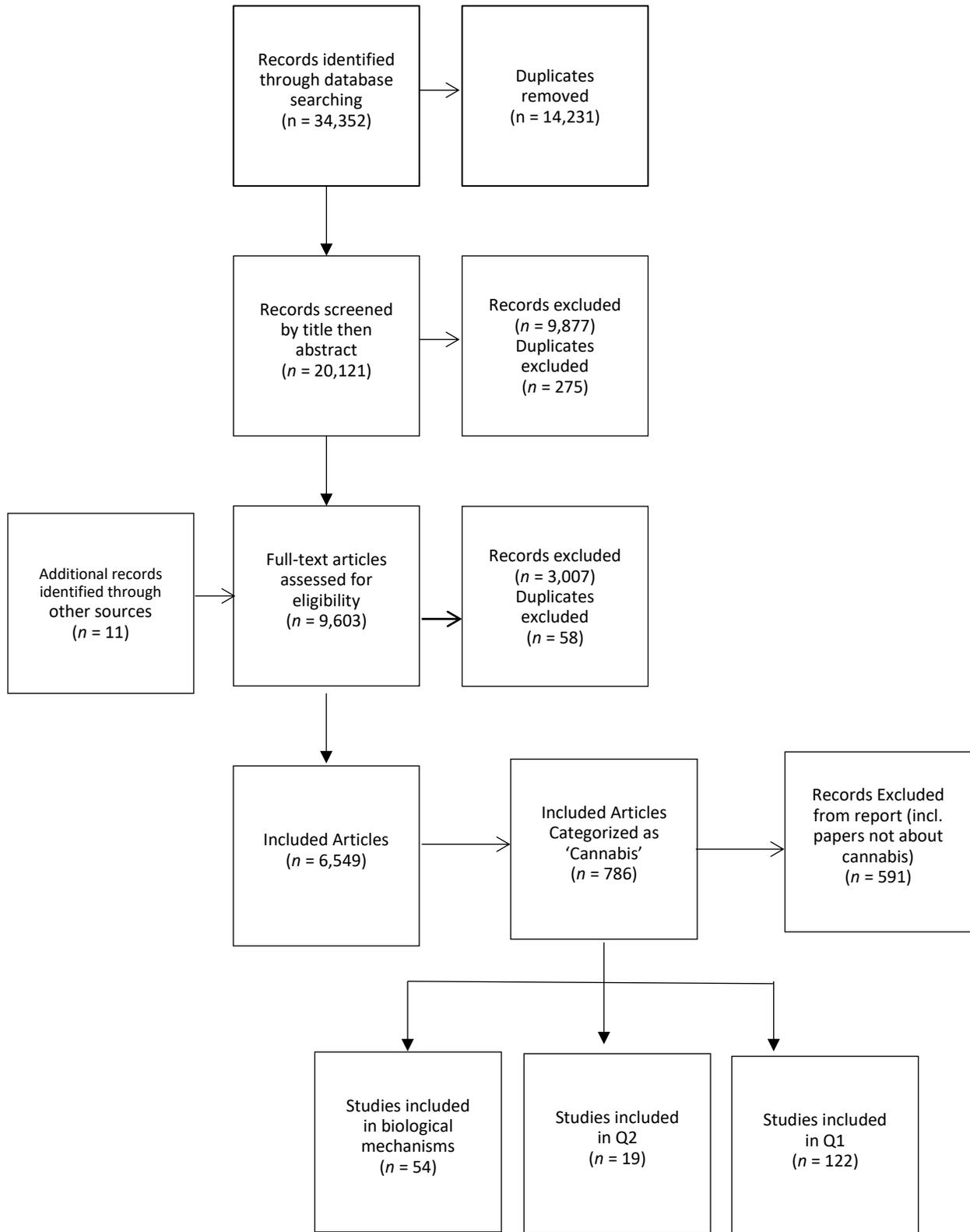
Q2) *What* harm reduction, health promotion/ prevention and treatment interventions and programs are available *that include sex, gender and gender transformative elements* and how effective are these in addressing opioid, alcohol, tobacco and cannabis use?

For the purposes of this report we are reporting on part of Q1: the *scoping review on cannabis patterns of use and health effects*. To identify relevant literature, a comprehensive search was conducted to identify relevant literature for all research questions. The academic literature search strategy is provided in the following section. During screening, relevant studies were sorted into either Q1 or Q2 as per the questions above.

We identified all cannabis studies in the overall scoping review. A research assistant completed data extraction, collecting details on the: aim of the study, study design, country of study, setting, recruitment, sample size, demographics, outcome measures, results, reporting on sex, gender or diversity and study limitations. The data extraction tables were then reviewed by a second researcher, and key findings narratively summarized. In summary,  $n=122$  Q1 cannabis papers and  $n=54$  biological mechanisms papers were identified and summarized for the scoping review and are reflected in this report. Note biological mechanisms studies that included one sex are not summarized in the report; however, these studies were data extracted. The data extraction tables are available on request. Figure 1 provides an idea of the size of these literatures and how they have been sifted.

We also manually searched Canadian, US and international websites for potentially relevant grey literature material. A list of the websites searched, and a short description of the review method is provided in Appendix B. Each website was hand-searched, and the first 50 results considered. Sixty-six (66) potentially relevant grey literature sources on cannabis were identified. This cannabis grey literature is currently being comprehensively screened. However, preliminary comments on key topics, issues, and gaps identified in the grey literature are provided. Finally, for the purposes of reflecting on the Cannabis Indicator Framework we purposively searched several outstanding questions, such as reproductive health and impaired driving.

Figure 1. Flow Chart



### *Academic Literature Search Strategy:*

A limited but systematic literature search was conducted to identify key material published in English from 2007 to 2017. Peer reviewed articles and papers were identified by searching health-related databases with international coverage (Medline, Embase, Cochrane Database of Systematic Reviews, and Cochrane Central Register of Controlled Trials via Ovid; CINAHL, PsycINFO, Social Work Abstracts, Women's Studies International, and LGBT Life via EbscoHost; and Social Science Citation Index via Clarivate Analytics).

Three database searches were performed by a librarian, resulting in the identification of 20,121 unique articles (Search one & two n=14,676; search three n=5, 445). These 20, 121 records have undergone three levels of screening to determine relevance to the review; articles have been screened by title, then by abstract and finally the full text of remaining papers was retrieved and screened a final time for inclusion (see inclusion criteria below). Abstracts and full papers were screened independently by two reviewers, sorted into one or more of the two main research questions, and any disagreements resolved by discussion and consensus. Inter-rater reliability was monitored on a regular basis (after each quarter of the retrieved papers) throughout the screening stage, to ensure the reliability score (Cohen's kappa) remained above  $\kappa = 0.6$ . The overall IRR was 0.71. Figure 1 provides an overview of the cannabis search results.

### **Academic Database Search Strategy**

#### **Search 1) August 2017**

- 1 "gender transformative".ti,ab.
- 2 ("gender informed" or "gender integrated" or "gender responsive").ti,ab.
- 3 ("sex informed" or "sex integrated" or "sex responsive").ti,ab.
- 4 ("gender equalit\*" or "gender equit\*" or "gender inequalit\*" or "gender inequit\*").ti,ab.
- 5 ("sex equalit\*" or "sex equit\*" or "sex inequalit\*" or "sex inequit\*").ti,ab.
- 6 ("gender related" or "gender difference\*" or "gender disparit\*").ti,ab.
- 7 ("sex related" or "sex difference\*" or "sex disparit\*").ti,ab.
- 8 "gender comparison\*".ti,ab.
- 9 "sex comparison\*".ti,ab.
- 10 "compar\* gender\*".ti,ab.
- 11 "compar\* sex\*".ti,ab.
- 12 "gender based".ti,ab.
- 13 "sex based".ti,ab.
- 14 ("gender divers\*" or "gender minorit\*").ti,ab.
- 15 "gender analys\*".ti,ab.
- 16 "sex analys\*".ti,ab.
- 17 (transgender\* or "trans gender\*" or LGBTQ or LGBTQ or LGBT or LGB or lesbian\* or gay or bisexual\* or queer\*).ti,ab.
- 18 ("transsexual\*" or "trans sexual\*").ti,ab.
- 19 17 or 18
- 20 (transgender\* or "trans gender\*" or LGBTQ or LGBTQ or LGBT or LGB or lesbian\* or gay or bisexual\* or queer\* or "transsexual\*" or

- "trans sexual\*").ti,ab.
- 21 ("non binar\*" or nonbinar\*).ti,ab.
- 22 homosex\*.ti,ab.
- 23 ("woman focused" or "woman focussed" or "girl focused" or "girl focussed" or "woman centred" or "girl centred" or "woman centered" or "girl centered" or "female focused" or "female focussed" or "female centred" or "female centered").ti,ab.
- 24 ("man focused" or "man focussed" or "boy focused" or "boy focussed" or "man centred" or "boy centred" or "man centered" or "boy centered" or "male focused" or "male focussed" or "male centred" or "male centered").ti,ab.
- 25 Transgender Persons/  
 26 Sexual Minorities/  
 27 Transsexualism/  
 28 Bisexuality/  
 29 exp Homosexuality/  
 30 Gender Identity/  
 31 (bigender\* or "bi gender\*").ti,ab.  
 32 ("gender identit\*" or "gender incongru\*").ti,ab.  
 33 "differently gendered".ti,ab.  
 34 or/1-33 [GENDER]  
 35 exp Opioid-Related Disorders/  
 36 exp Analgesics, Opioid/  
 37 (opiod\* or opiate\*).ti,ab.  
 38 (fentanyl or phentanyl or Fentanest or Sublimaze or Duragesic or Durogesic or Fentora or "R 4263" or R4263).ti,ab.  
 39 (oxycontin or oxycodone or oxycodan or percocet or percodan).ti,ab.  
 40 (heroin or morphine).ti,ab.  
 41 or/36-40 [OPIOIDS]  
 42 Prescription Drug Misuse/ or Prescription Drug Overuse/  
 43 (("prescription drug" or "prescription drugs" or "prescribed drug" or "prescribed drugs") and (dependen\* or misuse\* or mis-use\* or abuse\* or overuse\* or over-use\* or addict\*)).ti,ab.  
 44 exp Substance-Related Disorders/  
 45 ("substance disorder\*" or "substance related disorder\*" or "substance use disorder\*" or "drug use disorder\*" or "drug related disorder\*").ti,ab.  
 46 ("over prescription" or "over prescribed").ti,ab.  
 47 Drug Overdose/ or (overdose\* or over-dose\*).ti,ab.  
 48 or/42-47  
 49 35 or (41 and 48)  
 50 exp Alcohol-Related Disorders/  
 51 exp Alcohol Drinking/  
 52 (binge drink\* or underage drink\* or under-age drink\* or problem drink\* or heavy drink\* or harmful drink\* or alcoholi\* or inebriat\* or intoxicat\*).ti,ab.  
 53 ("alcohol dependen\*" or "alcohol misuse\*" or "alcohol mis-use\*" or

"alcohol abuse\*" or "alcohol overuse\*" or "alcohol over-use\*" or "alcohol addict\*").ti,ab.

54 alcohol.ti,ab. and (44 or 45)

55 Alcohol Abstinence/  
56 or/50-55

57 "Tobacco Use Disorder"/  
58 Tobacco/  
59 Nicotine/  
60 exp Tobacco Products/  
61 exp "Tobacco Use"/  
62 ((cigar\* or e-cigar\* or tobacco or nicotine or smoking or vaping) and (dependenc\* or misuse\* or mis-use\* or abuse\* or overuse\* or over-use\* or addiction\*)).ti,ab.  
63 (58 or 59 or 60 or 61) and (44 or 45)  
64 exp "Tobacco Use Cessation"/  
65 exp "Tobacco Use Cessation Products"/  
66 ((tobacco or smoking) and cessation).ti,ab.  
67 or/57,62-66

68 Cannabis Abuse/  
69 Cannabis/  
70 Cannabis Smoking/  
71 exp Cannabinoids/  
72 (cannabis or marihuana or hashish or ganja or bhang or hemp or cannabis or cannabinoid\* or cannabidiol or tetrahydrocannabinol).ti,ab.  
73 (69 or 70 or 71 or 72) and (43 or 44 or 45)  
74 or/68,73  
75 or/49,56,67,74

76 Harm Reduction/  
77 ("harm reduction" or "reducing harm" or "reducing harmful" or "harm minimization" or "minimizing harm" or "minimizing harmful" or "harm minimisation" or "minimising harm" or "minimising harmful").ti,ab.  
78 exp Risk Reduction Behavior/  
79 ("risk reduction" or "reducing risk" or "reducing risks" or "risk minimization" or "minimizing risk" or "minimizing risks" or "risk minimisation" or "minimising risk" or "minimising risks").ti,ab.  
80 or/76-79

81 exp Health Promotion/  
82 ("health promotion" or "promoting health" or "promoting healthy" or "promoting wellness" or "patient education" or "consumer education" or "client education" or outreach or "wellness program" or "wellness programs" or "wellness programme" or "wellness programmes").ti,ab.  
83 81 or 82

84 Preventive Health Services/  
85 Consumer Health Information/ or Health Literacy/  
86 Secondary Prevention/  
87 (prevention or "preventive health" or "preventive healthcare").ti,ab.

- 88 or/84-87
- 89 (prevention or preventive).ti,ab.
- 90 88 or 89
- 91 Rehabilitation/
- 92 (abstain\* or abstinence or detox\* or rehab\* or sobriety or sober or temperance or intervention\* or cessation or recovery).ti,ab.
- 93 Methadone/tu [Therapeutic Use]
- 94 "methadone maintenance".ti,ab.
- 95 Opiate Substitution Treatment/
- 96 ("opiate substitution" or "opioid substitution" or "withdrawal management" or "managing withdrawal").ti,ab.
- 97 (treatment\* or treating or therapy or therapies).ti,ab.
- 98 intervention\*.ti,ab.
- 99 or/91-98
- 100 or/80,83,88,99
- 101 or/80,83,90,99
- 102 34 and 75 and 101
- 103 limit 102 to (english language and yr="2007 - 2017") [Limit not valid in CDSR; records were retained]
- 104 (Animals/ or Animal Experimentation/ or "Models, Animal"/ or (animal\* or nonhuman\* or non-human\* or rat or rats or mouse or mice or rabbit or rabbit or pig or pigs or porcine or dog or dogs or hamster or hamsters or fish or chicken or chickens or sheep or cat or cats or raccoon or raccoons or rodent\* or horse or horses or racehorse or racehorses or beagle\*).ti,ab.) not (Humans/ or (human\* or participant\* or patient or patients or child\* or seniors or adult or adults).ti,ab.)
- 105 103 not 104
- 106 (editorial or comment or letter or newspaper article).pt.
- 107 105 not 106
- 108 (conference or conference abstract or conference paper or "conference review" or congresses).pt.
- 109 107 not 108  
EBM Reviews - Cochrane Database of Systematic Reviews <2005 to August 2, 2017>  
Embase <1980 to 2017 August 03>  
Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) <1946 to Present>  
EBM Reviews - Cochrane Central Register of Controlled Trials <July 2 017>
- 110 remove duplicates from 109  
EBM Reviews - Cochrane Database of Systematic Reviews <2005 to August 2, 2017>  
Embase <1980 to 2017 August 03>  
Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) <19

46 to Present>

EBM Reviews - Cochrane Central Register of Controlled Trials <July 2017>

- 111 110 use ppez [MEDLINE]
- 112 110 use emezd [EMBASE]
- 113 110 not (111 or 112) [selected 2 only as 13 were conference abstracts]

### **Search 2: September 2017**

After reviewing the returns from the original search in August 2017, we amended the search in September 2017 to identify studies on the health effects of substance use (for cannabis, alcohol, opioids, tobacco/ nicotine). In addition, we added sex/ gender terms and substance-specific terms. The search was amended as follows:

1. Health effects terms were added to the search terms.  
("health effect" or "heath effects" or "effect on health" or "effects on health" or "affect\* health" or "affect\* the health" or "heath impact\*" or "impact\* on health" or "impact\* health").ti,ab.  
[HEALTH EFFECTS]

These terms were searched in combination with the gender terms and substance terms as follows:

Concept 1 – Gender/sex

AND

Concept 2 – Substances (opioids, alcohol, tobacco, cannabis)

AND

Concept 3 – health effects

1. "gender determinant\*" or "gender specific" were added to the gender/sex terms (see lines 1-33 in original search strategy)
2. "alcohol use" or "use of alcohol" and "risky drink" were added to the alcohol terms

### **Search 3: April 2018**

After identifying multiple papers relevant to our review that were not being captured by the original searches, we conducted a third search in April 2018. Based on analysis of the keywords in the articles that were missed, we amended the search as follows:

1. The following terms were added to the gender/ sex terms:  
(woman or man or women or men or girl or boy or girls or boys or trans or transgender or transgendered or female or male or sex or gender).ti. [GENDER IN TI]

A search was then conducted of the article titles only, combining the following concepts:

Search strategy:

Concept 1 – Gender/sex terms

AND

Concept 2 – Substances (opioids, alcohol, tobacco, cannabis) terms

AND

Concept 3 – Harm reduction, health promotion, prevention, treatment, health effects terms

2. “heat not burn” was added to the tobacco terms.
3. The search included studies published up until April 2018

### Inclusion Criteria

#### *Study Design:*

- randomized controlled trials (RCTs) (not already covered in an included systematic review)
- case-control studies
- interrupted time series
- cohort studies
- cross sectional studies
- observational studies
- systematic reviews
- qualitative studies
- grey literature sources
- case series

#### Note:

- Narrative reviews will not be included but saved as context.
- Case studies will be excluded.

The following types of literature will be included in the grey literature review:

- book chapters
- reports
- practice guidelines
- health policy documents
- unpublished research, theses

Note: magazines and books will be excluded from the grey literature.

#### *Country of studies:*

-Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States

Studies published in all other countries will be excluded, including animal studies.

Studies including data from multiple countries, that include an out of scope country, will be excluded if the data is not disaggregated.

Systematic reviews which include studies from multiple countries will be included if reporting on one or more studies published in an eligible country.

*Date of publication:*

- The literature search will cover studies published between 2007 to 2017

*Language:*

- Only studies published in the English language will be included.

Research Q1

*Population:*

- Women, girls, men, boys, trans people/ gender diverse people
  - All ages, demographics within the defined populations
- Studies that are conducted primarily with pregnant girls and women will be excluded.
- Studies addressing the fetal health effects of maternal/ paternal substance use will be excluded
- Studies addressing the health effects of substance use on the infant among women who are breastfeeding will be excluded.
- Studies comparing heterosexual populations to LGBT populations, without sex or gender disaggregation will be excluded.

*Intervention:*

Q1 a) and b) includes non-intervention studies (e.g. patterns of use, health effects):

- Inclusive of tobacco in general (include e-cigarettes)
- Inclusive of all alcohol use (not just binge drinking)
- Inclusive of all opioid use issues (include illicit use/ heroin, prescription opioids, etc)
  - Opioid use for cancer pain management will be excluded
- Inclusive of all purposes (medical and non-medical), forms and modes of ingestion of cannabis (e.g. smoking, vaping, edibles, extracts, etc).
- Studies that report on “substance use” but do not disaggregate results by one or more of the four substances in our review will be excluded.

Q1 c) Harm reduction, health promotion, prevention, treatment (including brief intervention) responses to opioids, alcohol, cannabis, tobacco/ e-cigarettes

- Studies that report on “substance use” but do not disaggregate results by one or more of the four substances in our review will be excluded.
- Opioid substitution therapy for substances other than opioids (e.g. cocaine, methamphetamine) will be excluded

*Comparator:*

- Many Q1 a) and b) studies will be descriptive/ prevalence studies (not intervention studies) and may not include a comparator.
- Many qualitative and grey literature sources will likely not include comparators
- Q1 c) studies *must* include a comparison between gender groups e.g. women vs men; sub-groups of women/ men OR if sex- or gender- based factors are described or

discussed in the study (e.g. masculinity norms, hormones etc.) . Q1c studies that do not compare gender groups or describe sex- or gender- based factors will be excluded.

*Outcome:*

- For non-intervention studies: Prevalence/ patterns of use (frequency of use, form and method of ingestion, etc.);
- For intervention studies (Q1 c): outcomes reported in the reviews will be the outcomes that are reported in the individual papers that are reviewed. Relevant outcomes from the included studies might include:
  - Changes in substance use (uptake/ initiation, harms associated with use cessation, reduction)
  - Changes in client perceptions/ attitudinal change
  - Changes in service provider perceptions
  - Changes in retention/ treatment completion
  - Increased use of services
  - improved health and quality of life outcomes

Note: Studies that report on one or more of the four substances in relation to sex/gender *only* in the baseline characteristics of the sample will be excluded, even if statistical significance is reported.

## **Research Q2**

*Population:*

- Women, girls, men, boys, trans people/ gender diverse people
  - All ages, demographics within the defined populations
- Studies that are conducted primarily with pregnant girls and women will be excluded.
- Studies addressing the fetal health effects of maternal/ paternal substance use will be excluded
- Studies addressing the health effects of substance use on the infant among women who are breastfeeding will be excluded.

*Intervention:*

- Harm reduction, health promotion, prevention, treatment (including brief intervention) responses to opioids, alcohol, cannabis, tobacco/ e-cigarettes including some sex, gender and/or gender transformative elements
  - Studies that report on 'substance use' will be included if they potentially contain one of the four substances. However, if substance use is defined, and does not contain alcohol, tobacco, opioids or cannabis it will be excluded.
  - Opioid substitution therapy for substances other than opioids (e.g. cocaine, methamphetamine) will be excluded
- Examples of sex specific elements (address biological differences in substance use and dependence):
  - administering different types or quantities of pharmacotherapies based on evidence of biological differences in drug metabolism/ effectiveness

- timing tobacco cessation intervention for young women based on the menstrual cycle (hormonal fluctuations impact withdrawal)
- 
- Examples of possible gender/ gender transformative elements:
  - address gender based violence
  - provide social support
  - address caregiving
  - address poverty
  - address negative gender stereotypes
  - include education or messaging on gender norms/ relations
  - address employment issues/ work related stress
  - address discrimination and violence related to gender identity

Interventions to address these four substances are:

- Inclusive of tobacco in general (include e-cigarettes)
- Inclusive of all alcohol use (not just binge drinking)
- Inclusive of all opioid use issues (include illicit use/ heroin, prescription opioids, etc)
  - Opioid use for cancer pain management will be excluded
- Inclusive of all purposes (medical and non-medical), forms and modes of ingestion of cannabis (e.g. smoking, vaping, edibles, extracts, etc).

Note: Methadone maintenance therapy will only be included if it is provided to people who use opioids (i.e. exclude if provided to treat substances outside of scope such as cocaine).

*Comparator:*

- No intervention or usual practice (i.e. interventions that are not gender-informed/ gender transformative, sex-specific), or the comparison of two intervention types.
  - Many qualitative and grey literature sources will likely not include comparators.

*Outcome:*

- Outcomes reported in the reviews will be the outcomes that are reported in the individual papers that are reviewed. Relevant outcomes from the included studies might include:
  - Changes in substance use (uptake/ initiation, harms associated with use, cessation, reduction)
  - Changes in client perceptions/ attitudinal change
  - Changes in service provider perceptions
  - Changes in retention/ treatment completion
  - Increased use of services
  - improved health and quality of life outcomes
  - changes in health and gender equity

Note: Studies that report on one or more of the four substances in relation to sex/gender *only* in the baseline characteristics of the sample will be excluded, even if statistical significance is reported.

## APPENDIX B: WEBSITES SEARCHED FOR GREY LITERATURE AND PROCEDURE:

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These sites were searched by a research assistant for potentially relevant documents (e.g. web pages, reports), using the search terms: “sex or gender and alcohol/ tobacco/ opioid/ cannabis”). The first 50 returns were reviewed/ considered. The name, year, and URL of individual records that appear relevant through hand-searching were entered on an Excel spreadsheet.

### *Canada:*

1. CCSA
2. CEWH – and CEWH subsites e.g. IMPART, Coalescing on Women and Substance Use, Gender Transformative Health Promotion
3. Thunderbird Partnership Foundation
4. CPHA
5. Health Canada
6. PHAC
7. Canadian Best Practices Portal
8. CanFASD Research Network
9. Smokefree men

### Provincial/Territorial Substance Use research sites:

10. Centre for Substance use Research of BC (CISUR)
11. CAMH
12. BC Centre on Substance Use (BCCSU)
13. Addiction Research Chair (SK)

### *USA:*

1. NIDA
2. NIAAA
3. SAMHSA
4. CDC
5. Institute for Health and Recovery
6. Institute for Relational Development and Center for Gender and Justice (Covington)
7. CASA National Center on Addiction and Substance Use
8. Children and Family Futures
9. Smokefree women
10. Center on Alcohol Marketing and Youth, Johns Hopkins
11. Colorado Department of Public Health & Environment

### *International:*

1. WHO
2. INWAT
3. Alcohol Concern, UK
4. Drug Wise, UK
5. NDARC (National Drug & Alcohol Research Centre), and NDRI (Curtin) Australia
6. CAPR (Centre for Alcohol Policy Research) and FARE (Foundation for Alcohol Research and Education) Australia
7. Australian Indigenous Alcohol and Other Drugs Knowledge Centre
8. United Nations Office on Drugs & Crime

## APPENDIX C: INDICATOR FRAMEWORK

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
<p><b>1. Health</b></p>	<p>Sex-related factors such as biological or physiological characteristics play a dominant role in understanding this group of indicators. Differences in body size, metabolism, weight, or genetics that are, in general, linked to male or female bodies can affect the reaction to: cannabis consumption, exposure to cannabis smoke or vaping, and poly substance use. Sex related factors also affect myriad mental and physical health effects. Sex-specific issues linked to reproduction, pregnancy, fertility and breastfeeding are affected by cannabis consumption and exposure.</p>	<p>Factors such as gendered relations, norms, roles and policies affect cannabis use and exposure.</p> <p>Factors such as power imbalances in gender relations between individuals can affect who and how cannabis is used, whether poly substance use occurs or whether involuntary exposure to cannabis is more or less likely.</p> <p>Absorbed attitudes regarding masculinities or femininities affect the consumption of cannabis, mode of ingestion, amount ingested, responses to prevention and treatment, and the likelihood of injuries.</p>	<p>Lack of robust data on long term sex-specific impacts of cannabis use on reproduction for males and females [190, 191].</p> <p>More longitudinal research needed on the effects of prenatal use of cannabis on child development is required [192].</p> <p>Need to identify if there are adverse health effects with ongoing cannabis use while breastfeeding [192].</p> <p>Rigorous research needed on the health effects of different modes of cannabis consumption and potency of cannabis products [193], including investigation of gender related preferences and sex-specific health effects.</p> <p>Further research is needed on the role of combined use of medical and non-medical cannabis in the development of mental health disorders [109].</p> <p>Studies needed on cannabis and mental health that measure and report cannabis dose and frequency and patterns of diagnosis of psychosis [194], and that include a robust sex and gender-based analysis. Tracking of rates of psychosis in legalized contexts is needed to investigate causality [194].</p> <p>Rigorous research needed on the sex- specific health effects of cannabis; existing research is largely lacking sex/ gender plus based analysis, and is further limited by: high rates of polysubstance use in study samples, inconsistent measures of cannabis use, sample heterogeneity, and lack of validated measures of cannabis use [194].</p> <p>There is a need to develop medications and psychological interventions that might modify the effect of risk factors in different tiers at different stages of development [89].</p>

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
Patterns of use			Men report using cannabis more frequently than women [5, 7], and a greater quantity of cannabis use over time [5, 8]. Greater frequency and quantity of use have been associated with cannabis use disorder (CUD) [73] which also tends to be higher among men.
Poly substance use			Data gaps on sex and gender specific polysubstance use issues exist. Alcohol and cannabis, as well as nicotine and cannabis, imply greater risks
Mental health and cannabis use			Among males and females with a psychotic illness, those who used cannabis reported an earlier age of psychotic symptom onset [90, 91]; findings were similar for females and males, although in one study males reported an earlier age of first onset regardless of cannabis use [91].
Pregnancy and reproductive health			Men who regularly use cannabis have reported lower sperm count and morphology [195, 196]. The effect on ability to conceive is unclear. In one study, current cannabis use was associated with a slight reduction in fecundability in females, but increased fecundability in males [197]. The health effects for the fetus and developing child are also unclear; studies report mixed findings. Cannabis use during pregnancy has been associated with subtly lower: birth weight and IQ scores at age 6 [198, 199].
Drug substitution			In a US study, females who used medical cannabis reported more often substituting cannabis for prescription drugs than males [105].
Poisonings			More boys than girls under 12 years were admitted for unintentional cannabis ingestion at a hospital emergency department in Colorado. In addition, more boys had confirmed cannabis ingestion by urine toxicology screen [200].
Injuries			In a Canadian study, patients with cannabis oil burns were more likely to be male (83% in the group with cannabis oil burns v. 74% in the total burn group). They also sustained burns over a larger percentage of their total body surface area (24% v. 9%) [201]. Findings from the electronic Canadian Hospitals Injury Reporting and Prevention Program (eCHIRPP), years 2011 to 2016, showed that differences in the

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
			proportion of cannabis use cases between sexes were not observed in younger ages. However, adult males were more likely to be involved in an injury associated with cannabis use [202]. The use of both cannabis and alcohol at the same time resulted in greater severity of injury than cannabis alone among males. However, the differences were not statistically significant [203].
Respiratory effects			Findings from a case series with three male adolescents showed bilateral pulmonary nodules and ground glass opacities on chest imaging associated with recent cannabis inhalation [204].
Cerebrovascular health			In a US study, cannabis use predicted cerebrovascular accidents in both women and men [205].
Cardiovascular health			In a multivariate regression, after adjusting for age, sex, hypertension, diabetes mellitus, hyperlipidemia, coronary artery disease, tobacco use, and alcohol use, cannabis use was an independent predictor of heart failure [205]. In an Australian study, patients exposed to cannabis demonstrate an advanced cardiovascular age in the case of both men and women [206].
Cancer			In several studies that included data from US, Canada, UK, and New Zealand, findings suggest there are weak associations between cannabis smoking and lung cancer in never tobacco smokers. No sex differences were found [207].
<b>2. Road Safety</b>	Sex related factors such as anatomy, weight and size affect survival and injuries in road accidents in vehicles. Similarly, such factors affect rate and impact of impairment due to cannabis consumption.	Gender related factors affect the designation of drivers in mixed gender couples or groups, with most drivers assumed to be males. In such situations, more girls and women will be passengers. This affects the amount of influence a	<p>Research is needed that measures sex differences in “highness” in relation to driving performance [136].</p> <p>Further research needed on how cannabis is used with alcohol and other substances, and the differential contribution to risk of harms for men and women [80], including driving while impaired and while transporting children.</p> <p>Further research is needed on the risk of cannabis use on minor collisions; existing research has largely investigated major injuries and deaths [208].</p>

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
		<p>person may have on impaired driving or riding. Gender roles often affect whether men or women transport children. Rates of driving with THC in system is an area to investigate.</p>	
<p>Traffic accidents and fatalities*</p>			<p>A study with women and men who were randomly assigned to receive either an active or placebo cannabis joint, and then complete a simulated driving task and an hour of neuropsychological testing reported no sex differences or interactions of sex and cannabis for any driving tasks. Participants who received cannabis decreased their speed more so than placebo participants during a distracted driving task; no other changes in driving performance were found. Cannabis use did negatively impact responses to neuropsychological testing, suggesting people who use cannabis may have a hindered ability to use previously acquired information to make driving decisions [136].</p> <p>Combining cannabis and alcohol before driving increases impairment and the risk of accidents [136]. Males tend to report higher simultaneous use of cannabis and alcohol [39, 106, 107]. However, there is some evidence that women who combine alcohol and cannabis may be more vulnerable to risk of harms with similar or lesser use compared to males [80].</p>
<p><b>3. Market</b></p>		<p>Gender related factors affect the mode of acquisition of a range of substances (such as tobacco and e cigarettes) with more girls and women using social sources than public or</p>	<p>In a study in Norway, females were introduced to cannabis by their partners and did not interface with cannabis dealers. In contrast, males were more engaged with dealers and cultivators [62].</p> <p>Media reports are contradictory on whether the emerging legal cannabis industry is presenting new opportunities for women's involvement independent of men or reinforcing traditional gender disparities (with women taking a subordinate role to men in the</p>

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
		<p>legal outlets. More males are involved in cannabis production, both legal and illegal. More males are involved in cannabis company investment and product development than women.</p>	<p>industry). Further research is needed to explore the role and experiences of women in the legal cannabis market [209].</p> <p>Further research is needed to explore gender and diversity based differences in cannabis market segmentation, including the impact location of dispensaries and the products and services offered [210].</p> <p>Further research is needed to explore frequency of exposure to cannabis marketing for different genders [211].</p>
<p>Medical cannabis industry</p>			<p>According to a survey conducted by Marijuana Business Daily, 36% of those who held executive level positions in the US cannabis industry were women in 2015 and 27% in 2017. The investment sector of the cannabis industry is comprised mostly of men, as only 10% of women hold an executive position in this sector. In contrast, women are more represented in the ancillary services companies (42% of the executive positions) and in the medical dispensaries/recreational stores (35%) [212].</p> <p>Analysis of medical cannabis programs in 13 US States reveals that the majority of medical cannabis consumers are men. Oregon and Alaska reported the narrowest gender gap; however, in Colorado and Arizona, the gender gap appears to be narrowing [104].</p>
<p>Retail source and sales</p>			<p>A study in Christiania, Copenhagen, Denmark reported no gender differences in the number of joints purchased, the proportion of resin purchases, or the quantity of cannabis bought in retail purchases in 2004 [70].</p> <p>A study of medical cannabis dispensaries in California found that more males accessed the dispensaries [210].</p> <p>A study in Oregon reported no gender differences in exposure to cannabis marketing following legalization; over half reported exposure</p>

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
			to marketing. There were no differences in exposure based on race, age, or cannabis use. However, exposure was higher among people living in counties with retail sales [211].
<b>4. Knowledge, Attitudes and Behaviours (KAB)</b>	Sex-related factors are important to include in the content of knowledge about cannabis and impact the behaviours of both females and males during reproductive years, including fertility, pregnancy and parenting. They are a key component in measuring effectiveness and levels of KAB.	Gender related factors such as: job roles, family and parental roles or quality of refusal skills affect the content of knowledge about cannabis and affect attitudes and behaviours about cannabis consumption and exposure, impaired driving and reasons for use. They are a key component in measuring KAB.	<p>Overall, further research is needed on gender and cannabis related knowledge, attitudes and behaviours, particularly in the Canadian context. The majority of studies have been conducted in the US.</p> <p>Many studies on knowledge, attitudes and behaviours have been conducted with specific sub-populations (e.g. urban African American youth [213]), so findings lack generalizability. Further, measures of cannabis use are based on self-report, and therefore may be limited by socially desirable responses and poor recall.</p> <p>Studies differ in the measurement of cannabis use (e.g. yes/ no; cross-sectional surveys on frequency, quantity/amount, history of use) [194] and therefore it is difficult to accurately compare findings.</p>
Context of use			Females and males report using cannabis in different contexts; in a US study with adolescents, males were more likely to report using cannabis at school and on weeknights compared to females; in contrast, females were more likely to report cannabis use on the weekends [72].
Perceptions			Among a pan-European sample of adolescents, boys were significantly more likely than girls to endorse positive attitudes, including that cannabis would make them: "feel relaxed" (21.2% vs 18.5%) or "become more popular" (17.3% vs 14.7%) [119]. In a US sample of young adults, having positive attitudes regarding cannabis use was associated with self-reported use [118].
Risk perceptions			A Swedish survey found that women perceived cannabis use as more dangerous than men [121]. In a study with people who used cannabis medically and nonmedically in the USA, there were no gender differences in perceptions that cannabis is addictive or not, although

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
			women were more likely to report not knowing if cannabis is addictive [5].
Refusal skills			In a study examining risk and protective factors associated with substance use among girls, refusal skills were identified as a protective factor for cannabis consumption [214].
Benefits and harms			Women who experience social anxiety are more likely than men to use cannabis [86]. The relationship between anxiety symptoms and overall cannabis use is mediated by the expectancy that cannabis use will relieve tension to help women relax [215]. Among females, cannabis use frequency was positively associated with expectations regarding relaxation and tension reduction and inversely associated with expectations regarding both overall negative effects and cognitive and behavioral deficits [11]. Both males and females who used cannabis frequently had higher sex-related expectancies when compared to people who used cannabis infrequently [10].
Reasons for use			In a US study, women used cannabis because they expected that it will relieve tension and help them to relax [215]. Both males and females who used cannabis had higher sex-related expectancies when compared to people who used cannabis infrequently [10]. In a US study among people who used cannabis, more men than women indicated using cannabis for nonmedical purposes while more women than men indicated using cannabis for medicinal purposes. However, there was no sex difference in the percentages of men and women who reported using cannabis for religious reasons [5].
Social support			Among young Swiss males, while perceived social support from friends is a risk factor for alcohol and cannabis use, the perceived social support from a significant other was significantly and negatively associated with alcohol and cannabis use outcomes [216].
Public education			As fathers' knowledge of adolescents' activities rose, there were lower odds of former experimental and current cannabis use for boys and girls, but not for boys' experimental use. Mothers' knowledge of adolescents' activities was associated with lower odds of current frequent use (boys and girls), current occasional use (boys) and former

Indicator Category	Sex	Gender	Illustrations and Selected Data Gaps
			experimental use (girls). In a US study, there was evidence for differences in the age-specific effect of parental support on past 30-day cannabis use. Although parental support was protective in males during adolescence, there was no evidence it is protective for females at any age, and supplemental analyses showed relatively little qualitative difference in the effects for maternal vs. paternal support [217].
<b>5. Crime and Law Enforcement</b>	Sex related factors may affect the mechanisms and speed of impairment due to cannabis.	Gender related factors affect the likelihood of impaired driving and/or riding as a passenger, and therefore the rates of police reported charges.	Further research is needed to develop evidence-based measures for impaired driving, similar to blood-alcohol concentration (BAC) [113]; further, studies are needed that examine sex-specific measures of impairment. However, this is a challenge since cannabis impairment does not consistently correlate with high levels of THC [208].
Driving after use/ impaired driving			Driving after cannabis use and being a passenger with someone who has used cannabis, is higher among men compared to women [39, 113]. In one study, among the men and women drivers apprehended with blood THC concentrations, THC blood concentrations were higher in men than in women (mean 2.1 ng/ml vs mean 1.4 ng/ml) [113].

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## REFERENCES

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1. Cranford, J.A., D. Eisenberg, and A.M. Serras, *Substance use behaviors, mental health problems, and use of mental health services in a probability sample of college students*. *Addictive Behaviors*, 2009. **34**(2): p. 134-145.
2. Carliner, H., et al., *The widening gender gap in marijuana use prevalence in the U.S. during a period of economic change, 2002-2014*. *Drug & Alcohol Dependence*, 2017. **170**: p. 51-58.
3. Felton, J.W., et al., *Sex differences in self-report and behavioral measures of disinhibition predicting marijuana use across adolescence*. *Experimental & Clinical Psychopharmacology*, 2015. **23**(4): p. 265-274.
4. Farmer, R.F., et al., *Natural course of cannabis use disorders*. *Psychological Medicine*, 2015. **45**(1): p. 63-72.
5. Cuttler, C., L.K. Mischley, and M. Sexton, *Sex Differences in Cannabis Use and Effects: A Cross-Sectional Survey of Cannabis Users*. *Cannabis and Cannabinoid Research*, 2016. **1**(1): p. 166-175.
6. Legleye, S., et al., *Is there a cannabis epidemic model? Evidence from France, Germany and USA*. *International Journal of Drug Policy*, 2014. **25**(6): p. 1103-1112.
7. Foster, K.T., et al., *Gender Differences in Internalizing Symptoms and Suicide Risk Among Men and Women Seeking Treatment for Cannabis Use Disorder from Late Adolescence to Middle Adulthood*. *Journal of Substance Abuse Treatment*, 2016. **66**: p. 16-22.
8. Anderson, K.G., M. Sitney, and H.R. White, *Marijuana Motivations Across Adolescence: Impacts on Use and Consequences*. *Substance Use & Misuse*, 2015. **50**(3): p. 292-301.
9. Grunberg, V.A., et al., *Can Marijuana Make It Better? Prospective Effects of Marijuana and Temperament on Risk for Anxiety and Depression*. *Psychology of Addictive Behaviors*, 2015. **29**(3): p. 590-602.
10. Currin, J.M., J.M. Croff, and R.D. Hubach, *Baked sex: The exploration of sex-related drug expectancies of marijuana users*. *Sexuality Research & Social Policy: A Journal of the NSRC*, 2017.
11. Hayaki, J., et al., *Expectancies and marijuana use frequency and severity among young females*. *Addictive Behaviors*, 2010. **35**(11): p. 995-1000.
12. Schuster, R.M., R. Mermelstein, and L. Wakschlag, *Gender-specific relationships between depressive symptoms, marijuana use, parental communication and risky sexual behavior in adolescence*. *Journal of Youth & Adolescence*, 2013. **42**(8): p. 1194-1209.
13. Henchoz, Y., et al., *Associations of age at cannabis first use and later substance abuse with mental health and depression in young men*. *Journal of Substance Use*, 2016. **21**(1): p. 85-91.
14. Johnson, R.M., et al., *Past 15-year trends in adolescent marijuana use: Differences by race/ethnicity and sex*. *Drug and Alcohol Dependence*, 2015. **155**: p. 8-15.
15. Bhopal, R., *Glossary of terms relating to ethnicity and race: for reflection and debate*. *Journal of Epidemiology and Community Health*, 2004. **58**(6): p. 441-445.
16. Walls, M., K.J. Sittner Hartshorn, and L.B. Whitbeck, *North American Indigenous adolescent substance use*. *Addictive Behaviors*, 2013. **38**(5): p. 2103-2109.
17. Forman-Hoffman, V.L., C. Glasheen, and K.R. Batts, *Marijuana Use, Recent Marijuana Initiation, and Progression to Marijuana Use Disorder Among Young Male and Female Adolescents Aged 12-14 Living in US Households*. *Substance Abuse*, 2017. **11**: p. 1178221817711159.
18. Chung, T., et al., *White and Black Adolescent Females Differ in Profiles and Longitudinal Patterns of Alcohol, Cigarette, and Marijuana Use*. *Psychology of Addictive Behaviors*, 2013. **27**(4): p. 1110-1121.
19. Evans-Polce, R.J., S.A. Vasilenko, and S.T. Lanza, *Changes in gender and racial/ethnic disparities in rates of cigarette use, regular heavy episodic drinking, and marijuana use: ages 14 to 32*. *Addictive Behaviors*, 2015. **41**: p. 218-222.
20. Black, P. and L.J. Joseph, *Still Dazed and Confused: Midlife Marijuana Use by the Baby Boom Generation*. *Deviant Behavior*, 2014. **35**(10): p. 822-841.
21. Buu, A., et al., *Gender differences in the developmental trajectories of multiple substance use and the effect of nicotine and marijuana use on heavy drinking in a high-risk sample*. *Addictive Behaviors*, 2015. **50**: p. 6-12.
22. Sunder, P.K., J.J. Grady, and Z.H. Wu, *Neighborhood and individual factors in marijuana and other illicit drug use in a sample of low-income women*. *American Journal of Community Psychology*, 2007. **40**(3-4): p. 167-180.

23. Goldbach, J.T., E.H. Mereish, and C. Burgess, *Sexual Orientation Disparities in the Use of Emerging Drugs. Substance Use & Misuse*, 2017. **52**(2): p. 265-271.
24. Hahm, H.C., et al., *Substance use among Asian Americans and Pacific Islanders sexual minority adolescents: Findings from the National Longitudinal Study of Adolescent Health. Journal of Adolescent Health*, 2008. **42**(3): p. 275-283.
25. Bruce, D., et al., *Heavy Marijuana Use Among Gay and Bisexual Male Emerging Adults Living With HIV/AIDS. Journal of HIV/AIDS & Social Services*, 2013. **12**(1): p. 26-48.
26. Bernstein, M.H. and L.A. Stein, *Do bisexual girls report higher rates of substance use than heterosexual girls? A failure to replicate with incarcerated and detained youth. Journal of Bisexuality*, 2015. **15**(4): p. 498-508.
27. Roxburgh, A., et al., *Sexual identity and prevalence of alcohol and other drug use among Australians in the general population. International Journal of Drug Policy*, 2016. **28**: p. 76-82.
28. Trocki, K.F., L.A. Drabble, and L.T. Midanik, *Tobacco, Marijuana, and Sensation Seeking: Comparisons Across Gay, Lesbian, Bisexual, and Heterosexual Groups. Psychology of Addictive Behaviors*, 2009. **23**(4): p. 620-631.
29. Reback, C.J., et al., *Methamphetamine and other substance use trends among street-recruited men who have sex with men, from 2008 to 2011. Drug & Alcohol Dependence*, 2013. **133**(1): p. 262-265.
30. Ellen, J.M., et al., *Cross-sectional survey comparing HIV risk behaviours of adolescent and young adult men who have sex with men only and men who have sex with men and women in the U.S. and Puerto Rico. Sexually Transmitted Infections*, 2015. **91**(6): p. 458-461.
31. Dworkin, E.R., et al., *Daily-level associations between PTSD and cannabis use among young sexual minority women. Addictive Behaviors*, 2017. **74**: p. 118-121.
32. Robinson, M., *The role of anxiety in bisexual women's use of cannabis in Canada. Psychology of Sexual Orientation and Gender Diversity*, 2015. **2**(2): p. 138-151.
33. De Pedro, K.T., et al., *Substance Use Among Transgender Students in California Public Middle and High Schools. Journal of School Health*, 2017. **87**(5): p. 303-309.
34. Cabaj, R.P., *Substance use issues among gay, bisexual, and transgender people*, in *The American Psychiatric Publishing textbook of substance abuse treatment, 5th ed.*, M. Galanter, et al., Editors. 2015, American Psychiatric Publishing, Inc.: Arlington, VA, US. p. 707-721.
35. Smalley, K.B., J.C. Warren, and K.N. Barefoot, *Differences in Health Risk Behaviors Across Understudied LGBT Subgroups. Health Psychology*, 2016. **35**(2): p. 103-114.
36. Reback, C.J. and J.B. Fletcher, *HIV prevalence, substance use, and sexual risk behaviors among transgender women recruited through outreach. AIDS & Behavior*, 2014. **18**(7): p. 1359-1367.
37. Reisner, S.L., et al., *Gender minority social stress in adolescence: disparities in adolescent bullying and substance use by gender identity. Journal of Sex Research*, 2015. **52**(3): p. 243-256.
38. Gonzalez, C.A., J.D. Gallego, and W.O. Bockting, *Demographic Characteristics, Components of Sexuality and Gender, and Minority Stress and Their Associations to Excessive Alcohol, Cannabis, and Illicit (Noncannabis) Drug Use Among a Large Sample of Transgender People in the United States. The Journal of Primary Prevention*, 2017. **38**(4): p. 419-445.
39. Whitehill, J.M., F.P. Rivara, and M.A. Moreno, *Marijuana-using drivers, alcohol-using drivers, and their passengers: prevalence and risk factors among underage college students. JAMA Pediatrics*, 2014. **168**(7): p. 618-624.
40. Bryan, A.D., S.J. Schmiege, and R.E. Magnan, *Marijuana Use and Risky Sexual Behavior Among High-Risk Adolescents: Trajectories, Risk Factors, and Event-Level Relationships. Developmental Psychology*, 2012. **48**(5): p. 1429-1442.
41. Albertella, L., M.E. Le Pelley, and J. Copeland, *Frequent Cannabis Use Is Associated With Reduced Negative Priming Among Females. Experimental and Clinical Psychopharmacology*, 2016. **24**(5): p. 313-319.
42. Forster, M., et al., *The protective role of school friendship ties for substance use and aggressive behaviors among middle school students. Journal of School Health*, 2015. **85**(2): p. 82-89.
43. Rasic, D., S. Kisely, and D.B. Langille, *Protective associations of importance of religion and frequency of service attendance with depression risk, suicidal behaviours and substance use in adolescents in Nova Scotia, Canada. Journal of Affective Disorders*, 2011. **132**(3): p. 389-395.
44. Boyes, R., et al., *Gender-specific associations between involvement in team sport culture and canadian adolescents' substance-use behavior. SSM - Population Health*, 2017. **3**: p. 663-673.

45. Mehta, C., et al., *Associations Between Mixed-Gender Friendships, Gender Reference Group Identity and Substance Use in College Students*. *Sex Roles*, 2014. **70**(3-4): p. 98-109.
46. Guxens, M., M. Nebot, and C. Ariza, *Age and sex differences in factors associated with the onset of cannabis use: a cohort study*. *Drug & Alcohol Dependence*, 2007. **88**(2-3): p. 234-243.
47. Grigsby, T.J., et al., *Changes in the strength of peer influence and cultural factors on substance use initiation between late adolescence and emerging adulthood in a Hispanic sample*. *Journal of Ethnicity in Substance Abuse*, 2017. **16**(2): p. 137-154.
48. Black, D.S., et al., *Gender differences in body consciousness and substance use among high-risk adolescents*. *Substance Use & Misuse*, 2010. **45**(10): p. 1623-1635.
49. Wong, M.M., K.J. Brower, and R.A. Zucker, *Childhood sleep problems, early onset of substance use and behavioral problems in adolescence. Erratum appears in Sleep Med. 2010 Jan;11(1):110-1*. *Sleep Medicine*, 2009. **10**(7): p. 787-796.
50. Farhat, T., B. Simons-Morton, and J.W. Luk, *Psychosocial correlates of adolescent marijuana use: Variations by status of marijuana use*. *Addictive Behaviors*, 2011. **36**(4): p. 404-407.
51. Lac, A. and W.D. Crano, *Monitoring Matters: Meta-Analytic Review Reveals the Reliable Linkage of Parental Monitoring With Adolescent Marijuana Use*. *Perspectives on Psychological Science*, 2009. **4**(6): p. 578-586.
52. Nelson, K.M., et al., *Gender Differences in Relations among Perceived Family Characteristics and Risky Health Behaviors in Urban Adolescents*. *Annals of Behavioral Medicine*, 2017. **51**(3): p. 416-422.
53. Goldstick, J.E., et al., *Perceived Peer Behavior and Parental Support as Correlates of Marijuana Use: The Role of Age and Gender*. *Substance Use & Misuse*, 2018. **53**(3): p. 521-531.
54. Yabiku, S.T., et al., *Parental Monitoring and Changes in Substance Use Among Latino/a and Non-Latino/a Preadolescents in the Southwest*. *Substance Use & Misuse*, 2010. **45**(14): p. 2524-2550.
55. Voisine, S., et al., *Effects of Parental Monitoring, Permissiveness, and Injunctive Norms on Substance Use Among Mexican and Mexican American Adolescents*. *Families in Society-the Journal of Contemporary Social Services*, 2008. **89**(2): p. 264-273.
56. Lac, A., et al., *Marijuana use among Latino adolescents: gender differences in protective familial factors*. *Substance Use & Misuse*, 2011. **46**(5): p. 644-655.
57. Parsai, M., et al., *The Protective and Risk Effects of Parents and Peers on Substance Use, Attitudes, and Behaviors of Mexican and Mexican American Female and Male Adolescents*. *Youth & Society*, 2009. **40**(3): p. 353-376.
58. Mahalik, J.R., et al., *Gender, male-typicality, and social norms predicting adolescent alcohol intoxication and marijuana use*. *Social Science & Medicine*, 2015. **143**: p. 71-80.
59. Wilkinson, A.L., et al., *Adherence to gender-typical behavior and high-frequency substance use from adolescence into young adulthood*. *Psychology of men & masculinity*, 2018. **19**(1): p. 145-155.
60. Haines, R.J., et al., *"I couldn't say, I'm not a girl" – Adolescents talk about gender and marijuana use*. *Social Science & Medicine*, 2009. **68**(11): p. 2029-2036.
61. Haines, R.J., et al., *"I couldn't say, I'm not a girl"--adolescents talk about gender and marijuana use*. *Social Science & Medicine*, 2009. **68**(11): p. 2029-2036.
62. Dahl, S.L. and S. Sandberg, *Female Cannabis Users and New Masculinities: The Gendering of Cannabis Use*. *Sociology*, 2014. **49**(4): p. 696-711.
63. Eaton, D.K., et al., *Associations of dating violence victimization with lifetime participation, co-occurrence, and early initiation of risk behaviors among US high school students*. *Journal of Interpersonal Violence*, 2007. **22**(5): p. 585-602.
64. Exner-Cortens, D., J. Eckenrode, and E. Rothman, *Longitudinal Associations Between Teen Dating Violence Victimization and Adverse Health Outcomes*. *Pediatrics*, 2013. **131**(1): p. 71-78.
65. Davis, J.P., et al., *Examining within-person and between-person effects of victimization and social risk on cannabis use among emerging adults in substance-use treatment*. *Psychology of Addictive Behaviors*, 2016. **30**(1): p. 52-63.
66. Haynie, D.L., et al., *Dating violence perpetration and victimization among U.S. adolescents: prevalence, patterns, and associations with health complaints and substance use*. *Journal of Adolescent Health*, 2013. **53**(2): p. 194-201.
67. Reyes, H.L.M., et al., *Proximal and time-varying effects of cigarette, alcohol, marijuana and other hard drug use on adolescent dating aggression*. *Journal of Adolescence*, 2014. **37**(3): p. 281-289.

68. Hayatbakhsh, M.R., et al., *Maternal partner criminality and cannabis use in young adulthood: prospective study*. Australian and New Zealand Journal of Psychiatry, 2007. **41**(6): p. 546-553.
69. Pabayo, R., B.E. Molnar, and I. Kawachi, *Witnessing a Violent Death and Smoking, Alcohol Consumption, and Marijuana Use among Adolescents*. Journal of Urban Health-Bulletin of the New York Academy of Medicine, 2014. **91**(2): p. 335-354.
70. Moeller, K. and M. Pedersen, *Cannabis retail purchases in a low-risk market: Purchase size and sex of buyers*. Nordic Studies on Alcohol and Drugs, 2014. **31**(2): p. 161-174.
71. Andreas, J.B. and H. Pape, *Who receives cannabis use offers: A general population study of adolescents*. Drug and Alcohol Dependence, 2015. **156**: p. 150-156.
72. Goncy, E.A. and S. Mrug, *Where and when adolescents use tobacco, alcohol, and marijuana: comparisons by age, gender, and race*. Journal of Studies on Alcohol & Drugs, 2013. **74**(2): p. 288-300.
73. Noack, R., M. Hofler, and U. Lueken, *Cannabis use patterns and their association with DSM-IV cannabis dependence and gender*. European Addiction Research, 2011. **17**(6): p. 321-328.
74. Cranford, J.A., et al., *Prevalence and correlates of Vaping; as a route of cannabis administration in medical cannabis patients*. Drug & Alcohol Dependence, 2016. **169**: p. 41-47.
75. Lee, D.C., et al., *Online survey characterizing vaporizer use among cannabis users*. Drug & Alcohol Dependence, 2016. **159**: p. 227-233.
76. Conroy, D.A., et al., *Impact of Marijuana Use on Self-Rated Cognition in Young Adult Men and Women*. American Journal on Addictions, 2015. **24**(2): p. 160-165.
77. Pardini, D., et al., *Unfazed or Dazed and Confused: Does Early Adolescent Marijuana Use Cause Sustained Impairments in Attention and Academic Functioning?* Journal of Abnormal Child Psychology, 2015. **43**(7): p. 1203-1217.
78. Berger, A.T., M.R. Khan, and J.L. Hemberg, *Race differences in longitudinal associations between adolescent personal and peer marijuana use and adulthood sexually transmitted infection risk*. Journal of Addictive Diseases, 2012. **31**(2): p. 130-142.
79. Hendershot, C.S., R.E. Magnan, and A.D. Bryan, *Associations of marijuana use and sex-related marijuana expectancies with HIV/STD risk behavior in high-risk adolescents*. Psychology of Addictive Behaviors, 2010. **24**(3): p. 404-414.
80. Weiss, K.G. and L.M. Dilks, *Marijuana, Gender, and Health-Related Harms: Disentangling Marijuana's Contribution to Risk in a College "Party" Context*. Sociological Spectrum, 2015. **35**(3): p. 254-270.
81. Benner, A.D. and Y.J. Wang, *Adolescent Substance Use: The Role of Demographic Marginalization and Socioemotional Distress*. Developmental Psychology, 2015. **51**(8): p. 1086-1097.
82. Wilkinson, A.L., et al., *Testing Longitudinal Relationships Between Binge Drinking, Marijuana Use, and Depressive Symptoms and Moderation by Sex*. Journal of Adolescent Health, 2016. **59**(6): p. 681-687.
83. Crane, N.A., S.A. Langenecker, and R.J. Mermelstein, *Gender differences in the associations among marijuana use, cigarette use, and symptoms of depression during adolescence and young adulthood*. Addictive Behaviors, 2015. **49**: p. 33-39.
84. Marshal, M.P., et al., *Cross-sectional evidence for a stress-negative affect pathway to substance use among sexual minority girls*. Clinical and translational science, 2013. **6**(4): p. 321-322.
85. Repetto, P.B., M.A. Zimmerman, and C.H. Caldwell, *A longitudinal study of depressive symptoms and marijuana use in a sample of inner-city African Americans*. Journal of Research on Adolescence, 2008. **18**(3): p. 421-447.
86. Buckner, J.D., J. Silgado, and N.B. Schmidt, *Marijuana craving during a public speaking challenge: Understanding marijuana use vulnerability among women and those with social anxiety disorder*. Journal of Behavior Therapy and Experimental Psychiatry, 2011. **42**(1): p. 104-110.
87. Marmorstein, N.R., et al., *Associations Between First Use of Substances and Change in Internalizing Symptoms Among Girls: Differences by Symptom Trajectory and Substance Use Type*. Journal of Clinical Child and Adolescent Psychology, 2010. **39**(4): p. 545-558.
88. Aspis, I., et al., *Cannabis use and mental health-related quality of life among individuals with depressive disorders*. Psychiatry Research, 2015. **230**(2): p. 341-349.
89. Blanco, C., et al., *Towards a comprehensive developmental model of cannabis use disorders*. Addiction, 2014. **109**(2): p. 284-294.

90. Donoghue, K., et al., *Cannabis use, gender and age of onset of schizophrenia: data from the AESOP study*. Psychiatry Research, 2014. **215**(3): p. 528-532.
91. Dekker, N., et al., *Age at onset of non-affective psychosis in relation to cannabis use, other drug use and gender*. Psychological Medicine, 2012. **42**(9): p. 1903-1911.
92. Kim, S.W., et al., *Impact of Cannabis Use on Long-Term Remission in Bipolar I and Schizoaffective Disorder*. Psychiatry Investigation, 2015. **12**(3): p. 349-355.
93. Swahn, M.H., et al., *Early substance use initiation and suicide ideation and attempts among students in France and the United States*. International Journal of Public Health, 2012. **57**(1): p. 95-105.
94. Manzo, K., et al., *A comparison of risk factors associated with suicide ideation/attempts in American Indian and White youth in Montana*. Archives of Suicide Research, 2015. **19**(1): p. 89-102.
95. Delforterie, M.J., et al., *The influence of age and gender on the likelihood of endorsing cannabis abuse/dependence criteria*. Addictive Behaviors, 2015. **42**: p. 172-175.
96. Kerridge, B.T., et al., *DSM-5 cannabis use disorder in the National Epidemiologic Survey on Alcohol and Related Conditions-III: Gender-specific profiles*. Addictive Behaviors, 2018. **76**: p. 52-60.
97. Khan, S.S., et al., *Gender differences in cannabis use disorders: results from the National Epidemiologic Survey of Alcohol and Related Conditions*. Drug & Alcohol Dependence, 2013. **130**(1-3): p. 101-108.
98. Montgomery, L. and K. Bagot, *Let's Be Blunt: Consumption Methods Matter Among Black Marijuana Smokers*. Journal of Studies on Alcohol and Drugs, 2016. **77**(3): p. 451-456.
99. Lee, J.H., et al., *Discrimination, Mental Health, and Substance Use Disorders Among Sexual Minority Populations*. Lgbt Health, 2016. **3**(4): p. 258-265.
100. Sartor, C.E., et al., *Cannabis or alcohol first? Differences by ethnicity and in risk for rapid progression to cannabis-related problems in women*. Psychological Medicine, 2013. **43**(4): p. 813-823.
101. Gillespie, N.A., et al., *Are the symptoms of cannabis use disorder best accounted for by dimensional, categorical, or factor mixture models? A comparison of male and female young adults*. Psychology of Addictive Behaviors, 2012. **26**(1): p. 68-77.
102. Lev-Ran, S., et al., *Gender differences in health-related quality of life among cannabis users: results from the National Epidemiologic Survey on Alcohol and Related Conditions*. Drug & Alcohol Dependence, 2012. **123**(1-3): p. 190-200.
103. Sherman, B.J., et al., *Gender differences among treatment-seeking adults with cannabis use disorder: Clinical profiles of women and men enrolled in the achieving cannabis cessation-evaluating N-acetylcysteine treatment (ACCENT) study*. American Journal on Addictions, 2017. **26**(2): p. 136-144.
104. Fairman, B.J., *Trends in registered medical marijuana participation across 13 US states and District of Columbia*. Drug & Alcohol Dependence, 2016. **159**: p. 72-79.
105. Corroon, J.M., L.K. Mischley, and M. Sexton, *Cannabis as a substitute for prescription drugs - a cross-sectional study*. Journal of Pain Research, 2017. **10**: p. 989-997.
106. Subbaraman, M.S. and W.C. Kerr, *Simultaneous versus concurrent use of alcohol and cannabis in the National Alcohol Survey*. Alcoholism: clinical and experimental research, 2015. **39**(5): p. 872-879.
107. Yurasek, A.M., E.R. Aston, and J. Metrik, *Co-use of alcohol and cannabis: A review*. Current Addiction Reports, 2017. **4**(2): p. 184-193.
108. Lynskey, M.T., et al., *Stimulant use and symptoms of abuse/dependence: epidemiology and associations with cannabis use--a twin study*. Drug & Alcohol Dependence, 2007. **86**(2-3): p. 147-153.
109. Park, J.Y. and L.T. Wu, *Differences in behavioral health disorders and unmet treatment needs between medical marijuana users and recreational marijuana users: Results from a national adult sample*. Drug & Alcohol Dependence, 2017. **180**: p. 311-318.
110. Zielinski, L., et al., *Association between cannabis use and methadone maintenance treatment outcomes: an investigation into sex differences*. Biology of sex differences, 2017. **8**: p. 8.
111. Camenga, D.R., et al., *Marijuana and alcohol use and attempted smoking cessation in adolescent boys and girls*. Substance Abuse, 2014. **35**(4): p. 381-386.
112. Milicic, S. and S.T. Leatherdale, *The Associations Between E-Cigarettes and Binge Drinking, Marijuana Use, and Energy Drinks Mixed With Alcohol*. Journal of Adolescent Health, 2017. **60**(3): p. 320-327.
113. Jones, A.W., A. Holmgren, and F.C. Kugelberg, *Driving under the influence of cannabis: a 10-year study of age and gender differences in the concentrations of tetrahydrocannabinol in blood*. Addiction, 2008. **103**(3): p. 452-461.

114. O'Malley, P.M. and L.D. Johnston, *Driving after drug or alcohol use by U.S. high school seniors, 2001–2011*. American Journal of Public Health, 2013.
115. Buckley, L., et al., *Marijuana and other substance use among male and female underage drinkers who drive after drinking and ride with those who drive after drinking*. Addictive Behaviors, 2017. **71**: p. 7-11.
116. Patrick, M.E., et al., *Perceived friends' use as a risk factor for marijuana use across young adulthood*. Psychology of Addictive Behaviors, 2016. **30**(8): p. 904.
117. Labrie, J.W., J.R. Grossbard, and J.F. Hummer, *Normative Misperceptions and Marijuana Use Among Male and Female College Athletes*. Journal of Applied Sport Psychology, 2009. **21**: p. 577-585.
118. Ito, T.A., et al., *Testing an Expanded Theory of Planned Behavior Model to Explain Marijuana Use Among Emerging Adults in a Promarijuana Community*. Psychology of Addictive Behaviors, 2015. **29**(3): p. 576-589.
119. Vigna-Taglianti, F., et al., *Is universal prevention against youths' substance misuse really universal? Gender-specific effects in the EU-Dap school-based prevention trial*. Journal of Epidemiology & Community Health, 2009. **63**(9): p. 722-728.
120. de Dios, M.A., et al., *Marijuana use subtypes in a community sample of young adult women*. Womens Health Issues, 2010. **20**(3): p. 201-210.
121. Blomqvist, J., *Perceptions of addiction and recovery in Sweden: The influence of respondent characteristics*. Addiction Research & Theory, 2012. **20**(5): p. 435-446.
122. Craft, R.M., J.A. Marusich, and J.L. Wiley, *Sex differences in cannabinoid pharmacology: a reflection of differences in the endocannabinoid system?* Life sciences, 2013. **92**(8-9): p. 476-481.
123. Fattore, L. and W. Fratta, *How important are sex differences in cannabinoid action?* British Journal of Pharmacology, 2010. **160**(3): p. 544-548.
124. Lundahl, L.H. and M.K. Greenwald, *Effect of oral THC pretreatment on marijuana cue-induced responses in cannabis dependent volunteers*. Drug & Alcohol Dependence, 2015. **149**: p. 187-193.
125. Wetherill, R.R., et al., *Sex differences in associations between cannabis craving and neural responses to cannabis cues: Implications for treatment*. Experimental & Clinical Psychopharmacology, 2015. **23**(4): p. 238-246.
126. Fogel, J.S., et al., *Sex differences in the subjective effects of oral DELTA<sup>9</sup>-THC in cannabis users*. Pharmacology, Biochemistry & Behavior, 2017. **152**: p. 44-51.
127. Lundahl, L.H. and C.E. Johanson, *Cue-induced craving for marijuana in cannabis-dependent adults*. Experimental & Clinical Psychopharmacology, 2011. **19**(3): p. 224-230.
128. Metrik, J., et al., *Marijuana's Acute Effects on Cognitive Bias for Affective and Marijuana Cues*. Experimental and Clinical Psychopharmacology, 2015. **23**(5): p. 339-350.
129. Wetherill, R.R., et al., *The impact of sex on brain responses to smoking cues: a perfusion fMRI study*. Biology of sex differences, 2013. **4**(1): p. 9.
130. Anderson, B.M., et al., *Sex, drugs, and cognition: effects of marijuana*. Journal of Psychoactive Drugs, 2010. **42**(4): p. 413-424.
131. Cooper, Z.D. and M. Haney, *Investigation of sex-dependent effects of cannabis in daily cannabis smokers*. Drug and Alcohol Dependence, 2014. **136**: p. 85-91.
132. Haney, M., *Opioid antagonism of cannabinoid effects: differences between marijuana smokers and nonmarijuana smokers*. Neuropsychopharmacology, 2007. **32**(6): p. 1391-1403.
133. Mokrysz, C., et al., *Are adolescents more vulnerable to the harmful effects of cannabis than adults? A placebo-controlled study in human males*. Translational Psychiatry, 2016. **6**.
134. Buckner, J.D., et al., *The interactive effect of anxiety sensitivity and frequency of marijuana use in terms of anxious responding to bodily sensations among youth*. Psychiatry Research, 2009. **166**(2-3): p. 238-246.
135. Wiers, C.E., et al., *Cannabis Abusers Show Hypofrontality and Blunted Brain Responses to a Stimulant Challenge in Females but not in Males*. Neuropsychopharmacology, 2016. **41**(10): p. 2596-2605.
136. Anderson, B.M., et al., *Sex differences in the effects of marijuana on simulated driving performance*. Journal of Psychoactive Drugs, 2010. **42**(1): p. 19-30.
137. Medina, K.L., et al., *Prefrontal cortex morphometry in abstinent adolescent marijuana users: subtle gender effects*. Addiction Biology, 2009. **14**(4): p. 457-468.
138. French, L., et al., *Early Cannabis Use, Polygenic Risk Score for Schizophrenia and Brain Maturation in Adolescence*. JAMA Psychiatry, 2015. **72**(10): p. 1002-1011.

139. Chye, Y., et al., *Orbitofrontal and caudate volumes in cannabis users: a multi-site mega-analysis comparing dependent versus non-dependent users*. *Psychopharmacology*, 2017. **234**(13): p. 1985-1995.
140. Price, J.S., et al., *Effects of marijuana use on prefrontal and parietal volumes and cognition in emerging adults*. *Psychopharmacology*, 2015. **232**(16): p. 2939-2950.
141. Crane, C.A., et al., *Relationship status acceptance, alcohol use, and the perpetration of verbal aggression among males mandated to treatment for intimate partner violence*. *Journal of Interpersonal Violence*, 2013. **28**(13): p. 2731-2748.
142. Crane, N.A., et al., *Neuropsychological sex differences associated with age of initiated use among young adult cannabis users*. *Journal of Clinical & Experimental Neuropsychology: Official Journal of the International Neuropsychological Society*, 2015. **37**(4): p. 389-401.
143. Hefner, K.R. and M.J. Starr, *Altered subjective reward valuation among female heavy marijuana users*. *Experimental & Clinical Psychopharmacology*, 2017. **25**(1): p. 1-12.
144. Looby, A. and M. Earleywine, *Gender moderates the impact of stereotype threat on cognitive function in cannabis users*. *Addictive Behaviors*, 2010. **35**(9): p. 834-839.
145. Hunault, C.C., et al., *Cognitive and psychomotor effects in males after smoking a combination of tobacco and cannabis containing up to 69 mg delta-9-tetrahydrocannabinol (THC)*. *Psychopharmacology*, 2009. **204**(1): p. 85-94.
146. Pacek, L.R., et al., *Sleep continuity, architecture and quality among treatment-seeking cannabis users: An in-home, unattended polysomnographic study*. *Experimental & Clinical Psychopharmacology*, 2017. **25**(4): p. 295-302.
147. Cooper, Z.D. and M. Haney, *Sex-dependent effects of cannabis-induced analgesia*. *Drug and Alcohol Dependence*, 2016. **167**: p. 112-120.
148. VanderVeen, J.D., A.R. Hershberger, and M.A. Cyders, *UPPS-P model impulsivity and marijuana use behaviors in adolescents: A meta-analysis*. *Drug and Alcohol Dependence*, 2016. **168**: p. 181-190.
149. Buckner, J.D. and R.J. Turner, *Social anxiety disorder as a risk factor for alcohol use disorders: A prospective examination of parental and peer influences*. *Drug and Alcohol Dependence*, 2009. **100**(1-2): p. 128-137.
150. Lisdahl, K.M. and J.S. Price, *Increased marijuana use and gender predict poorer cognitive functioning in adolescents and emerging adults*. *Journal of the International Neuropsychological Society*, 2012. **18**(4): p. 678-688.
151. Scott, J.C., et al., *Cognitive Functioning of Adolescent and Young Adult Cannabis Users in the Philadelphia Neurodevelopmental Cohort*. *Psychology of Addictive Behaviors*, 2017. **31**(4): p. 423-434.
152. Patel, V.P. and A. Feinstein, *Cannabis and cognitive functioning in multiple sclerosis: The role of gender*. *Multiple Sclerosis Journal Experimental Translational & Clinical*, 2017. **3**(2): p. 2055217317713027.
153. Britch, S.C., et al., *Cannabidiol- $\Delta^9$ -tetrahydrocannabinol interactions on acute pain and locomotor activity*. *Drug and Alcohol Dependence*, 2017. **175**: p. 187-197.
154. Craft, R.M., et al., *Sex differences in cannabinoid 1 vs. cannabinoid 2 receptor-selective antagonism of antinociception produced by  $\Delta^9$ -tetrahydrocannabinol and CP55,940 in the rat*. *The Journal of Pharmacology and Experimental Therapeutics*, 2012. **340**(3): p. 787-800.
155. Klug, M. and M. van den Buuse, *Chronic cannabinoid treatment during young adulthood induces sex-specific behavioural deficits in maternally separated rats*. *Behavioural Brain Research*, 2012. **233**(2): p. 305-313.
156. Wiley, J.L. and J.J. Burston, *Sex differences in DELTA(9)-tetrahydrocannabinol metabolism and in vivo pharmacology following acute and repeated dosing in adolescent rats*. *Neuroscience Letters*, 2014. **576**: p. 51-55.
157. Britch, S.C., et al., *Cannabidiol- $\Delta^9$ -tetrahydrocannabinol interactions on acute pain and locomotor activity*. *Drug and alcohol dependence*, 2017. **175**: p. 187-197.
158. Harte-Hargrove, L.C. and D.L. Dow-Edwards, *Withdrawal from THC during adolescence: sex differences in locomotor activity and anxiety*. *Behavioural Brain Research*, 2012. **231**(1): p. 48-59.
159. Keeley, R.J., et al., *Part II: Strain- and sex-specific effects of adolescent exposure to THC on adult brain and behaviour: Variants of learning, anxiety and volumetric estimates*. *Behavioural Brain Research*, 2015. **288**: p. 132-152.
160. Llorente-Berzal, A., et al., *Sex-dependent psychoneuroendocrine effects of THC and MDMA in an animal model of adolescent drug consumption*. *Erratum appears in PLoS One*. 2013;8(12).

- doi:10.1371/annotation/89e38eb6-e8e3-402d-a6fb-84ebf9fcb27. PLoS ONE [Electronic Resource], 2013. **8**(11): p. e78386.
161. Burston, J.J., et al., *Regional enhancement of cannabinoid CB<sub>1</sub> receptor desensitization in female adolescent rats following repeated DELTA<sup>9</sup>-tetrahydrocannabinol exposure*. British Journal of Pharmacology, 2010. **161**(1): p. 103-112.
  162. Lee, T.T., et al., *Sex, drugs, and adult neurogenesis: sex-dependent effects of escalating adolescent cannabinoid exposure on adult hippocampal neurogenesis, stress reactivity, and amphetamine sensitization*. Hippocampus, 2014. **24**(3): p. 280-292.
  163. Lian, J. and C. Deng, *The effects of antipsychotics on the density of cannabinoid receptors in selected brain regions of male and female adolescent juvenile rats*. Psychiatry Research, 2018: p. 16.
  164. Llorente, R., et al., *Gender-dependent cellular and biochemical effects of maternal deprivation on the hippocampus of neonatal rats: a possible role for the endocannabinoid system*. Developmental Neurobiology, 2008. **68**(11): p. 1334-1347.
  165. Silva, L., et al., *Sex-specific alterations in hippocampal cannabinoid 1 receptor expression following adolescent delta-9-tetrahydrocannabinol treatment in the rat*. Neuroscience Letters, 2015. **602**: p. 89-94.
  166. Marusich, J.A., et al., *The Impact of Gonadal Hormones on Cannabinoid Dependence*. Experimental and Clinical Psychopharmacology, 2015. **23**(4): p. 206-216.
  167. Llorente-Berzal, A., et al., *Sex-dependent effects of maternal deprivation and adolescent cannabinoid treatment on adult rat behaviour*. Addiction Biology, 2011. **16**(4): p. 624-637.
  168. Cha, Y.M., et al., *Sex differences in the effects of delta9-tetrahydrocannabinol on spatial learning in adolescent and adult rats*. Behavioural Pharmacology, 2007. **18**(5-6): p. 563-569.
  169. Marusich, J.A., et al., *Evaluation of sex differences in cannabinoid dependence*. Drug & Alcohol Dependence, 2014. **137**: p. 20-28.
  170. Minney, S.M. and H.H. Lopez, *Adolescent cannabinoid treatment negatively affects reproductive behavior in female rats*. Pharmacology, Biochemistry & Behavior, 2013. **112**: p. 82-88.
  171. Keeley, R.J., J. Trow, and R.J. McDonald, *Strain and sex differences in puberty onset and the effects of THC administration on weight gain and brain volumes*. Neuroscience, 2015. **305**: p. 328-342.
  172. Carliner, H., et al., *The widening gender gap in marijuana use prevalence in the U.S. during a period of economic change, 2002–2014*. Drug and Alcohol Dependence, 2017. **170**: p. 51-58.
  173. Hara, M., et al., *Concurrent life-course trajectories of employment and marijuana-use: Exploring interdependence of longitudinal outcomes*. Journal of Substance Abuse Treatment, 2013. **45**(5): p. 426-432.
  174. Noack, R., M. Höfler, and U. Lueken, *Cannibals use patterns and their association with DSM-IV cannabis dependence and gender*. European Addiction Research, 2011. **17**(6): p. 321-328.
  175. Patrick, M.E., et al., *Perceived friends' use as a risk factor for marijuana use across young adulthood*. Psychology of Addictive Behaviors, 2016. **30**(8): p. 904-914.
  176. Chapman, C., et al., *Evidence for Sex Convergence in Prevalence of Cannabis Use: A Systematic Review and Meta-Regression*. Journal of Studies on Alcohol and Drugs, 2017. **78**(3): p. 344-352.
  177. Wilkinson, A.L., et al., *Adherence to gender-typical behavior and high frequency substance use from adolescence into young adulthood*. Psychol Men Masc, 2018. **19**(1): p. 145-155.
  178. Centre for Addiction and Mental Health, *Cannabis Policy Framework*. 2014, Centre for Addiction and Mental Health, Toronto, ON.
  179. Young, M.M., et al., *Cross-Canada report on student alcohol and drug use: Technical report*. 2011, Canadian Centre on Substance Abuse: Ottawa, ON.
  180. CCSA, *Clearing the Smoke on Cannabis*. 2016, CCSA: Ottawa, ON.
  181. Best Start Resource Centre, *Risks of Cannabis on Fertility, Pregnancy, Breastfeeding and Parenting*. 2017, Best Start Resource Centre, Toronto, ON.
  182. Colorado Department of Public Health & Environment, *Marijuana and Your Baby*. 2017, Colorado Department of Public Health & Environment, Denver, Colorado.
  183. Harding, K.D. and N. Poole, *CanFASD Issue Paper: Cannabis Use During Pregnancy*. parenting, 2018. **8**: p. 9.
  184. Canada Task Force on Cannabis Legalization Regulation, *A framework for the legalization and regulation of cannabis in Canada: The final report of the task force on cannabis legalization and regulation*. 2016, Ottawa, ON: Health Canada.

185. Fischer, B., et al., *Lower-risk cannabis use guidelines: a comprehensive update of evidence and recommendations*. American journal of public health, 2017. **107**(8): p. e1-e12.
186. George, T. and F.E. Vaccarino, *Substance abuse in Canada: The Effects of Cannabis Use during Adolescence*. 2015, CCSA: Ottawa, ON.
187. National Institute on Drug Abuse, *Substance Use in Women and Men: Differences in Marijuana Use Disorder*. 2016, NIDA: Bethesda, Maryland.
188. National Institute on Drug Abuse. *Drug Facts: Sex and Gender Differences in Substance Use*. 2018.
189. UN Women, *A gender perspective on the impact of drug use, the drug trade, and drug control regimes: UN Women policy brief*. 2014, United Nations Women: New York.
190. Hsiao, P. and R.I. Clavijo, *Adverse Effects of Cannabis on Male Reproduction*. European Urology Focus, 2018. **4**(3): p. 324-328.
191. Brents, L.K., *Focus: Sex and Gender Health: Marijuana, the Endocannabinoid System and the Female Reproductive System*. The Yale Journal of Biology and Medicine, 2016. **89**(2): p. 175.
192. Metz, T.D. and E.H. Stickrath, *Marijuana use in pregnancy and lactation: a review of the evidence*. American Journal of Obstetrics and Gynecology, 2015. **213**(6): p. 761-778.
193. Russell, C., et al., *Routes of administration for cannabis use – basic prevalence and related health outcomes: A scoping review and synthesis*. International Journal of Drug Policy, 2018. **52**: p. 87-96.
194. National Academies of Sciences, E. and Medicine, *The health effects of cannabis and cannabinoids: The current state of evidence and recommendations for research*. 2017: National Academies Press.
195. Gundersen, T.D., et al., *Association between use of marijuana and male reproductive hormones and semen quality: a study among 1,215 healthy young men*. American journal of epidemiology, 2015. **182**(6): p. 473-481.
196. Pacey, A., et al., *Modifiable and non-modifiable risk factors for poor sperm morphology*. Human Reproduction, 2014. **29**(8): p. 1629-1636.
197. Wesselink, A., et al., *Marijuana use and fecundability in an internet-based prospective cohort study*. Fertility and Sterility, 2015. **104**(3): p. e236.
198. Zuo, H., et al., *Gender-specific associations of sleep duration with uncontrolled blood pressure in middle-aged patients*. Clinical & Experimental Hypertension (New York), 2016. **38**(2): p. 125-130.
199. Zhang, A., et al., *What effects--if any--does marijuana use during pregnancy have on the fetus or child?* Journal of Family Practice, 2017. **66**(7): p. 462-466.
200. Wang, G.S., G. Roosevelt, and K. Heard, *Pediatric marijuana exposures in a medical marijuana state*. JAMA Pediatr, 2013. **167**(7): p. 630-3.
201. Sinha, S., et al., *Burns from illegal cannabis oil manufacturing: a case series*. CMAJ Open, 2018. **6**(1): p. E39-e43.
202. Rao, D.P., et al., *The lows of getting high: sentinel surveillance of injuries associated with cannabis and other substance use*. Can J Public Health, 2018. **109**(2): p. 155-163.
203. Sewell, R., *I Do... Better*. Outlook Ohio Magazine, 2014. **19**(2): p. 35-35.
204. McGraw, M.D., et al., *Marijuana medusa: The many pulmonary faces of marijuana inhalation in adolescent males*. Pediatr Pulmonol, 2018. **53**(12): p. 1619-1626.
205. Kalla, A., et al., *Cannabis use predicts risks of heart failure and cerebrovascular accidents: results from the National Inpatient Sample*. J Cardiovasc Med (Hagerstown), 2018. **19**(9): p. 480-484.
206. Reece, A.S., A. Norman, and G.K. Hulse, *Cannabis exposure as an interactive cardiovascular risk factor and accelerant of organismal ageing: a longitudinal study*. BMJ Open, 2016. **6**(11): p. e011891.
207. Zhang, L.R., et al., *Cannabis smoking and lung cancer risk: Pooled analysis in the International Lung Cancer Consortium*. Int J Cancer, 2015. **136**(4): p. 894-903.
208. Asbridge, M., J.A. Hayden, and J.L. Cartwright, *Acute cannabis consumption and motor vehicle collision risk: systematic review of observational studies and meta-analysis*. BMJ, 2012. **344**.
209. Anderson, T.L. and P.R. Kavanaugh, *Women's Evolving Roles in Drug Trafficking in the United States: New Conceptualizations Needed for 21st-Century Markets*. Contemporary Drug Problems, 2017. **44**(4): p. 339-355.
210. Cooke, A., B. Freisthler, and E. Mulholland, *Examination of Market Segmentation among Medical Marijuana Dispensaries*. Substance Use & Misuse, 2018. **53**(9): p. 1463-1467.
211. Fiala, S.C., et al., *Exposure to Marijuana Marketing After Legalization of Retail Sales: Oregonians' Experiences, 2015–2016*. American Journal of Public Health, 2017. **108**(1): p. 120-127.

212. Marijuana Business Daily, *Chart: Portion of women executives in cannabis industry dips to 27% but still strong*. 2017.
213. Zaharakis, N., et al., *School, Friends, and Substance Use: Gender Differences on the Influence of Attitudes Toward School and Close Friend Networks on Cannabis Involvement*. *Prevention Science*, 2017: p. 05.
214. Schwinn, T.M., et al., *Risk and protective factors associated with adolescent girls' substance use: Data from a nationwide Facebook sample*. *Substance Abuse*, 2016. **37**(4): p. 564-570.
215. de Dios, M.A., et al., *General Anxiety Disorder Symptoms, Tension Reduction, and Marijuana Use Among Young Adult Females*. *Journal of Womens Health*, 2010. **19**(9): p. 1635-1642.
216. Studer, J., et al., *Substance Use in Young Swiss Men: The Interplay of Perceived Social Support and Dispositional Characteristics*. *Subst Use Misuse*, 2017. **52**(6): p. 798-810.
217. Goldstick, J.E., et al., *Perceived Peer Behavior and Parental Support as Correlates of Marijuana Use: The Role of Age and Gender*. *Substance Use & Misuse*, 2017: p. 1-11.