BUSINESS ANALYTICS CONSULTING CAPSTONE PROJECT
BAN240 – SECTION NAA

MENTAL HEALTH AND SUICIDES IN CANADA

Objective: To analyze the relationship between mental health and suicides in Canada

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The importance of mental well-being can be ascertained from the fact that the World Health Organization (WHO) defines health as a complete state of physical, social, and mental well-being (Constitution, WHO). The evidence suggests that there exists an interrelationship between mental health and suicide incidents. Individuals that suffer from a mental disorder have an approximately eight-fold increased risk of suicide in comparison to those without a mental health problem and unfortunately, suicide is one of the top ten causes of death in Canada (Too et al). The research aims to examine and analyze the relationship between mental health and suicides in Canada by examining the age group and gender that are more affected by mental health problems in Ontario, finding which mental disorders are most likely to cause deaths and inspecting the early signs of suicide in mental health patients.

The analysis found that Ontario recorded the most suicidal thoughts among its citizens with young adults and females experiencing more suicidal thoughts than their counterparts. Among the mental and behavioral disorders, organic mental disorders especially unspecified dementia causes the greatest number of deaths, and people showing early signs of depression are most likely to commit suicide. The risk of suicide is found to be indirectly proportional to the number of days after diagnosis as patients with mental illness are more likely to commit suicide within the first 90 days after diagnosis. These observations highlight the association between psychosocial factors and focus on the relevance of identification of overall psychological functioning rather than specific symptoms of mental health issues or suicidal thoughts. The research is thus helpful for health professionals to take adequate steps in the initial years of diagnosis with these mental issues to lower the risks of suicide attempts and suicides.

INTRODUCTION

The prevention, detection, treatment or cure of disease, illness, injury, and other physical and mental disabilities in individuals is referred to as health care. The Canadian HealthCare Industry accounts to $308 billion which comes to $8,019 on a per capita basis. (*Health Expenditure Data in Brief*)

People of all ages, education, income levels, and cultures are impacted by mental illness; however, systemic disparities such as poverty, homelessness, racism, discrimination, and gender-based violence, among others, can deteriorate mental health and symptoms of mental illness, particularly if mental health supports are inaccessible. Depression and anxiety disorders affect roughly around 5.4% and 4.6% of the Canadian population respectively. There was a 61% growth in emergency department visits and a 60% increase in hospitalizations for mental disorders among youth between 2009 and 2019. Mental illnesses had an economic cost of approximately $80 billion for the year 2021 to the Canadian healthcare and social support system. (Fast Facts about Mental Health and Mental Illness)

Similarly, suicide also impacts people of all ages and backgrounds. On average, approximately 4,000 Canadians commit suicide every year, more than 10 Canadians commit suicide every day and about 11 suicides per 100,000 people occur in Canada. (Kellner) One-third of deaths among middle aged population are caused by suicide and it is the second leading reason of death among youth. (Suicides in Canada: Key Statistics) The rise in mental health disorders leading to suicide require attention at individual, societal and federal level.

Most suicides are related to psychiatric disease, with depression, substance use disorders, psychosis, anxiety, personality, eating, and trauma-related disorders, as well as organic mental

disorders. Mental illness often develops at an early age leading to disability. One in ten youth reported having experienced symptoms of depression in their lifetime, and one in seven reported suicidal thoughts, among these more than 150,000 individuals attempted suicides. Knowledge of the risk factors may enable early intervention. The association between psychosocial factors and seeking professional support highlights the relevance of identification of overall psychological functioning rather than specific symptoms of mental health issues or suicidal thoughts. (Depression and Suicidal Ideation among Canadians Aged 15 to 24)

Suicide continues to be a leading cause of death globally. Every year around 800,000 people die from suicide. Globally, 1.3% of all deaths are from suicides. Suicide deaths have held steady in Canada with an average of about 4000 a year. 90% of those were already suffering from mental health illness. Further statistics state that there are 25 - 30 attempts for every suicide disestablishing the correlation between mental health issues and likelihood for onset of suicidal thoughts can help provide recommendations for suicide prevention. Through this project, we aim to answer which age group and gender are more affected by mental health problems. We will also try to identify the early stages of suicidal tendencies in mental health patients and categorize which mental disorders are more likely to result in deaths.

LITERATURE REVIEW

Many developed countries have seemed a rise in the number of suicide cases annually. In Japan, the number of cases increased drastically around the turn of the millennia and stayed high ever since (Hirokawa et al.). There are many factors that may influence suicidal thoughts. However, the most important risk factor associated with suicides is a mental disorder. In fact, according to studies, around 87.3 % of suicide cases have a history of mental disorders (Arsenault

et. al). Also, in the study, it was found that there is a distinction between male and female profiles suicide victims. While males possess more risk of substance-related disorders, personality disorders, and childhood disorders, females, on the other hand, are more affected by depression disorder (Arsenault et. al). Another factor that was considered in the study was the geographical location. There seems to be a difference in suicide completers in different parts of the world regarding various mental disorders. As per the study, it is observed that affective disorders are more prevalent in Asians while substance-related issues are more seen in Americans (Arsenault et. al).

A systematic review and meta-analysis of record linkage studies conducted by San et al provide the evidence of the association between mental disorders and suicide. Findings suggest that the individuals that suffer from a mental disorder have approximately eight-fold increased risk of suicide in comparison to those without a mental health problem. It is found that the risk of suicide is strong in anorexia nervosa in women with 31-fold greater risk, 20-fold greater risk can be seen in depression, opioid use (14-fold greater risk), and schizophrenia have 13-fold greater risk. (Too et al) Research performed on a sample of US adults shows that during the 3-year follow-up, mental disorders are strongly associated with the risk of suicide attempt, and their effect on this risk can be seen in both genders almost exclusively through a general psychopathology measurement representing the shared effects across all mental disorders and history of prior suicide attempts. (Hoertel et al)

Some mental disorders have high risk of instances of suicides associated with them as compared to others. Although, the risk of suicide incidents decreased over time for anxiety disorders (AD), Major Depressive Episodes (MDE), and SD (Substance Dependence), but remained high for bipolar disorders (BPD) (Adhikari et al 2020). This may indicate improvement

over period in MDE, AD and SD, but suggests that people living with BPD have a constant elevated risk of suicide events. Also, the risk of suicide events is higher in initial year of diagnosis with mental illness. A systematic study was conducted by Randall et al to determine the degree of risk of suicide and suicide attempts during the first year after diagnosis with a mental illness. It was found that the risk of dying by suicide was particularly high within the first 90 days after initial diagnosis for many disorders, including depression, and schizophrenia and anxiety disorders. (Randall et al). These observations are very helpful for health professionals to take adequate steps in the initial years of diagnosis with these mental issues to lower the risks of suicide attempts and suicides.

Studies estimated variation in suicide risks by predicting the relative risks for suicide with respect to different types of disorder, namely Major Depressive disorder (MDD), bipolar disorder, anxiety disorders, schizophrenia, and dysthymia (Moitra et al 2021). The relative risks for suicide were found to be greater for MDD, schizophrenia, and bipolar disorder than the others (Moitra et al). Studies examined the relationship between mental disorders and completed suicide among young people with Mood disorders being the most common mental disorder constituting to 42.1% of the deceased, substance related disorder being the second most common disorder that accounted for 40.8%, followed by disruptive behavior disorder constituting to 20.8% (Fleischmann et al). However, this study didn't distinguish the psychiatric diagnoses between young males and young females.

A relationship can be found between prior mental disorders and subsequent suicide through studies in the developed world. Suicide is the second leading cause of death among young people (World Health Organization, 2016; Lozano et al.). According to various studies, young people in the age group of 15-29 years showed high rates of psychiatric comorbidity (54%). Most of the

adolescents with suicidal behavior meet lifetime criteria for at least one mental disorder (Nock, 2013). However, meta-analysis for specific mental disorder as a risk factor could not be conducted in this paper due to lack of published studies. Further, looking at a specific country South Africa, a national survey of 4185 South African adults was conducted using the WHO Composite International Diagnostic Interview (CIDI) to generate psychiatric diagnoses and suicidal behavior. DSM-IV mental disorders and PTSD were amongst the strongest predictors of suicide attempts but were less predictive for suicide ideation. The results of the present study showed that 61% of South Africans who considered killing themselves and 70% who made a suicide attempt were found to have prior mental disorder.

There is inadequate data to assist health-care practitioners and policymakers. Studies show that there are significant interprovincial disparities in the frequency of mental diseases and suicidality and this comparison will facilitate understanding the reasons behind the same as well as availability and utilization of mental healthcare services in various provinces thereby bridging the gap between service providers and those in need. (Palay et al.) This gap can be further reduced by examining and comparing help seeking, perceived need, satisfaction with healthcare professionals. A large number of individuals suffering from mental disorders are reluctant to seek help. It has been noted that individuals who engage in suicidal behaviour are more likely to use services and perceive a need for treatment than those who do not engage in suicidal behaviour. However, a significant proportion still resist seeking help in this matter and it is imperative that the mental healthcare services reach the individuals in time. (Pagura et al.)

INDUSTRY OVERVIEW

The prevention, detection, treatment or cure of disease, illness, injury, and other physical and mental disabilities in individuals is referred to as health care. It comprises work done in primary, secondary, and tertiary care settings. Health-care access varies by country, community, and individual, and is influenced by social and economic factors as well as health-care regulations. A well-functioning health-care system can make a substantial contribution to a country's economic growth and development. ("Health care")

The Canadian HealthCare Industry accounts to $308 billion which comes to $8,019 on a per capita basis. (*Health Expenditure Data in Brief*)

Healthcare industry includes the following sectors:

1. **Pharmaceuticals:** This is one of the most innovative industries in Canada. It comprises of companies manufacturing and developing innovative medicines, drug products and generic pharmaceuticals. ("Healthcare in Canada")
2. **Biotechnology:** This sector supports the regulatory and research activities of various agencies and federal departments of Canada. Canada's largest biotechnology and life sciences industries are in British Columbia. (Health Canada)
3. **Medical instruments and equipments:** Canadian firms manufacture and distribute medical devices that include dental, surgical equipments, orthopaedic appliances, electro-medical equipment, prosthetics and assistive devices, diagnostic kits, furniture, supplies and consumables.

4. **Hospitals and Care facilities:** This sector consists of general medical and surgical that provides surgical and non-surgical medical treatment and diagnostic to the patients in medical conditions. Hospitals and care facilities have consistently been the top healthcare expenditure sector in Canada.

The structure of Canada's health care system is mostly defined by the Canadian Constitution, in which roles and responsibilities are divided between the federal, and provincial and territorial governments. The federal government is also responsible for some delivery of services for certain groups of people. Publicly funded health care is financed with general revenue raised through federal, provincial, and territorial taxation, such as personal and corporate taxes, sales taxes, payroll levies and other revenue. Provinces may also charge a health premium on their residents to help pay for publicly funded health care services, but non-payment of a premium must not limit access to medically necessary health services. Total health expenditure measures annual public and private spending for healthcare goods and services in Canada. The Canadian government contributes 70.4% of this expenditure, according to a 2020 Canadian Institute for Health Information report (Health Canada).

The health IT space is an important and rapidly growing field within the Information Technology and Healthcare sectors in general and remains a priority for Canada as demonstrated by a strong commitment from public and private sectors. Some examples of multinationals making successful and profitable investments in the Canadian Health IT market include Microsoft; Agfa; General Electric (GE); Philips Healthcare; IBM Canada Healthcare; Siemens Canada; and McKesson Canada (“Perspective”). The market size, measured by revenue, of the hospitals industry in Canada is $71.3bn in 2022 and is expected to increase by 2.3% in 2022 (IBIS World)

The target market of healthcare industry consists of doctors, medical personnel, hospital staff, patients and families, communities, and society.

There are a total of 282,888 establishments in this Industry having an average revenue of $352.9 thousand. (“Health care and social assistance”). 94.5% of the total establishments are profitable. The sales in 2021 were $308 billion. The same in 2020 and 2019 were $301.5 billion (*Health Expenditure Data in Brief*) and $265.5 billion respectively (*National Expenditure Health Trends* 5).

The Canadian healthcare industry has encountered many challenges in recent years, due to several factors, including changes in the delivery of services, fiscal constraints, aging of baby boom generation. However, in 2020, with the onset of COVID-19 pandemic, health spending growth spiked at 12.8% due to additional funding to scale up health system capacity, testing, vaccinations, and other responses to the pandemic while measures relating to contain the spread of virus (lockdowns, closure of non-essential businesses) resulted in a 4.6% drop in GDP.

While Canadians aged 65 and older account for about 18% of Canada’s population (up from 14% a decade ago), they continue to consume about 45% of all public-sector health care dollars spent by the provinces and territories. As the population continues to age, decision-makers face the challenge of determining the level of care (hospital, long-term institutional and community care) for older Canadians that balances access to, and quality and appropriateness of care with the cost of care.

Canadian Medical association aims at optimizing health system performance by improving the patients’ experience of health care that includes quality and satisfaction, attaining better value for the money invested in health care, and improving health of populations. Health system innovation can be achieved by embracing health informatics and health information technologies

through meaningful usage of electronic medical records. The establishment of National Health System Innovation fund would help the provinces to adopt innovations in health care including models that support integrated care.

Healthcare is harder than any other industry to secure a foothold in the market. Barriers to entry in health care industry are government permits and unique regulations and laws that include Government's pricing controls on medical technology services and supporting universal health coverage, reputation, resources, more risk aversion which also attributes to impediments in adopting innovation, huge capital requirements.

DATA COLLECTION AND METHODOLOGY

The objective of the research is to determine the relationship between suicide and mental health issues. To ascertain the link between age and gender and suicide incidents in Canada, data from Statistics Canada is used, which is the agency of the Government of Canada commissioned with producing statistics. One of the datasets pertains to the years 2015 and 2019 and contains both numerical and categorical attributes. The data includes 124,763 observations and 18 variables and therefore it is an example of big data. The following variables would be used for analysis: 'Ref_Date' representing the year of data collection, 'Geo' depicting the geographical province, 'Age Group', 'sex' indicating age and gender respectively, 'Indicator' depicting whether the person had suicidal thoughts or positive mental health. The other dataset that deals with the number of deaths broken down by various mental and behavioral disorders would be used to examine which mental health disorders are most likely to cause deaths. The data includes 231,265 observations spanning across 20 years (2000 – 2020). Some of the features used in the analysis

will be: ‘Ref_Date’, ‘Age Group’, ‘sex’, and ‘Cause of death (ICD-10)’ representing the year of data collection, age group of the deceased, gender, and mental/behavioral disorder respectively. Both the datasets are present in the excel file which can be easily imported into any software for analysis.

To determine the early signs of suicide in mental health patients, research papers and journal articles would be used for the purpose of secondary research. According to the Privacy and Ethical Regulations of Canada, any agency is prohibited by law from releasing any information it collects which could identify any person, business, or organization, and various confidentiality rules are applied to health data that are released or published to prevent the publication or disclosure of any information deemed confidential, therefore primary research articles would be used in the analysis. All the data collected to resolve the problem statement is structured which can be processed as required to analyze and solve the given research question.

We would make use of the mixed method that involves both qualitative and quantitative analysis for this project. From the dataset, we would perform an aggregation analysis to determine the state of mental health among various age groups, in terms of gender for the years 2015 and 2019. The pragmatic methodology will be used since both quantitative and qualitative data are required to solve the problem statement. The secondary data collection method is used for conducting the research. Quantitative data will be used to determine the relationship between age, and gender with the occurrences of suicides in Canada. A pragmatic approach i.e., both qualitative and quantitative data will be used to determine patients with which mental disorders are most likely to die and the early signs of suicide in mental health patients.

MAJOR FINDINGS AND DISCUSSION

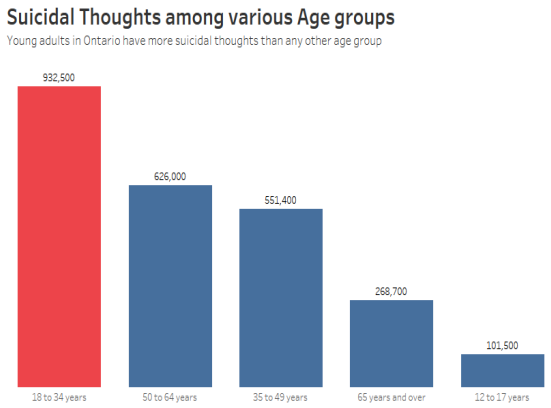

Figure 1: Breakdown of Suicidal thoughts among various age groups in Ontario

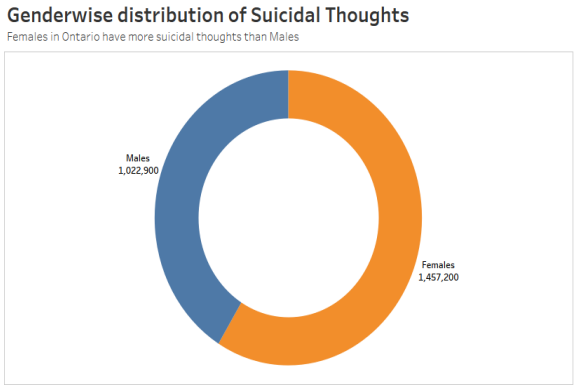

Figure 2: Gender wise distribution of Suicidal thoughts in Ontario

From our explanatory analysis on the dataset that deals with mental health characteristics of people in Canada, we observed that there was significant disparity among different age groups. From Figure 1, we can see that young adults (18 to 34 years old) were the most affected age group that experienced suicidal thoughts in Ontario. In the years 2015 and 2019, the cumulative count of young adults experiencing suicidal thoughts is nearly around 1 million. On the other hand, teenagers (12 to 17 years old) experienced the least number of suicidal thoughts in comparison to other age groups. By conducting further analysis on the dataset, we observed significant difference in suicidal thoughts between males and females. From Figure 2, we found that females were more likely to experience more suicidal thoughts than males in Ontario. For the years 2015 and 2019, around 1.5 million female subjects experienced suicidal thoughts whereas around 1 million male subjects experienced suicidal thoughts. Females in Ontario recorded to have more suicidal thoughts in comparison to males among young adults. In all the age groups, females constituted for more than 50% of suicidal thoughts (Appendix A).

Analysing the dataset that deals with deaths caused by various mental disorders in Canada, we found that around 45,000 of the total deaths were related to Mental and behavioral disorder. From Figure 3, we observed that mental and behavioral disorders accounted for 7.61% of total number of deaths in 2015 and 2019.

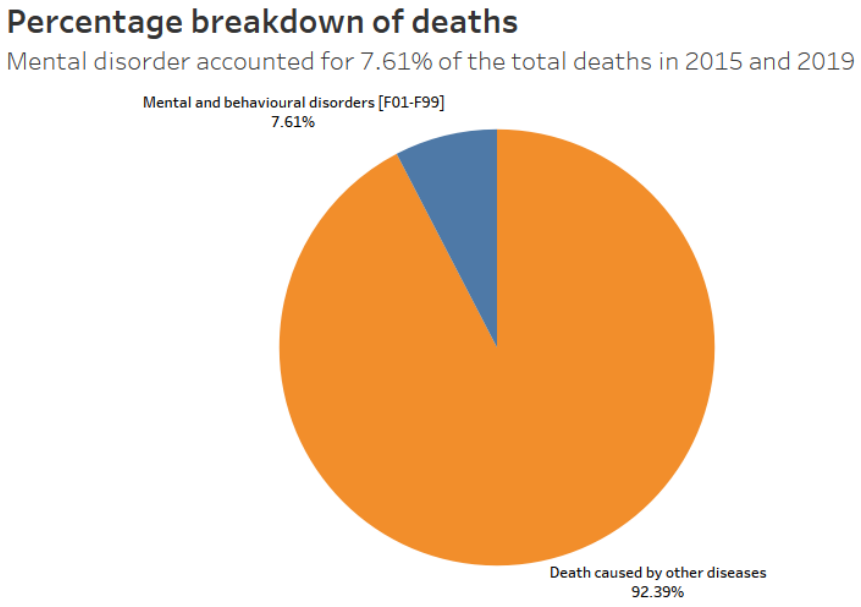

Figure 3: Mental and Behavioural Disorder death share in Canada in 2015 and 2019.

Breakdown of deaths among various mental disorders

Organic mental disorders is the leading cause of death among mental and behavioural disorder in Canada

Cause of death (ICD-10)	
Organic, including symptomatic, mental disorders [F01-F09]	42,051
Mental and behavioural disorders due to psychoactive substance use [F10-F19]	2,185
Mood [affective] disorders [F30-F39]	263
Schizophrenia, schizotypal and delusional disorders [F20-F29]	209
Mental retardation [F70-F79]	97
Behavioural syndromes associated with physiological disturbances and physical factors [F50-F59]	37
Disorders of psychological development [F80-F89]	35
Neurotic, stress-related and somatoform disorders [F40-F48]	24
Disorders of adult personality and behaviour [F60-F69]	14
Behavioural and emotional disorders with onset usually occurring in childhood and adolescence [F90-F98]	0

Table 1:Breakdown of deaths among various Mental and Behavioural disorders

Analysing the breakdown of deaths among various mental and behavioral disorders from the dataset, Organic, including symptomatic, mental disorders had attributed to the greatest number of deaths in Canada. More than 42,000 of the total number of deaths caused by mental disorders were due to Organic mental disorder. Psychoactive substance use is the second leading cause of deaths among mental and behavioral disorders. Among deaths caused by Organic mental disorder, more than 90% of the deceased suffered from unspecified dementia (Appendix B).

	Rate of Disorder within each group.%		
Mental Disorder	Subjects n=2100	Control Subjects n=6300	AOR(95% CI)
Depression	48.5	15.2	3.9(3.37 to 4.52)
Anxiety	19.9	5.9	1.5(1.23 to 1.83)
Substance Use	27.2	6.7	3.5(2.92 to 4.18)
Schizophrenia	6.9	1.2	3.06(2.15 to 4.32)
Dementia	7.7	2	1.3(0.95 to 1.77)

Table 2:Rate of death among various Mental disorders groups

	Time Since Diagnosis (In Days)		
Mental disorder	1 to 90 AOR (95% CI)	91 to 364 AOR (95% CI)	>=365 AOR (95% CI)
Depression	7.33 (4.76 to 11.3)	3.17 (2.35 to 4.28)	2.91 (2.49 to 3.39)
Anxiety	7.18 (2.26 to 22.9)	1.33 (0.67 to 2.65)	1.60 (1.31 to 1.95)
Substance abuse	4.07 (2.43 to 6.82)	2.92 (1.99 to 4.28)	3.15 (2.59 to 3.82)
Schizophrenia	20.9 (2.55 to 172)	6.02 (2.41 to 15.1)	2.52 (1.73 to 3.68)
Dementia	2.17 (1.03 to 4.58)	3.14 (1.66 to 5.94)	1.06 (0.74 to 1.51)

Table 3:Risk of suicide among various mental disorders

Performing qualitative analysis on research based in Manitoba, we observed initial causes of mental disorders and their likelihood of resulting in suicide attempt. The dataset spans from 1996 to 2009 examining the risk related to five major mental disorders namely Depression, Anxiety, Substance abuse, Schizophrenia, Dementia. From Table 2, we see that adjusted odds ratio is the highest for Depression followed by Substance use which indicates out of the five mental disorders, people suffering from depression are more likely to commit suicide. Overall, we see that subjects with mental disorders are at higher risk of committing suicide in the first 90 days after initial diagnosis. From Table 2, we can conclude that the odd of suicide drops as we go beyond 90 days. People with Schizophrenia are more likely to be at the maximum risk of committing suicide.

CONCLUSIONS AND RECOMMENDATIONS

It can be concluded through the analysis that mental health is a topic of great significance which requires immediate attention. Research shows significant interprovincial differences in the prevalence of mental disorders and suicidal thoughts in Canada. A huge number of female young adults living in Ontario have been experiencing suicidal thoughts. The highest number of deaths have been observed in patients suffering from unspecified dementia, an organic mental disorder. The risk of suicide is indirectly proportional to the number of days after diagnosis i.e., the risk of suicide is the greatest from 1 to 90 days of diagnosis and it reduces after the 90-day mark. Studies have shown that people suffering from early signs of depression are more inclined towards committing suicide. Hence, better mental healthcare and its access is essential for people suffering from a mental disorder to reduce the risk of suicide.

Mental healthcare services can be improved in many ways. Firstly, focus should be on specific groups of patients so as to provide help at the right time. Facilities related to mental health should be enhanced in the provinces where the risk of suicide is high. Special attention should be given to patients especially during initial diagnosis of mental illness as they are more vulnerable to committing suicide. Lastly, regular awareness programs should be conducted to promote positive mental health and motivate people to seek professional help.

Further research could be conducted to explore interprovincial differences and their impact on mental healthcare services. Comparing the results of this analysis to more recent administrative data could also be meaningful. A more granular dataset pertaining to a larger timeframe could lead to more valuable insights. A similar approach could be used to analyze the dependence of suicide on psychosocial factors, relationship between repulsiveness and suicide, etc.

IMPLICATIONS FOR BUSINESS ANALYTICS MANAGERS

This research can assist Business Analytics Managers to carry out analysis for identifying the need of specific mental health services for women as they are highly affected by suicidality. Strategies to tackle this issue can be improvised especially for young adults who seem to be particularly susceptible to mental health challenges. A detailed plan can be formulated to prevent unspecified dementia and depression as they are the main causes of death or suicide in patients. Analysis can be conducted to highlight unidentified factors that contribute to suicide. Conducting further study can provide better understanding about the factors influencing mental health and suicidality which can help in identifying vulnerable patients thereby reducing suicide rates.

LIMITATIONS

Though selected dataset is the most recent survey data available on Statistics Canada, it pertains to the year 2015 and 2019 which makes the scope of the analysis limited. Extensive quantitative data was not available due to which research papers were used. The number of studies available was also relatively small, particularly for suicide and some specific mental disorders.

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APPENDICES

Appendix A

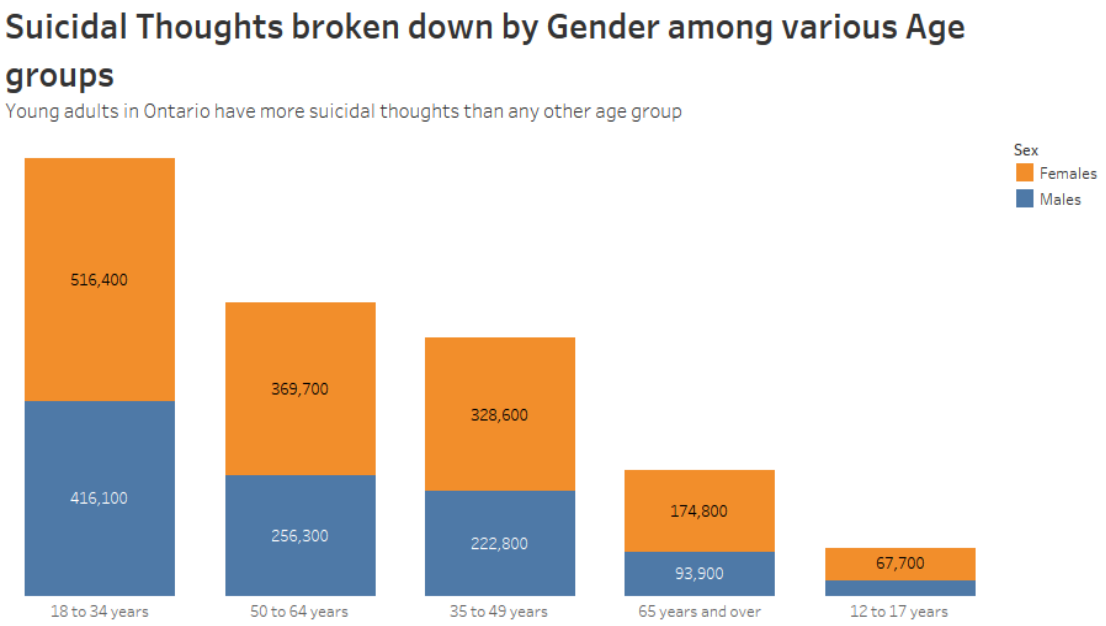

Figure 4: Suicide Thoughts broken down by Gender among various Age Group

Breaking down the suicidal thoughts experienced by subjects by Gender among various age groups in Ontario for 2015 and 2019. It is observed in every age group, females constitute to more than 50% of all the subjects having suicidal thoughts.

Appendix B

Breakdown of deaths caused by organic mental disorder

Unspecified Dementia accounts for the maximum number of deaths among organic mental disorder in Canada

Cause of death (ICD-10)	
Unspecified dementia [F03]	38,067
Vascular dementia [F01]	3,464
Delirium, not induced by alcohol and other psychoactive substances [F05]	421
Other mental disorders due to brain damage and dysfunction and to physical disease [F06]	85
Unspecified organic or symptomatic mental disorder [F09]	11
Personality and behavioural disorders due to brain disease, damage and dysfunction [F07]	3
Organic amnesic syndrome, not induced by alcohol and other psychoactive substances [F04]	0

Table 4: Breakdown of deaths caused by organic mental disorders in Canada

Examining the deaths caused by organic mental disorders for Canadians, we see that people with Unspecified Dementia recorded the maximum number of deaths of around 38000 in 2015 and 2019 followed by Vascular dementia recording only around 3000 deaths.