Future Trends and the Economic Burden of Dementia in Manitoba: Comparison with the Rest of Canada and the World

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Keywords

Dementia · Manitoba · Canada · Statistics · Gender · Age · Healthcare costs

Abstract

Dementia is a growing public health concern in Canada. This epidemic is linked to huge human and economic costs. The number of Manitobans (65+) with dementia in 2045 (47,021), representing 2.58% of the Manitoban population, will be 2.3 times that of the year 2015 (20,235). The number of cases of dementia in Manitoba grew by 20.7% from 2015 to 2025, 68.16% from 2015 to 2035 and at an alarming rate of 125% from 2015 to 2045. Importantly, the total economic burden of dementia in Manitoba is close to one billion USD and is expected to grow more than 28 billion USD during the year 2038. The focus of this review is to compare dementia rates and the financial burden of dementia in Manitoba with the rest of Canada and the world from 2012 to 2048.

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Introduction

In general, dementias are progressive, irreversible, neurodegenerative disorders that typically begin with a minor loss of intellectual functioning and sometimes progress to severe cognitive impairment. Eventually dementia patients become completely dependent on other people for personal care [1]. Dementia is actually an umbrella term, and several forms exist such as Alzheimer's disease [2], vascular dementia [3, 4], frontotemporal dementia [5], Lewy body dementia [6], dementia associated with Parkinson's disease, and mixed dementia [7]. Current studies are investigating whether each form of dementia has its own cause or results from multiple causes. Dementia affects not only the patient but also has a profound effect on relatives, caregivers, and the society as a whole. Overall, dementia is a costly disease in terms of both economic loss and personal suffering. There is currently no cure for Alzheimer's dementia. However,

Table 1. Dementia statistics at a glance

	2015 count	Future count
Manitoba	20,760 as of 2015 by Alzheimer Society report [97] 21,900 as of 2015 by our MBS report [26]	34,097 by 2038 [97] 40,700 by 2038 – MBS report [26]
Canada	747,129 as of 2011 [97]	1.4 million by 2031 [97]
World-wide	47.5 million as of 2015 [98]	75.6 million by 2030 [98] 135.5 million by 2050 [98]

some pharmacological therapies can improve some symptoms of dementia and/or slow the progression of the disease in some individuals [8, 9]. It is believed that the efficacy of treatment could be optimized if interventions were initiated in the early or prodromal stage of the disease.

Dementia Worldwide

A study by Alzheimer's Disease International (ADI, www.alz.co.uk) has reported the following estimated percentages of people living with dementia, as of 2015, by geographic region: North America (6.4%), Western Europe (5.4%), Latin America (4.6%), Australia and New Zealand (4.3%), Eastern Europe (3.9%), North Africa (3.6%), Middle East (3.6%), Indonesia, Thailand, Sri Lanka (2.7%), India and South Asia (1.9%) [10]. Therefore, global estimates predict 47.5 million world-wide are living with dementia, which is more than the population of Canada. This number is expected to rise considerably in the years ahead, reaching 135 million by 2050 [11] (Table 1). Available epidemiological studies also estimated the annual diagnosis of new dementia cases to be greater than 7.7 million people. This suggests that one new dementia case is identified globally almost every 4 s [12]. Moreover, the number of individuals living with dementia is projected to double by 2030 and subsequently triple by 2050 [10, 13]. Although there is a similar pattern in increases in diagnosed dementia cases around the world, the rate of increase region-by-region does vary [14]. For example, in 2040, it is estimated that the rate of dementia cases is expected to rise by 100% in developed countries; however, in Southern Asia, China, India, and Western Pacific neighbors, rates are expected to increase by 300–400% during this period [10]. The significant increased prevalence of dementia must be taken seriously

as a worldwide health problem. Any future action plans will need to consider how the prevalence of dementia will change worldwide.

Dementia in Canada

The Canadian Study of Health and Aging (CSHA) proposed that dementia prevalence is different across various regions in Canada [15, 16]. However, in Ontario, the low prevalence of dementia in men appeared to be due to differences in the use of diagnostic methods [15]. Variances in socio-economic conditions, such as low educational attainment as well as lower income, also likely contribute to higher dementia rates in some regions as compared to others [17, 18]. The Alzheimer Society of Canada (www.alzheimer.ca) compared 4 reports that provided estimates of present and future prevalence of dementia in Canada: The National Population Health Study of Neurological Conditions, 2014 (NPHSNC); the CSHA, 1994; the Alzheimer Society of Canada, 2010 (Rising Tide); and the Mental Health Commission of Canada, 2011 (MHCC; Table 2). It is important to note that different reporting sources used various estimation methods on the prevalence of dementia [19]. In addition, variations among studies were related to the definition of dementia adopted, testing instruments used to measure dementia status, population surveys versus administrative databases, and the range of ages. For example, the CSHA estimated a higher prevalence of dementia as compared to NPHSNC, where the reason appeared to be based on inclusion of health administrative data. The CSHA and Rising Tide studies included individuals who do not have access to the healthcare system, whereas the NPHSNC and MHCC excluded such people [19]. In the MHCC report, mild cognitive impairment (MCI) individuals were counted together with dementia cases. However, some estimates stated that 39–60% of individuals with MCI will progress to dementia [20–23]. In other reports where

Table 2. Estimated dementia prevalence in Canada from 4 sources

Sources of report and age of individuals with dementia	Year 2011	Year 2021	Year 2031
NPHSNC [99] (≥40 years old)	340,170	461,651	673,991
CSHA [15] (≥65 years old)	480,000	600,000	780,000
Rising Tide [100] (all ages)	521,280	687,552	923,763
MHCC [44] (≥65 years old)	747,129	1,024,465	1,435,923

MCI and dementia are included together, the estimation would be approximately 50% more than if dementia alone was included in the estimate. The MHCC, unlike the other 3 reports, included the highest estimates of dementia prevalence [24]. This is likely because it included MCI in their estimations. Unlike the Riding Tide study, which included estimation of dementia prevalence for all ages, the NPHSNC, CSHA, and MHCC studies presented estimation of dementia in a limited range of ages. In comparison to the other 3 reports, CSHA appeared to be the best population-based data source to use as a basis to build estimates given the age categories included [19]. In 2016, CSHA estimated there are 564,000 individuals living with dementia in Canada. By 2033, it is estimated that the dementia prevalence will increase significantly to 986,000 in Canada. Table 3 shows the number of individuals with dementia in Canada for the years 2014 and 2033.

Dementia in Manitoba

According to the CSHA study, the number of Manitobans affected by Alzheimer's disease and other forms of dementia is rising sharply, especially for those aged 65 and above. In 2011, according to the Alzheimer Society of Canada, 20,760 Manitobans were affected with Dementia. This number is growing at an alarming rate and is expected to rise to 40,700 by 2038 – a 60% increase [25, 26]. The overall number of cases of dementia in Manitoba is expected to grow by 20.7% from the 2015 to 2025, 68.16% from 2015 to 2035, and 125% from 2015 to 2045 (Fig. 1). However, it should also be noted that these age groups are increasing in number as well. Nevertheless, Manitoba's healthcare systems need to be prepared, both from social and economic perspectives. In the near future, increases in dementia cases will also have a critical impact on caregivers and supportive services, which will be challenging to deal with.

With regard to any racial-ethnic disparities in dementia across Manitoba, almost nothing has been published. How-

Table 3. Estimated prevalence of dementia by Alzheimer Society of Canada from 2014 to 2033

Year	Prevalence
2014	514,000
2015	539,000
2016	564,000
2017	587,000
2018	614,000
2019	638,000
2020	663,000
2021	688,000
2022	713,000
2023	738,000
2024	763,000
2025	788,000
2026	813,000
2027	838,000
2028	863,000
2029	887,000
2030	912,000
2031	937,000
2032	962,000
2033	987,000

ever, approximately 14% of the total Indigenous population in Canada lives in Manitoba. In fact, Statistics Canada (www.statcan.gc.ca) 2016 census states there are 223,310 Indigenous people in Manitoba out of 1,673,780 across Canada [27]. Winnipeg actually has the largest Indigenous population as compared to other Canadian cities. According to Diabetes Canada (www.diabetes.ca), Aboriginals are at higher risk of contracting type 2 diabetes [28, 29]. In particular, studies show that modifiable risk factors such as diabetes are strongly correlated with increased AD risk [30]. Indigenous peoples in Canada have a higher prevalence of modifiable risk factors as compared to non-Indigenous subpopulations [30]. However, these differences are seen more in Indigenous people who live on reserves. Therefore, it is highly likely that Indigenous people in Manitoba are at greater risk for dementia than other subpopulations.

Fig. 1. Projection of dementia statistics of Manitoba (45+) gender-wise in both sexes.

Caregivers and Dementia

It is likely that the rising numbers of elderly individuals with dementia will place greater demands on caregiving systems [31]. Two types of care systems (formal and informal) are available for most individuals with dementia. Formal care is provided by organizations with paid/volunteer workers. Informal care is delivered by family, friends, or neighbors. According to Statistics Canada, approximately 85% of patients with dementia are cared for, at least in part, at home by family members – mostly spouses or by adult children [32]. Approximately 75% of caregivers were female, 23% of caregivers were the person's wife, 12% were the husband, 37% were an adult child (28% daughters, 9% sons), and 23% were friends and/or relatives [33–36]. Almost 43% of patients with dementia received at least some type of formal care. Approximately 15% of patients with dementia did not receive any care (formal or informal) based on their financial situation and availability of caregivers [36]. According to the Alzheimer Society of Canada, in 2011, informal caregivers spent over 444 million unpaid hours of caring for their family member(s) with dementia [37]. This represents 11 billion dollars in lost income. By 2040, this

number is expected to increase by 1.2 billion unpaid hours per year [19]. Therefore, dementias have an enormous impact on individuals with the disease as well as their families.

In 2015, the Winnipeg Regional Health Authority Home Care System reported over 20,000 individuals with dementia accessed the home care service [38]. Among these individuals, 76% of them were ≥ 65 and 61% ≥ 75 years old [38]. The proportion of Manitoba seniors is increasing sharply and the increasing age of the population in the next few decades is associated with increased need for formal care support. Overall, the number of caregivers is crucial not only to care recipients but also to the health-care system and the economy.

Economic Impact of Dementia

Dementias are a serious global health challenge and also an economic challenge for all governments [39]. According to the World Health Organization (WHO, www.who.int) and the World Alzheimer Reports from Alzheimer's Disease International, the total global cost associated with treating and supporting individuals with

Table 4. Dementia costs at a glance in USD

	2011	Future dollars on an annual basis (adjusted for inflation)
Manitoba	USD 1 billion [48]	USD 28 billion by 2038 [48]
Canada	USD 33 billion [101]	USD 293 billion by 2040 [101]
World-wide	USD 604 billion [40, 42]	–

dementia was more than 1% of the world gross domestic product (GDP) or 604 and 818 billion USD in 2010 and 2015 respectively (Table 4) [40, 41]. This estimate contains the cost of providing health and social care and also includes the reduction or loss of income in individuals with dementia and their caregivers [39]. The majority of costs are incurred in high-income countries (1.4% of GDP) compared to low and middle-income countries (0.2%) [42]. In Canada, the combined direct costs (medical) and indirect costs (lost earnings) are 33 billion USD annually, which will increase significantly to 293 billion USD annually by 2040 (Table 4) [19, 43]. Direct health expenses related to dementia can accrue within the formal health care system (i.e., cost of prescription medication, long-term care staff costs, support staff costs, long-term care administrative costs, physician and hospital costs) or outside the formal health care system (cost of over-the-counter medications, long-term care accommodation and out-of-pocket expenses) [25]. Indirect costs have no direct connection to dementia but are a result of it. The indirect costs consist of the loss in wages resulting from disability associated with dementia and/or in corporate profits that result from the reduction in labor productivity for both the individuals with dementia who are working at the time of symptom onset and providers of informal care.

The public system only presents a portion of the total monetary costs of dementia. In order to obtain an accurate measure of costs, indirect costs (informal caregiving) should be counted in addition to direct costs. Different population-based studies utilized different types of costs, methods, and data sources in the way they attributed costs to dementia. Therefore, estimated costs of dementia from different reports are varied. In predicting the costs involved in caring for individuals with dementia, the MHCC and Rising Tide studies include direct costs in their analyses, while the Economic Burden of Illness in Canada and CSHA studies include indirect/informal costs in their analyses [15, 43–46]. Unlike other reports, the Population Health Study of Neurological Conditions

(PHSNC) is the only available study that includes direct, indirect, and intangible costs [47]. Analysis by the NPHSN, showed that total health care system costs and out-of-pocket costs of caring for individuals with dementia were USD 10.4 billion in 2016, and are expected to rise by 2031 [47].

In Manitoba alone, the total economic burden of dementia (direct health costs, unpaid caregiver costs, and indirect costs) is close to 1 billion dollars, and this amount is expected to grow to more than 28 billion by 2038 [25, 26, 48]. This number is the total annual economic burden of dementia in Manitoba that is the sum of direct health costs, and opportunity costs (foregone wages) of unpaid informal caregivers and indirect costs. Due to these rising costs and the expected increase in number of dementia cases in Manitoba, it will be very challenging to provide proper healthcare and social services. Table 4 compares the global estimation of monetary costs of dementia with Canada and Manitoba.

Risk Factors and Dementia

Our current knowledge on dementia, mainly the AD type, shows that dementias are multifactorial disorders, in which various risk factors are involved [16, 49, 50]. The question of how risk factors affect dementia onset and disease progression needs further investigation. Within North America, as elsewhere, aging is the greatest risk factor for the prevalence of dementia [10, 51]. The risk of dementia is expected to double every 5 years after the age of 65 [52–54]. Currently, “baby boomers” across North America have reached 51–70 years of age. According to Health Canada, the senior population in Canada is projected to increase from 3.92 million in 2001 to 9.2 million by 2041 [55]. It was reported at the 2015 Alzheimer’s Association International Conference that over 28 million “baby boomers” will develop dementia between 2015 and 2050 [56]. Table 5 shows the prevalence of dementia in Canada categorized by age (65–74, 75–84,

Table 5. Projection of dementia statistics of Canada age-wise in both sexes

Year	Canada cases of dementia: both sexes			total cases
	ages			
	65–74 years	75–84 years	85+ years	
2014	74,428	189,126	220,399	483,953
2033	114,940	390,246	481,768	986,954

and 85+ years old). The overall number of cases of dementia across Canada will grow by 103.93% from 2014 to 2033 (19 years). The largest increase occurs in those aged 85 and older with a growth of 118.58% by the year 2033, while the 75–84 age group is projected to have a 106.34% increase and the 65–74 age group a 54.41% increase.

Since age is a major factor for the onset of dementia, as the proportion of seniors in Manitoba likewise in Canada increases, the rate of dementia is expected to rise. The number of Manitobans (65+) with dementia in the year 2015 (20,235) is expected to increase 2.3 times when compared to year 2045 (47,021). Information in Table 6 shows the Manitoba population projection data categorized by age for 2015–2045. The overall number of cases of dementia in Manitoba will grow by 20.7% from 2015 to 2025, 68.16% from 2015 to 2035, and 125% from 2015 to 2045. The largest increase occurs in the 75–84 years old category with an increase of 98.83% by the year 2035, while the 85+ age group shows a 61.36% increase. Given these dramatic shifts within the elderly population in Manitoba, expected increases in dementia rates will create additional pressure on Manitoba's healthcare system and society as a whole.

Gender and Dementia

Generally, dementia occurs more often in women than men, especially at older ages [52]. According to a 2014 report by the Alzheimer Society of Canada, approximately 3.2 million or two-thirds of Canadian seniors living with AD are women [37]. Since aging is a key risk factor for dementia, it has been suggested that more women are affected by dementia as compared with men, as women tend to outlive men [14]. However, this notion is controversial and more sex- and gender-based research is needed to address this statistic. For example, rapid decreases in sex hormones at menopause increase the risk of dementia in elderly women [57]. Another risk factor is a

Table 6. Projection of dementia statistics of Manitoba age-wise in both sexes

Age	Year 2015	Year 2025	Year 2035	Year 2045
45–64	1,638	1,702	1,830	2,144
65–74	2,449	3,418	3,778	3,751
75–84	6,597	9,155	13,116	14,726
85+	11,190	12,126	18,057	28,544
Total	21,874	26,401	36,782	49,166

genetic linkage to the APOE gene. Several studies reported a positive correlation between the presence of one or more APOE-e4 alleles and neuritic plaques in AD [58, 59]. Furthermore, research has shown that females carrying a copy of the APOE-e4 gene possess a 7–10% greater risk of developing Alzheimer's as compared with men [60, 61]. Unlike AD, LBD, VaD, and PDD are more likely to affect men than women [62–64]. Although some dementias are more common as well as more severe in women, the mechanisms associated with gender differences are not well understood.

The Alzheimer Society of Canada estimated that the prevalence of dementia in females is higher than males with a ratio of approximately 65% in 2014 that decreases slowly over the years to 61% in 2033. The estimated proportion of men with dementia in Canada is expected to increase from 35% in 2014 to 39% in 2033 (Table 7).

Figures 2 and 3 provide information about the prevalence rates that are applied to the Manitoba population projection data 2012–2048, age-wise and sex-wise. The number of new cases of dementia is increasing over time. The proportion of women diagnosed with dementia, who are over the age of 85, is expected to increase from 40.95% in 2015 to 41.25% in 2045; there is no perceptible change over the 30 year period. The prevalence of dementia is higher in females than in males with a ratio of approximately 1.96% in 2015 that decreases slowly over the years to 1.66% in 2025, 1.51% in 2035 and 1.44% in 2045. What is responsible for the increasing rates in men and decreasing rates in women is not clear, but one possibility is that men are expected to live longer, given improvements in health care and decreases in other age-related chronic illnesses.

Indigenous People and Dementia

According to Statistics Canada, the population of Indigenous peoples in Canada from 2006 to 2011 increased 20.1% compared with 5.2% [65] for non-Indig-

Fig. 2. Projection of dementia statistics of Manitoba (45+) gender-wise in males.

Table 7. Projection of dementia statistics of Canada (65+) gender-wise in both sexes

Year	Ages			Total cases
	65–74 years	75–84 years	85+ years	
<i>Canada cases of dementia: females</i>				
2014	45,618	110,304	179,453	335,357
2033	69,549	217,523	316,686	603,758
<i>Canada cases of dementia: males</i>				
2014	28,810	78,822	70,946	178,578
2033	45,391	172,723	165,082	383,196

enous Canadians. In 2016, 1.6 million or 4.9% of the total Canadian population identified as Indigenous people [65]. Approximately, 6% of the total Indigenous population was 65 years and older. This percentage is almost half of the non-Indigenous senior population (14.2%). Table 8 shows the number and distribution of Indigenous people in all provinces and territories in Canada (2011). Approximately 14% of the total Indigenous populations in Canada live in Manitoba (Table 8) [65]. Particularly, Winnipeg has the largest Indigenous

population who live mostly off reserves with a population of 25,970 compared to Edmonton and Vancouver with a population of 18,210 and 15,080 respectively [65].

Since dementia is a growing public health concern, it important to examine potential differences in the experience of dementia within Indigenous communities. According to most Indigenous peoples of Canada, dementia is not considered a health problem; rather Indigenous people tend to consider dementia as non-

Fig. 3. Projection of dementia statistics of Manitoba (45+) gender-wise in females.

Table 8. Distribution of the Indigenous population in all provinces and territories of Canada in 2011 [65]

Provinces and territories	Indigenous population	Indigenous population as percentage of the total population	Percentage of distribution
Newfoundland and Labrador	35,800	7.1	2.6
Prince Edward Island	2,230	1.6	0.2
Nova Scotia	33,845	3.7	2.4
New Brunswick	22,615	3.1	1.6
Quebec	141,915	1.8	10.1
Ontario	301,425	2.4	21.5
Manitoba	195,900	16.7	14.0
Saskatchewan	157,740	15.6	11.3
Alberta	220,695	6.2	15.8
British Columbia	232,290	5.4	16.6
Yukon	7,705	23.1	0.6
Northwest Territories	21,160	51.9	1.5
Nunavut	27,360	86.3	2.0
Canada	1,400,685	4.3	100.0

pathological brain aging [66, 67]. The prevalence of dementia in the Indigenous population in Canada has not been well defined. One study found that dementia is more prevalent among Indigenous peoples in Alberta as compared to non-Indigenous individuals [68]. Re-

cent studies show that modifiable risk factors (e.g., hypertension, physical inactivity, diabetes, obesity, and smoking) are strongly related with increased AD risk. It is known that indigenous peoples in Canada have higher prevalence of modifiable risk factors compared

to their non-Indigenous counterparts [30]. These differences are more in Indigenous people who live on reserve. It is likely that environmental, socioeconomic, and sociocultural factors are associated with the increased rate of AD among Indigenous peoples in Canada [30].

Overall, available information about the prevalence and incidence of all types of dementia among Indigenous population of Canada is very minimal. This lack of information is anticipated to be a critical challenge for federal and provincial healthcare systems as they strive to provide services to the population [68]. By expanding our knowledge on the impact of dementia on Indigenous people and communities, one could advocate for greater resources for culturally suitable strategies to reduce risk factors for dementia, as well as to assist communities in providing care for individuals affected by these diseases.

Type-2 Diabetes and Dementia

Type-2 diabetes is a metabolic disorder where the ability to produce or to respond to the hormone insulin is impaired. As a result, there are high blood sugar levels over a prolonged period, which leads to pathology [69]. According to the Canadian Diabetes Association, in 2016, 29% of Canadian's had type-2 diabetes and this number is expected to rise by 33% in 2026 [70]. Moreover, in Manitoba approximately 94,000 people are living with type-2 diabetes and this number is projected to increase to 139,000 by 2020 [71]. Type-2 diabetes is one of the important modifiable risk factors for dementia [72, 73]. Research suggests that the rate of cognitive decline is accelerated in aged people with dementia and type-2 diabetes [74, 75]. Interestingly, it has been shown that accumulation of A β plaques interferes with insulin receptors in the AD brain and causes brain cells to become unresponsive to insulin [76–78]. Several factors that may be involved in the linkage between diabetes and dementia include brain white matter structural changes, hyperinsulinaemia, glycemic index changes, increased rate of stroke, metabolic syndrome, cross-association of type-2 diabetes and obesity, and genetic factors such as APOE-e4 [79–83]. To date, the linkage between type-2 diabetes and dementia is not well-understood [69, 84, 85]. Early studies indicated a low rate of type-2 diabetes in AD patients [86, 87]; however, more recent studies have reported evidence that show that type-2 diabetes increased the risk of develop-

ing dementia [74, 81, 83, 88–95]. These differences may be related to the definition of dementia, the stage of dementia, the age range of individuals, and/or the method used to measure dementia status [95]. It is estimated that the rate of elderly people with diabetes is predicted to increase significantly over the next few decades [96]. Therefore, more studies will be required to acquire a better understanding of risk factors, mediators, and/or mechanisms that link dementia and type-2 diabetes.

Conclusions and Recommendations

The number of Manitobans living and affected by dementia has dramatically increased, especially for those aged 65 and above. The largest increase is projected to occur in the 75–84 years of age group with a growth of 98.83% by the year 2035, while for ages 85+ a 61.36% increase is estimated.

The prevalence of 85+ men identified with dementia is also expected to rise from 31.4% in 2015 to 79% in 2045, which is a shift from past statistics. The prevalence of dementia in women (85+) is expected to rise from 40.95% in 2015 to 41.25% in 2045, which is not a remarkable change over the long period.

These results strongly suggest that Manitobans must urge their government and other key stakeholders to take action now and confront the challenge of controlling the dementia epidemic. The future projections presented here need immediate attention. It is strongly recommended that national and provincial strategies be created and acted upon. Action items would include increased dementia awareness, promotion of preventative strategies, and increased funding to support dementia research and care [10].

Acknowledgments

The data presented in this review were taken from several sources, but primarily from the Manitoba Bureau of Statistics (MBS). All sources are referenced below. This work was funded by Research Manitoba (Dr. Aida Adlimoghaddam), the Alzheimer's Society of Manitoba, and the St. Boniface Hospital Research Foundation (to BCA). BCA is a Research Affiliate at the University of Manitoba's Centre on Aging and holds the Honourable Douglas Everett, Patricia Everett and the Royal Canadian Properties Endowment Fund Chair and the Manitoba Dementia Research Chair. We thank Drs. Campbell, St. John, and Millikin and also Ms. Wendy Schettler (CEO-Alzheimer's Society of Manitoba) for a critical reading of the manuscript.

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