Final Project

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**Background**

The rise in the number of people in Canada living with dementia should be of major concern to Canadians. According to data from the Landmark Study (Alzheimer Society, 2022), there were over 597,000 people in Canada living with dementia in 2020. The same study is projecting that by the year 2030, this number will increase to 955,900 which is a 60% increase in dementia prevalence. This rise in dementia prevalence is partly fueled by the increasing age of our population. According to Statistics Canada (2023), from 2018 to 2022 the number of Canadians aged 50 or older increased from 14.1 million to 15 million. This number will continue to grow as medical advances and education around lifestyle choices are allowing individuals to live longer. According to the same Landmark Study (Alzheimer Society, 2022), it is estimated that the annual cost of dementia to the Canadian economy is over $10.4 billion.

Dementia is a chronic illness that presents considerable mental, social, and physical burdens to those afflicted with it. Ultimately, many individuals who suffer from dementia will end up dying from it. Since 2000, Alzheimer’s has consistently ranked in the top ten leading causes of death in Canada with over 127,000 Canadians dying from its complications. It is a disease in which the etiology is still not well known and there are very few treatments available to halt its progress. Just recently the FDA granted traditional approval for “Leqembi”, the first Alzheimer’s drug of its kind in over two decades (U.S. Food and Drug Administration, 2023). While this represents a breakthrough, the drug is only beneficial to certain cases of Alzheimer’s. Due to the difficulty of treating dementia, many researchers have been exploring possible ways to prevent dementia. Many risk factors have been explored and empirically shown to increase the risk of developing dementia. The majority of these revolve around living an active and healthy lifestyle.

One preventative measure that is often overlooked is socialization. Staying socially active has been demonstrated to help stave off dementia. Being active socially helps stimulate our brains and reduces the likelihood of depression and social isolation, which are common risk factors for dementia. Research from Sommerlad et al. (2023) found that individuals with greater social participation in midlife and late life have 30-50% lower subsequent dementia risk. One research project (Kim et al., 2020) studied over 600 older adults who were attending community health centres in South Korea. They classified individuals as either high-risk or low-risk for developing dementia. Those who were high risk were those who scored poorly on measures of depression, loneliness, social support, daily activities of living, and life satisfaction. The study found that those in the high-risk group showed smaller social support network size and life satisfaction than their counterparts in the low-risk group. This is in line with a systematic review conducted by Desai et al. (2020), where they found social isolation is more significant for developing dementia than other more well-known risk factors like physical inactivity and hypertension. Social support has also been shown to be a protective factor against dementia (Murata et al., 2019; Khondoker et al., 2017).

As we get older, our social networks can tend to get smaller. People become busy with their personal and professional lives and are unable to dedicate time to socializing. Many Canadians will start families and invest their time with them. They raise children who grow older and move away from home to start their own families. This leaves some older Canadians in a vulnerable situation, as they may have a diminished social network compared to earlier on in their lives. Those who were able to maintain strong social connections might lose them through no fault of their own, such as friends dying or becoming ill. Chronic illness or physical disability also becomes more likely as we get older, and these are known barriers to effective socialization. It can become more difficult to get the required social support with all these potential barriers. Elderly individuals who do not receive adequate social support have a higher risk of developing dementia.

One of the earliest symptoms of dementia is known as Subjective Cognitive Decline (SCD). This is the self-reported experience of worsening or more frequent confusion or memory loss (Centers for Disease Control and Prevention, 2019). Many individuals who report SCD will end up with a diagnosis of dementia further down the line. This makes SCD an important health indicator for early intervention of memory problems. In 2015, the CDC collected data on the prevalence of SCD in the USA across all 50 states (See Appendix A). They found that from their national sample that one in nine (11.1%) of adults over the age of 45 have SCD. However, less than half of these individuals (45.3%) reported discussing their SCD symptoms with a healthcare provider. This means that over 50% of individuals who are experiencing SCD are not seeking help, which can be due to a variety of reasons such as stigma, lack of education, lack of access to services, etc.

Given that SCD is a precursor to dementia in many cases, it is reasonable to believe that some of the risk factors associated with developing dementia may also apply to the development of SCD. If this is the case, then individuals who self-report SCD could be considered targets for early intervention for dementia prevention. Of these risk factors, we are most interested in the perceived level of social support and social isolation as they are often not considered as important as other risk factors such as lifestyle choices.

Our research questions in this study are:

1. Is self-reported SCD associated with perceived social support while controlling for education and sex?
2. Is self-reported SCD associated with several individuals living in the household?

We hypothesize that individuals who perceive less social support will be more likely to self-report SCD. We also hypothesize that individuals living alone will be more likely to self-report SCD. We will be including control variables in our models for education level and sex. Research from Langa et al. (2017) found that dementia prevalence in a cohort of 21,000 US adults in 2000 and 2012 fell, and this drop was associated with higher education levels. There is evidence that those with higher education levels build a “cognitive reserve” (Stern, 2013) that can help reduce the risk of developing dementia. We will be controlling for sex differences as research from Murata et al. (2019) found that social support was only protective among men with dementia and not for women.

**Data Selection**

As the focus of this research paper is addressing SCD in Canada, we began by searching for open-access data that collected information on SCD and social support in Canadians. However, we were unable to find anything aside from Alzheimer’s dementia prevalence, incidence, and mortality data from Statistics Canada. We decided to look to the US as they have much more comprehensive open-access data portals and Americans share a lot of similarities with Canadians.

We found the Behaviour Risk Factor Surveillance System (BRFSS). The BRFSS is an annual survey in the US that looks at behavioural risk factors. It began in 1984 and utilizes a Computer Assisted Telephone Interview (CATI) system to administer health surveys across the country. They include both landline and cellphone respondent data in their annual dataset. There is a core module each year where all the questions are the same, but individual states have the option to administer additional survey modules based on their health interests. These modules may consist of only a few questions on particular health behaviours or many. Once the data has been collected and cleaned, it is posted on the CDC website and available for anyone.

We chose the BRFSS as they are the only open-access data source that administered survey items related to SCD and social support. The optional state modules “Cognitive Decline” and “Emotional Support and Life Satisfaction” ask respondents questions about their memory state and one question on their perceived level of social and emotional support. However, since these are optional modules, they are not always administered by each state each year. We decided then to focus on state data in 2015 from Minnesota and Rhode Island, as this is one of the only times where a state administered the cognitive decline and emotional support modules.

**Methodology**

For our analysis, we focused on the following items within these modules:

|  |  |
| --- | --- |
| **Survey Item** | **Responses** |
| **CIMEMLOS** –  *“During the past 12 months, have you experienced confusion or memory loss that is happening more often or is*  *getting worse?”* | 1. No 2. Yes |
| **EMTSUPRT**–  *“How often do you get the social and emotional support you need?”* | 1. Always 2. Usually 3. Sometimes 4. Rarely 5. Never |
| **SEX** | 1. Male 2. Female |
| **EDUCATION** | 1. Did not graduate High School 2. Graduated High School 3. Attended College or Technical School 4. Graduated from College or Technical School |
| **NUMADULT** –  “*Number of adults in Household (18+ years of age)”* | 1. Live alone (1) 2. Two or more (2+) |
| **CHILDREN** – “How many children less than 18 years of age live in your household?” | 1. One or more (1+) 2. None |

Table 1. Survey items utilized from BRFSS 2015.

We performed data cleaning to remove missing data and recoded some response options to help simplify our categories in relation to our research questions. This resulted in a sample size of 8,963 respondents. Of these 8,963 respondents, we found 896 (10%) indicated worsening confusion or memory loss in the last 12 months (i.e., SCD in the past 12 months). This is representatively close to the national prevalence in 2015.

A graph with blue squares

Description automatically generated *Figure 1. Presence of SCD in BRFSS respondents in Minnesota and Rhode Island in 2015.*

We conducted two multivariate logistic regression models to explore the relationship between SCD, social support, and social isolation. All our variables in this model were categorical and therefore had to be transformed into dummy variables to run the analysis. CIMEMLOS was our response variable in both models, with the answer “No” serving as our reference category. The first level of each of our predictor variables served as the reference category. Model 1 explored CIMEMLOS and EMTSUPRT while controlling for education and sex. Model 2 explored CIMEMLOS, NUMADULT, and CHILDREN, while also controlling for education and sex.

**Results**

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Dependent variable: | |
|  | |  | |
|  | | CIMEMLOS | |
|  | MODEL 1 | | MODEL 2 |
|  | | | |
| EDUCATION2 | -0.503\*\*\* (0.147) | | -0.562\*\*\* (0.143) |
| EDUCATION3 | -0.527\*\*\* (0.147) | | -0.580\*\*\* (0.143) |
| EDUCATION4 | -0.601\*\*\* (0.145) | | -0.641\*\*\* (0.140) |
| EMTSUPRT2 | 0.621\*\*\* (0.086) | | . |
| EMTSUPRT3 | 1.229\*\*\* (0.103) | | . |
| EMTSUPRT4 | 1.582\*\*\* (0.162) | | . |
| EMTSUPRT5 | 0.998\*\*\* (0.160) | | . |
| SEX2 | -0.096 (0.074) | | -0.147\*\* (0.073) |
| NUMADULT2 | . | | -0.500\*\*\* (0.073) |
| CHILDREN1 | . | | -0.200 (0.127) |
| Constant | -2.096\*\*\* (0.147) | | -1.259\*\*\* (0.137) |
|  | | | |
| Observations | 8,963 | | 8,963 |
| Log Likelihood | -2,796.876 | | -2,870.974 |
| Akaike Inf. Crit. | 5,611.752 | | 5,755.948 |
|  | | | |
| Note: | | \*p\*\*p\*\*\*p<0.01 | |

Table 2. Regression Results Output.

Our first logistic regression model yielded statistically significant results for both level of education and perceived emotional and social support. For Education, all the coefficients are negative and significant (β = -0.503, -0.527, and -0.601, p<0.001) which suggests that higher educations levels are associated with lower log odds of having SCD compared to those in the reference group (did not graduate high school). According to our model, individuals who have graduated college or technical school are 35% less likely to self-report SCD than those who did not graduate high school. This is consistent with the literature on cognitive reserves preventing dementia. For Emotional and Social Support, all the coefficients are significant (β = 0.621, 1.229,1.582 and 0.998, p<0.001) which suggests that lesser perceived emotional and social support is associated with higher log odds of reporting SCD compared to those in the reference group (always have emotional and social support). According to our model, individuals who “Never” get the emotional and social support they need are 73% more likely to self-report SCD than those who “Always” get this support. Sex was an insignificant predictor of self-reported SCD. We conducted a chi-square likelihood ratio test using a reduced model that removed our control demographic variables from the model but found that the full model was a better fit (df = 5, χ2(1) =17.63, p=0.001643).

Our second logistic regression model yielded statistically significant results for the level of education, adults in the household, and sex. The effect of education when removing emotional and social support from this model was slightly increased (β = -0.562, -0.580, and -0.641, p<0.001). The coefficient for the number of adults living in a household was negative and significant (β = -0.500, p<0.001), which suggests that adults who live with other adults have lower log odds of reporting SCD compared to those who live alone. According to our model, adults who live with other adults are 38% less likely to self-report SCD than adults who live alone. The coefficient for sex was negative and significant, albeit at a lower threshold than our other predictors (β = -0147, p<0.05), which suggests that women are less likely to self-report SCD when controlling for a number of adults and children living in a household. According to our model, women are 46% less likely than men to self-report SCD. The number of children living in the household was not a significant predictor of self-reported SCD. We conducted a chi-square likelihood ratio test using a reduced model that removed our control demographic variables from the model but found that the full model was a better fit (df = 3, χ2(1) = 23.207, p=0.0001151).

We assessed the goodness of fit of our model using two Pseudo R2 measures, the McFadden R-Squared, and the Cox-Snell R-Squared. Our first model had a McFadden R-Squared of 0.04 (4%) and a Cox-Snell R-Squared of 0.03 (3%). Our second model had a McFadden R-Squared of 0.014(1.4%) and a Cox-Snell R-Squared of 0.01(1%). We also created two effect plots to help demonstrate the relationship between emotional support and the number of adults living in a household with self-reported SCD.

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Figure 2. Effect plot of emotional and social support on self-reported SCD.

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Figure 3. Effect plot of living alone versus living with other adults on SCD.

**Discussion**

According to our 2015 Minnesota and Rhode Island BRFSS dataset, there appears to be a significant relationship between social support, social isolation and the likelihood of self reporting SCD. Those individuals who are less socially supported and more isolated are more likely to report SCD. This is consistent with the findings in the literature as these are major risk factors with dementia. This presents an opportunity for public health programs to design interventions to actively address social support and social isolation amongst older citizens. Home care is becoming more common as health care systems become overburdened. If we consider the implications that socialization has not only with SCD and dementia, but other health indicators as well, it makes it easier to see that there should be more public interventions targeting those in our community who are socially isolated. As of right now, we currently do not believe that this is something that governments are actively following within North America. The BRFSS Cognitive Decline and Emotional Support modules are used sparingly each year. 2015 was the last year we were able to find both used by individual states, which is concerning considering how closely linked cognitive health and socialization are. In Canada, this information is not being captured so we do not know how severe the problem is. Public health surveillance programs should begin mandatory data collection on SCD and social isolation considering the increasing incidence and prevalence of dementia. However, it is difficult to draw conclusions from this dataset as it may be only significant in the states from which the data is drawn. The dataset is also from 2015, so things could be significantly different in those states. It is difficult to draw current conclusions as these optional modules are not often completed together, and the emotional and social support module has been scarcely used, which leads us to believe it is not heavily prioritized. Our Pseudo R2 values for both models were quite low, indicating that much of the variance was unaccounted for. This was to be expected however, as there are an incredible number of factors that contribute to SCD outside of socialization. Our model likely suffers from omitted variable bias and could use more predictors to improve its fit. Also, we hypothesized that less perceived social support would result in higher rates of self-reported SCD. This was true, however, there was a drop off between the level of “Rarely” and “Never”. This suggests that those who perceive that they rarely are socially supported are more likely to report SCD than those who perceive that they never receive social support. There is an unexplained phenomenon here that runs counter to our hypothesis, but nonetheless still indicates that less perceived support is associated with higher self-reported SCD.

Ultimately, we recommend that governments begin collecting data on social isolation, social support, and cognitive decline more actively in order to be able to better assess these conditions. This data will allow them to effectively demonstrate whether to fund interventions for social isolation and loneliness. In North America, we have more older individuals than ever before, and this number will continue to grow. While there are promising treatments and more education on dementia, it will remain a persistent problem over the next few decades if there is no cure developed. This represents trillions of dollars of lost economic burden and major increases in Disability-Adjusted Life Years. Further research is required on the associations between social support, social isolation, and SCD.

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**Appendix A**

A map of the united states with blue and white colors

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Figure 4. Centers for Disease Control. (2018). Subjective Cognitive Decline - A Public Health Issue.

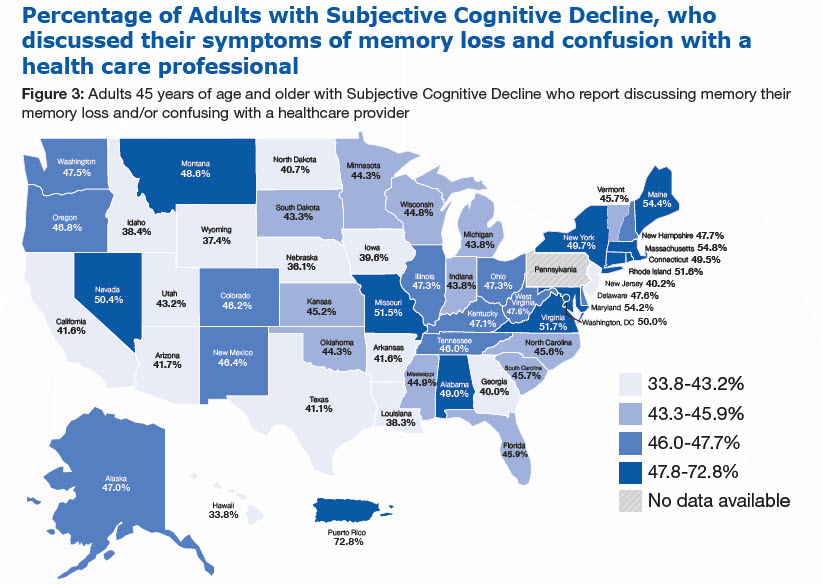
**Appendix B**

Figure 5. Centers for Disease Control. (2018). Subjective Cognitive Decline - A Public Health Issue.