Consistent Demographic Patterns in Cannabis Use Across Canada May Positively Correlate to High Frequency Use*

Understanding Cannabis Usage in Canada: An analysis of the 2021 Canadian Tobacco and Nicotine Survey (CTNS)

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The widespread use of tobacco, vaping, and cannabis in Canada has been an ongoing public health concern given their commonly associated negative health impacts including respiratory issues, impaired cognitive development, and addiction. To gain a deeper understanding of the factors driving usage rates for cannabis specifically, this paper aims to investigate the relationship between demographics such as gender and region, versus consumption method and frequency in Canada. By utilizing the data from Statistics Canada, we found that young adults and males are more likely to use cannabis products with higher usage rates in certain regions of Canada. The implications and possible solutions for addressing high usage rates are also discussed.

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*Code and data are available at: https://github.com/emilykimto/CTNS-analysis.git

1 Introduction

In 2018, the Canadian government led by Prime Minister Justin Trudeau, made the landmark decision to legalize the use of marijuana after a century of prohibition. While this move was praised as a step towards progressive drug policy by some, others expressed concerns about the potential negative effects on public health. Of particular concern was the potential increase in cannabis usage rates among the general population, especially young adults who would be at a higher long-term risk of negative health outcomes similar to those associated with tobacco, such respiratory issues, impaired cognitive development, and addiction.

In light of this recent legalization and the still ongoing research surrounding the effects of marijuana, I analyzed data from the 2021 Canadian Tobacco and Nicotine Survey (CTNS) obtained from Open Government Data of Statistics Canada to uncover the demographic that would be the most impacted by any negative health effects of cannabis products. To gain a more comprehensive understanding of what factors drive usage rates, I explore the estimand, how does user characteristics such as age, gender, and region correlate with cannabis consumption methods (smoking, vaping, taking edibles) and their respective frequencies of usage in Canada.

I will first discuss the source of our data, its biases, and review the CTNS sampling and key features. Then, I will create a model and discuss analysis results to identify the demographic patterns of cannabis usage in Canada, cannabis product type, and consumption frequency to discuss potential underlying user behaviour and motivations. Finally, I discuss the implications of the findings and possible solutions as to how public policy can better tackle the ongoing phenomenon of increasing substance use, as well as the weaknesses and future steps of this paper.

2 Data and Methods

2.1 Data Management

This paper utilizes the R statistical programming language (R Core Team 2020), along with packages tidyverse (Wickham et al. 2019), here (Müller 2020), janitor (Firke 2021), and dplyr (Wickham et al. 2022). The figures in this paper have been created using ggplot2 (Wickham 2016) and the tables have been created using knitr (Xie 2023) and kableExtra (Zhu 2021). The color styles in graphs have been created using the RColorBrewer packages (Neuwirth 2022).

2.2 Source

This paper uses data extracted from the Public Use Microdata File (PUMPF) for the 2021 Canadian Tobacco and Nicotine Survey (CTNS). The CTNS is a national survey conducted by Health Canada to collect information about the prevalence of cigarette smoking, vaping, and cannabis use in Canada. Until 2017, Statistics Canada administered the Canadian Tobacco, Alcohol and Drugs Survey (CTADS), which gathered information on the use of tobacco, alcohol, and drug use across Canada (Canada 2022b). However, in 2019, the Canadian Alcohol and Drugs Survey (CADS) was carried out specifically to collect data on alcohol and drug use, separately from the Canadian Tobacco and Nicotine Survey (CTNS), which is focused mainly on gathering data on tobacco and nicotine use, including cannabis (Canada 2022b).

The PUMPF is a dataset that contains anonymized, individual-level data from the CTNS (Canada 2022b). It is a subset of the full survey dataset that involves balancing the preservation of respondent confidentiality and providing the most useful data which is then made available to researchers and analysts who require access to detailed information on tobacco, nicotine, and cannabis use in Canada (Canada 2022b). The CTNS PUMF includes information on a wide range of variables, including frequency of use, attitudes and beliefs, and use of cessation aids (Canada 2022b). It also includes demographic variables such as age, gender, and province of residence (Canada 2022b).

Data collection for the 2022 reference period was conducted from December 1, 2020 to May 3, 2021, and was gathered directly and voluntarily from survey respondents either through an electronic questionnaire (EQ) or through CATI (computer- assisted telephone interviewing) (Canada 2022a). The 2021 CTNS electronic questionnaire was developed in consultation with Health Canada, and underwent a process of cognitive testing through in-depth interviews conducted by Statistics Canada's Questionnaire Design Resource Centre to test the survey content in both of Canada's official languages (Canada 2022a).

2.3 Sampling

The CTNS is designed to provide a comprehensive picture of tobacco, nicotine, and cannabis use, attitudes, and behaviours among non-instituionalized Canadians ages 15 years and older who are not members of collectives or living on reserves (Canada 2022a). The survey has a stratified sample and cross-sectional design with sampling units: individuals aged 15 to 24 and individuals aged 25 and older (Canada 2022a). For the former (individuals aged 15 to 24), the CTNS sample has a one-stage desion, and the individual is the sampling unit (Canada 2022a). For the latter (individuals aged 25 and older), the CTNS sample has a two-stage design where the sampling unit for the first stage is the dwelling, and the sampling unit for the second stage is the individual (Canada 2022a). The CTNS used different methods for stratification. For those aged 15 to 24, the sample was stratified by age group and province, with a systematic sample selected independently for each group (Canada 2022a). For those aged 25 and older, the sample was stratified by province and a simple random sample of dwellings was selected (Canada 2022a). In terms of sampling and subsampling, the survey allocated samples to produce province-level and region-level estimates for the age groups. The initial sample size was 12,000 individuals aged 15-24 and 15,000 dwellings for those aged 25 and older (Canada 2022a). The survey sent an initial sample of 27,000 dwellings or individuals for collection (Canada 2022a).

2.4 Key Features

This paper investigates the relationship between demographic factors and cannabis use in Canada. More specifically, it explores the estimand, how does characteristics such as user age, gender, and region correlate with cannabis consumption methods (smoking, vaping, taking edibles) and their respective frequencies of usage in Canada. The variables I selected for my analysis can be seen in Table 1.

Table 1: Variable Descriptions

Variable	Variable Description
AGEGROUP	Age group of person
GENDER	Gender of person
PROV_C	Province of residence (collection)
CAN_10AR	Frequency smoked cannabis - past 30 days
CAN_25AR	Frequency vaped cannabis - past 30 days
CAN_17R	Frequency consumed edibles - past 30 days

The variables were measured using answer categories, which are as follows:

- AGEGROUP: 15 to 19 years old, 20 to 24 years old, 25 to 34 years old, 35 to 44 years old, 45 to 54 years old, 55 to 64 years old, 65 years old and older.
- GENDER: Male, Female, Not stated.

- PROV_C: Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia.
- CAN_10AR: Daily, Less than daily but at least once a week, Less than once a week but at least once in the past month, Not at all, Valid skip, Not stated.
- CAN_25AR: Daily, Less than daily but at least once a week, Less than once a week but at least once in the past month, Not at all, Valid skip, Not stated.
- CAN_17R: At least once in the past 30 days, Not at all, Valid skip, Not stated.

2.5 Bias and Ethics

The 2021 Canadian Tobacco and Nicotine Survey (CTNS) dataset is a valuable resource for understanding smoking habits and attitudes in Canada. However, it is important to consider the ethical and bias implications of the survey.

When it comes to online surveys that rely on voluntary participation from respondents, it's important to ensure that the survey is designed in an ethical manner, meaning that questions are phrased neutrally and not leading, and that respondents are not coerced into participating. To avoid this, the questionnaire underwent cognitive testing through in-depth interviews in both of French and English, conducted by Statistics Canada's Questionnaire Design Resource Centre (Canada 2022a). In addition, since participation is voluntary, there may be some bias in the data, as certain individuals or groups may be more likely to respond than others. This can result in a skewed sample that doesn't accurately reflect the population being studied. To address this, the 2021 CTNS implemented a variety of strategies to increase the representation of the sample and minimize potential biases. First, the CTNS used a stratified random sampling method to select participants from all Canadian provinces and territories, ensuring that the sample was diverse and reflective of the Canadian population (Canada 2022a). Additionally, the survey was available in both English and French and used a mix of online and phone surveys to reach a broad range of participants (Canada 2022a).

3 Model

Through exploratory analysis, I discovered a correlation between the gender variable and frequency of smoking cannabis. The relationship appears to be linear as the figures generally demonstrate increasing trends. This also aligns with a 2017 featured research article published the Canadian Institutes of Health Research, in which men were identified as more likely to use cannabis recreationally (Gender and Health 2017). The gender influence continues as the article reported a higher probability for women to consume edible products while men reported more smoking, vaporizing, and use of hash concentrates and oils along with higher rates of use overall (Gender and Health 2017).

To further proceed with the analysis and predict the future situation regarding gender and cannabis use via smoking method, I will create a simple linear regression model. In the model,

gender will be the predictor variable and cannabis use via smoking method the response variable. One important aspect to note is that this simple linear regression only accounts for the relationship between the two chosen variables and does not account for other variables that may also be influencing the response variable.

4 Results

When looking at Figure 1, we can see that the majority of respondents identified as male or female with a small portion as "not stated" Among male respondents, there was a higher frequency of smoking cannabis compared to female respondents with a significant, visible difference in "Daily" and "Less than daily but at least once a week" usage. This trend holds true across all answer categories, with higher rates of cannabis use via smoking method among males compared to females aside from the least frequency response "Less than once a week but at least once a month", which may correlate to the aforementioned article in which women tend to use cannabis for medicinal uses whereas males more often use cannabis for recreational purposes.

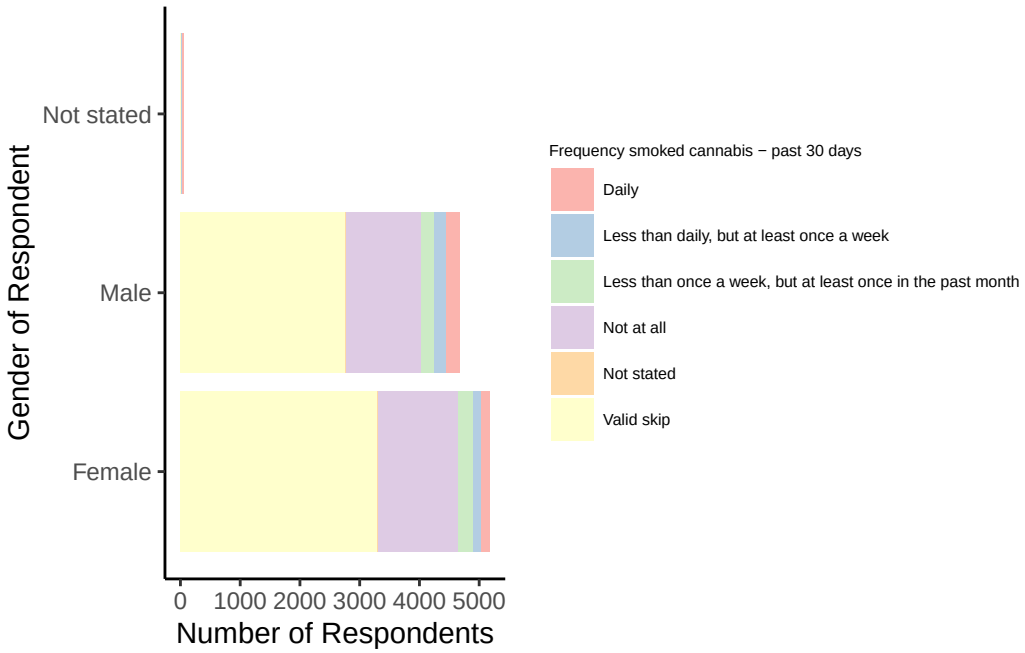

Figure 1: Frequency smoked cannabis - past 30 days against Gender

Figure 2 further highlights the trend of higher cannabis usage through smoking and vaping among male respondents compared to their female counterparts. Notably, the data shows a

significant difference between the genders in terms of the "not at all" category for cannabis vaping, indicating that more male respondents prefer smoking over vaping.

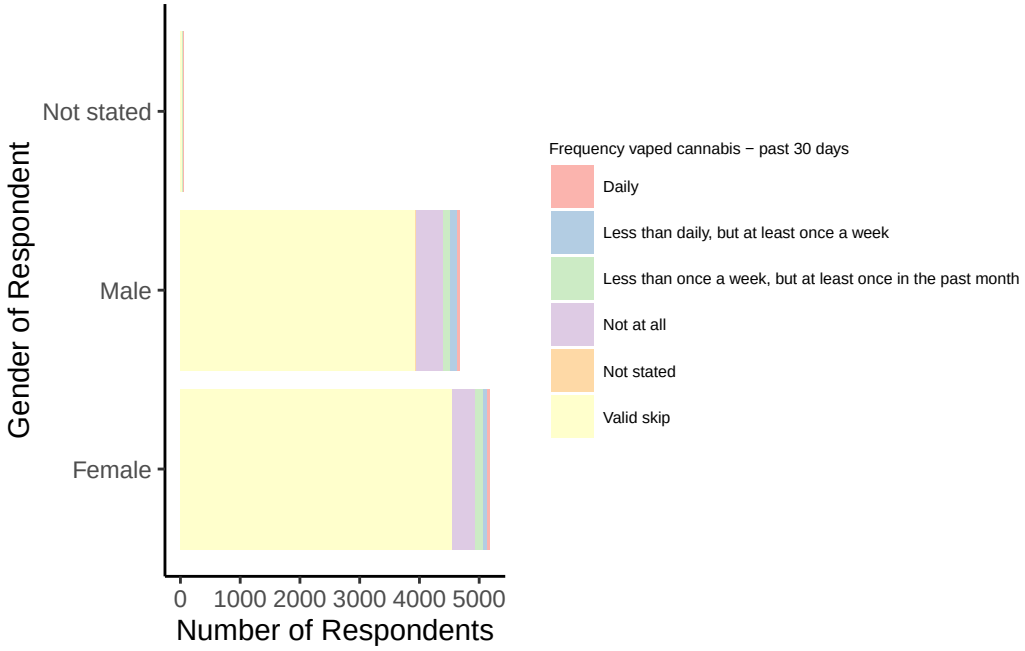

Figure 2: Frequency vaped cannabis - past 30 days against Gender

Figure 3 depicts a large number of respondents indicating a valid skip, with a larger proportion being females, as with the other figures. The graph also further demonstrates the consistent trend of males engaging in more cannabis use, with more males consuming edibles more frequently than their female counterparts.

In Figure 4, we can see that the top two provinces with the highest number of respondents are Ontario and Quebec. Interestingly, the number of male and female respondents in these provinces are almost equally represented, which seemingly contrasts the initial hypothesis that there would be more male cannabis users. However, it is important to note that the graph displaying the relationship between gender and province of residence is affected by the presence of factors like valid skips and not stated responses which accounted for a significant portion of the survey answers, as shown in the earlier figures. On the other end of the spectrum, the survey has the lowest number of respondents from Newfoundland and Labrador and New Brunswick.

Figure 5 demonstrates the top three age groups with the highest number of respondents, namely 20 to 24 years old, 15 to 19 years old, and 65 years and older. These results allude to the broader societal trends in which the higher number of younger respondents may be due to the fact that cannabis use has become increasingly normalized and socially accepted among younger generations. On the other hand, the higher number of oldere respondents may

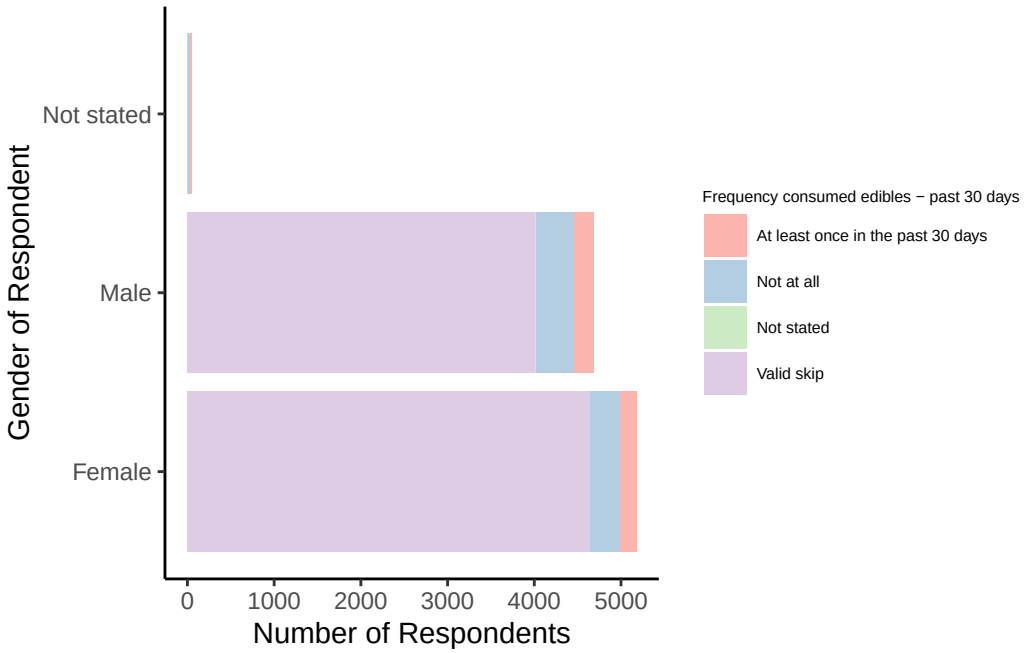

Figure 3: Frequency consumed edibles - past 30 days against Gender

be attributed to the fact that cannabis use has become more widely accepted for medicinal purposes, leading to an increase in use among older adults. In terms of the ratio of male and female respondents within these age groups, it is also equal to that of Figure 4. Furthermore, it is important to note that the previous figures revealed a trend of more male respondents reporting cannabis usage via smoking, vaping, and consuming edibles. This indicates that the prevalence of cannabis use may be higher among males across all age groups.

5 Discussion

5.1 The Demographic Patterns of Cannabis Usage across Canada

The demographic patterns of cannabis usage across Canada offer valuable insights into which groups are more likely to use these products and why. The data shows a clear positive correlation between cannabis use and males, with a higher frequency of smoking cannabis among male respondents compared to females. Across all answer categories, males reported higher rates of cannabis use via smoking, vaping, and consuming edibles than their female counterparts. According to a research article on cannabis use and patterns among Canadians prior to legalization using data from the Canadian Tobacco, Alcohol and Drugs Survey (CTADS), in a 2017 analysis of a total of 4789 individuals in Canada, the prevalence of cannabis use

was higher in males (9%) than females (5.9%), with an overall prevalence of 7.4% in the sample (Keethakumar et al. 2021). Other studies have noted that there are distinct differences between male and female cannabis use behaviours. Canadian males reported a 2.4% increase in their lifetime cannabis use between 2002 and 2010, while cannabis use among females remained stagnant during that period (Keethakumar et al. 2021). These insights are evident in Figure 1, Figure 2, and Figure 3, which demonstrates an increased cannabis use in males across all methods of intake.

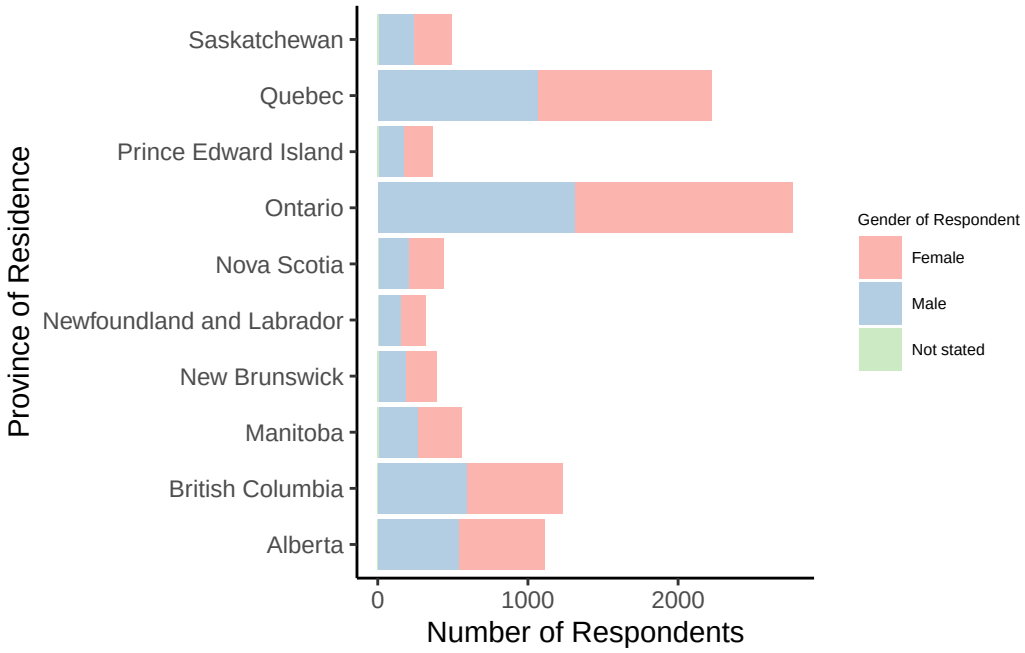

Figure 4: Gender against Province

Interestingly, in Figure 4 the highest number of respondents came from Ontario and Quebec, with British Columbia following in third. This disparity in number of respondents per province may be attributed to the proportion in which both males and females use cannabis for that region in Canada. Among these regions, the highest number of respondents were in the age groups of 20 to 24 years old, 15 to 19 years old, and 65 years and older, indicating that cannabis use is becoming more normalized among younger generations and more widely accepted among older adults. These insights may be used to predict the demographics that engage in cannabis use in Canada for public health and policy.

With the CTADS and CTNS results put together, we can see that overall in Canada, the sociodemographic and economic factors associated with overall increased cannabis use include being male, dwelling in urban areas, having a lower socioeconomic status, lower levels of post-secondary education attainment, and lower employment rates (Keethakumar et al. 2021). In the next section, I discuss the second half of identifying factors surrounding mental health

complications including depression, emotional distress, and psychosis have been associated with cannabis use.

5.2 Why do Canadians use cannabis?

The reasons behind cannabis use in Canada are complex and multifaceted, in this section I discuss the potential underlying user behaviour and motivations. While the trend of increased prevalence of cannabis in men may be attributed to the fact that men tend to use cannabis more frequently for recreational purposes, the research article also describes cultural and behavioural acceptance of learned smoking habits to also be a significant contributing factor (Keethakumar et al. 2021). These results are in agreement with other investigations that revealed that males in general have an increased prevalence of cannabis addiction and use disorders, which increase the difficulty to quit overall cannabis intake (Keethakumar et al. 2021). On the flip side, females who experienced poorer self-reported mental health were more likely to be cannabis users as compared to those who reported very good or excellent mental health (Keethakumar et al. 2021). This finding is consistent with a study conducted in the US which found that people who use cannabis have poorer mental well-being than those who don't - especially among female users (Keethakumar et al. 2021). Despite the popular belief that cannabis can improve mental health, long-term use has been associated with negative outcomes, including depression, anxiety, and panic disorders. In general, cannabis use can be driven by various factors such as stress relief, pain management, mental health, socialization, and peer influence, particularly among male groups. These observations are supported by Figure 5, which reveals that the highest number of respondents were aged between 20 and 24 years old, followed by 15 to 19 years old. These age groups are often associated with increased levels of stress, social pressure, and experimentation, which may lead to the use of cannabis as a means of coping or fitting in. Additionally, cannabis has been reported to provide pain relief for chronic pain conditions, making it an attractive option for individuals seeking alternative treatment options. However, it is essential to note that despite potential benefits, long-term cannabis use can lead to negative outcomes such as dependence, addiction, and mental health complications.

Understanding the underlying factors that drive cannabis use in Canada is critical in developing effective policies and regulations around its use. While the legalization of cannabis for recreational purposes has been a significant step towards minimizing the harms associated with its use, policymakers must also consider the complex social and behavioral factors that contribute to its use. For example, policies aimed at reducing cannabis use among males should take into account the cultural and social pressures that lead to its frequent use among this group. Similarly, policies aimed at promoting mental health among women should consider the potential negative effects of cannabis use on mental health outcomes. Furthermore, healthcare professionals should be informed about the potential risks and benefits of cannabis use to provide effective counseling to patients who use it for medical purposes. Thus, while the legalization of cannabis has created opportunities for individuals to access its potential benefits, policymakers, healthcare professionals, and the public must remain vigilant about

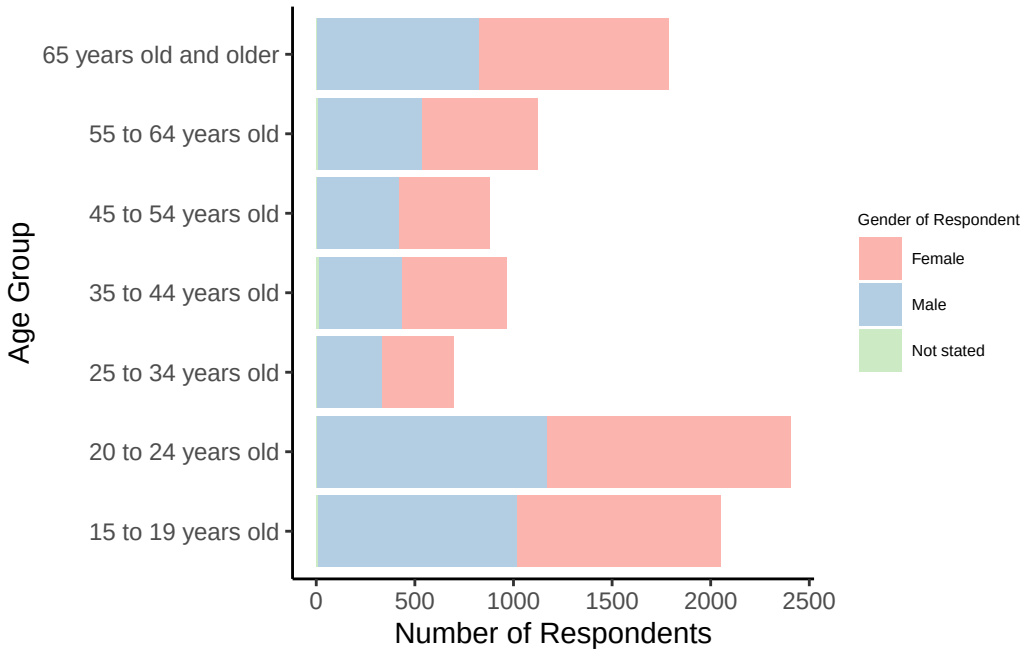

Figure 5: Gender against Age Group

the potential risks associated with its long-term use. Through a comprehensive understanding of the factors that drive cannabis use, policies and regulations can be developed that prioritize public health and safety.

5.3 Weaknesses and Next Steps

The weaknesses of any research study are important to acknowledge and address in order to improve the validity and reliability of future studies. One weakness of the current research on cannabis use in Canada is that it relied on self-reported data from participants, which can be subject to biases and inaccuracies such as recall bias. Moreover, participants may be hesitant to report certain behaviors or may not accurately remember their past behaviors in their drug usage.

Additionally, the Canadian Tobacco and Nicotine Survey (CTNS) is a cross-sectional survey. It collects data from a representative sample of Canadians aged 16 years and older at a single point in time. The survey is conducted occasionally to monitor trends and changes in tobacco, nicotine, and cannabis use behaviors, and as a result, this design does not allow for the examination of causal relationships between variables or for the tracking of changes in drug use over time.

To address these weaknesses, future studies could employ more objective, quantitative measures of cannabis use rather than methods that depend on participants' voluntary response. Another weakness of the current research is that it did not examine the potential differences in cannabis use among different ethnic and socio-economic groups, which could be important in understanding disparities in cannabis use and related outcomes as these tend to have a correlation in socio-economic factors of cannabis use such as lower levels of education and lower employment rates which are not solely dependent on variables such as age or province of residence.

The findings from this research have important implications for policymakers and healthcare providers in Canada. Specifically, policymakers could use this information to develop targeted prevention and intervention strategies for high-risk groups, such as young males and individuals with poor mental health. Healthcare providers could also use this information to educate their patients about the potential risks and benefits of cannabis use and to screen for cannabis use disorders among their patients.

Overall, while this paper may provide valuable insights on the relationship between cannabis use and demographic factors especially for decisions in policy-making, it is important to consider the various limitations, ethical concerns, and potential biases in the data and interpretation of the insights and findings. Next steps for research in this area could include longitudinal studies that track changes in cannabis use over time and examine the potential long-term effects of cannabis use on health outcomes. Additionally, studies could investigate the effectiveness of different prevention and intervention strategies for cannabis use disorders. Overall, continued research in this area is important for informing policy and practice related to cannabis use in Canada.

References

Canada, Statistics. 2022a. "Canadian Tobacco and Nicotine Survey (CTNS)." Statistics Canada. https://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=1492763#shr-pg0.

———. 2022b. "Canadian Tobacco and Nicotine Survey: Public Use Microdata File." Statistics Canada. https://www150.statcan.gc.ca/n1/pub/13-25-0001/132500012022001-eng.htm.

Firke, Sam. 2021. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. https://CRAN.R-project.org/package=janitor.

Gender, Institute of, and Health. 2017. "Science Fact or Science Fiction: Do Sex and Gender Matter in Cannabis Use?" Canadian Institutes of Health Research. https://cihr-irsc.gc.ca/e/50594.html.

Keethakumar, Asvini, Vrati M. Mehra, Nazilla Khanlou, and Hala Tamim. 2021. "Cannabis Use and Patterns Among Middle and Older Aged Canadians Prior to Legalization: A Sex-Specific Analysis of the Canadian Tobacco, Alcohol and Drugs Survey." *BMC Public Health* 21 (1). https://doi.org/10.1186/s12889-020-10074-z.

Müller, Kirill. 2020. *Here: A Simpler Way to Find Your Files*. https://CRAN.R-project.org/package=here.

Neuwirth, Erich. 2022. *RColorBrewer: ColorBrewer Palettes*. https://CRAN.R-project.org/package=RColorBrewer.

R Core Team. 2020. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. https://ggplot2.tidyverse.org.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.

Wickham, Hadley, Romain François, Lionel Henry, and Kirill Müller. 2022. *Dplyr: A Grammar of Data Manipulation*. https://CRAN.R-project.org/package=dplyr.

Xie, Yihui. 2023. *Knitr: A General-Purpose Package for Dynamic Report Generation in r*. https://yihui.org/knitr/.

Zhu, Hao. 2021. *kableExtra: Construct Complex Table with 'Kable' and Pipe Syntax*. https://CRAN.R-project.org/package=kableExtra.