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Original quantitative research

Prevalence and sequence of chronic conditions in older people with dementia: a multi-province, population-based cohort study

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Abstract

Introduction: Comorbid chronic conditions contribute to increased health service use and poor outcomes for people with dementia, but there is little information about the prevalence of these conditions in this population.

Methods: We used linked administrative data from British Columbia (BC), Ontario (ON), Quebec (QC) and Prince Edward Island (PE) to identify a cohort of 287 453 individuals aged 65 years and older with prevalent dementia in April 2015, and followed this population until March 2020. We determined the prevalence of comorbid chronic conditions and ascertainment dates using Canadian Chronic Disease Surveillance System definitions, and used descriptive statistics to compare patterns across provinces.

Results: Sociodemographic characteristics were similar across provinces (mean age: 83.0 [PE]–84.3 [BC] years; female sex: 61.8% [BC]–66.2% [QC]; and long-term care facility residence: 39.5% [QC]–41.6% [BC]). People with dementia commonly experienced five or more comorbid conditions (38.8% [PE]–53.5% [ON]); the most prevalent were hypertension (76.4% [PE]–81.4% [ON]), mental illness and alcohol- or drug-induced disorders (44.4% [QC]–91.2% [BC]) and osteoarthritis (43.8% [PE]–60.4% [ON]). Hypertension, diabetes and stroke were frequently apparent before dementia ascertainment, whereas heart failure and traumatic brain injury were apparent almost as frequently after dementia ascertainment as before.

Conclusion: Patterns of comorbid chronic conditions were similar across provinces, with most present prior to dementia ascertainment. Health service planning strategies should be developed and shared across provinces to address the complex health care needs of people with dementia.

Highlights

- One-third to one-half of people with dementia also have five or more comorbid chronic conditions (from 38.8% in Prince Edward Island to 53.5% in Ontario).
- Common comorbid chronic conditions include hypertension (from 76.4% in Prince Edward Island to 81.4% in Ontario), mental illness and alcohol- or drug-induced disorders (from 44.4% in Quebec to 91.2% in British Columbia) and osteoarthritis (from 43.8% in Prince Edward Island to 60.4% in Ontario).
- Most chronic conditions, including hypertension, diabetes and stroke, were present before dementia was ascertained.
- A small number of chronic conditions, such as heart failure and traumatic brain injury, were present with equal frequency before and after dementia was ascertained.

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Keywords: *dementia, chronic disease, comorbidity, epidemiology, hypertension, mental illness, osteoarthritis, pan-Canadian*

Introduction

Alzheimer disease and related dementias (referred to as dementia in this article) are progressive neurodegenerative diseases that affected 6.4% of Canadians aged 65 years and older in fiscal year 2020 to 2021.[1] The prevalence of dementia in Canada is rising, partly due to longer lifespans, and the number of individuals with dementia is expected to double by 2050, to 1.3 million in Canada and 153 million globally.[2] The large burden of cognitive and behavioural symptoms frequently associated with dementia is also stressful for people with the disease and their care partners.[3] The direct health care costs for people living with dementia in Canada are projected to increase to CAD 18.2 billion by 2031.[4]

Because the number of chronic conditions increases with age and because specific conditions (such as diabetes and hypertension) are modifiable risk factors for dementia, people with dementia often have comorbid conditions.[5] Comorbidity can exacerbate functional decline[5] and accounts for significant additional health service use, fragmented care and poorer outcomes.[6] Management of comorbid chronic conditions requires an integrated, interdisciplinary approach to improve the quality of life of people with dementia.[7]

Public health in Canada focusses on promoting health, preventing disease and injuries, responding to public health threats and providing information to support decision-making. Canada released its first national dementia strategy in 2019.[8] One of the objectives of the strategy is prevention, which is supported by surveillance and data that provide a more accurate picture of the impact of dementia in Canada and ensure that preventive efforts are appropriately targeted.[8] Surveillance includes tracking modifiable risk and protective factors and bridging evidence gaps.[8]

Describing the prevalence of comorbid chronic conditions, and their sequence of occurrence in relation to dementia case ascertainment, would help decision makers understand the complexity of the care required in order to plan services, to ensure the availability of adequate health care personnel and to educate health care providers on the management of comorbidity.[9,10] However, there is limited information on the prevalence of chronic conditions among people with dementia across Canada. Our objective is to describe the prevalence of comorbid chronic conditions among older people with dementia, in four Canadian provinces, and to determine the temporal sequence of conditions relative to dementia ascertainment.

Methods

Study design and data sources

We conducted a series of population-based, retrospective cohort studies of adults aged 65 years and older living in the provinces of British Columbia (BC), Ontario (ON), Quebec (QC) and Prince Edward Island (PE). These four provinces, where more than 75% of the Canadian population reside,[11] participated in an initiative led by the Public Health Agency of Canada to report on the prevalence of comorbid chronic conditions among people with dementia. We used the health administrative databases available in each province to identify and characterize each cohort and to examine chronic conditions. These databases included provincial health insurance registries, the Canadian Institute for Health Information's Discharge Abstract Database, physician billing claims and prescription drug dispensation databases (see Table 1). Database availability varied across provinces and some analyses used unique jurisdiction-specific datasets, such as the Ontario Mental Health Reporting System.

Study population

We identified all adults aged 65 years and older with dementia on 1 April 2015 (the index date) using the Canadian Chronic Disease Surveillance System (CCDSS) dementia case ascertainment algorithm,[12] an adaptation of an algorithm previously validated in ON.[13] The algorithm defines dementia as one or more hospital separation records (generated each time a patient is discharged or transferred from a health care facility, signs out against medical advice or dies); three or more physician claims for dementia within 2 years (at least 30 days between each); or one or more cholinesterase inhibitor drug prescriptions. The algorithm has a sensitivity of 79.3% and a specificity of 99.1% among older adults when validated against family physician records.[13] An individual's dementia ascertainment date was defined as the date they first met one of the criteria the algorithm uses.

We chose a study time period that excluded the COVID-19 pandemic in the follow-up period because of the changes that were occurring in health system use and health care service availability.

Chronic conditions

We identified 15 comorbid chronic conditions according to CCDSS algorithms based on hospital discharge abstracts, physician billing claims and dispensed medication claims (see Table 2 for the list of conditions and definitions).[12] We selected conditions identified by the Lancet Commission report on dementia prevention, intervention and care[14] as modifiable risk factors for dementia and by a 2017 study that used CCDSS data to examine multimorbidity,[15] and based on the conditions' associations with age.[16] We also included traumatic brain injury based on a definition obtained from the literature,[17-19] but as emergency department visit data were not available for all the participating provinces, case ascertainment was based solely on hospital records.

Ascertainment for all conditions involved a look-back period, defined by data availability in each province and CCDSS case definitions,[12] of approximately two decades except for mental illness and alcohol- or drug-induced disorders for which the look-back period was 10 years. Individuals were followed until 31 March 2020 for the development of chronic conditions and were censored on their death date, if applicable, to allow for a minimum follow-up of 5 years after the study index date (1 April 2015). The unequal length of the look-back and follow-up periods reflect the natural progression of dementia, which tends to be ascertained later in life. The case ascertainment date for each condition was defined as the date individuals first met algorithm criteria.

Other characteristics

We used each province's health insurance registry to obtain sociodemographic characteristics for individuals on the study index date, including their age, sex and postal code. The latter was linked to Statistics Canada's Postal Code Conversion

TABLE 1
Summary of health administrative databases available by province, Canada

Database	Characteristics used in this study	Availability by province			
		BC	ON	QC	PE
Provincial health insurance registry	• Age • Sex • Postal code (to report community size, neighbourhood income quintile and other area-based measures, where available via linkage to census data using Statistics Canada's Postal Code Conversion File)	✓	✓	✓	✓
Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD)	• Acute care hospitalization within the 1 year prior to the index date • Chronic conditions	✓	✓	✓	✓
Ontario Mental Health Reporting System (OMHRS)	Inpatient health service use for mental illnesses	NA	✓	NA	NA
Physician billing claims	• Outpatient visits to family physicians, dementia specialists and other specialists within the 1 year prior to the index date • Chronic conditions	✓	✓	✓	✓
Prescription drug dispensations	• Chronic conditions Note: Generally available for people aged ≥ 65 years and other select populations, e.g. long-term care residents, people receiving social assistance, people who do not have private drug coverage (QC)	✓	✓	✓	✓
Continuing Care Reporting System – Long-term care	Long-term care residents at the index date	✓	✓	✓ NA[a]	NA
Canadian Index of Multiple Deprivation (CIMD)	Situational vulnerability and economic dependency quintiles	✓	NA	NA	NA
Ontario Marginalization Index (ON-MARG)	Situational vulnerability and economic dependency quintiles	NA	✓	NA	NA
Institut national de santé publique du Québec (INSPQ) Material and Social Deprivation Index	Situational vulnerability and economic dependency quintiles	NA	NA	✓	✓

Abbreviations: BC, British Columbia; NA, not applicable; ON, Ontario; PE, Prince Edward Island; QC, Quebec.

[a] Information was derived from other health administrative databases using a validated algorithm.

File to identify neighbourhood income quintiles and community size. The geocode, in turn, was linked to structural determinants of health indices that measure situational vulnerability and economic dependency. Neighbourhood income quintiles were defined based on the average household income of the neighbourhood (dissemination area) relative to the income level of the larger census regions.

We also identified health service utilization during the year preceding cohort index date. These included acute care hospitalizations, emergency department visits, family physician visits, dementia specialist visits (i.e. neurology, geriatrics and psychiatry) and other specialist visits.

Statistical analyses

We compared sociodemographic characteristics, prior health system use and prevalent comorbid chronic conditions across the provinces by reporting the mean (and standard deviation) for continuous variables (e.g. age) and counts and percentages for categorical variables (e.g. sex). To describe the temporal sequence of chronic conditions relative to dementia onset, we compared the number and percentage of chronic conditions ascertained before versus after dementia case ascertainment.

Ethics approval

In BC, this work was part of a comprehensive population health surveillance and research initiative of the Office of the Provincial Health Officer and was reviewed by the University of British Columbia Research Ethics Board (#H22-01818).

In ON, these datasets were linked using unique encoded identifiers and analyzed at ICES. ICES is an independent, nonprofit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement. The use of the data in this project is authorized under section 45 of Ontario's *Personal Health Information Protection Act* and does not require review by a research ethics board.

In QC, this work is part of the ongoing chronic disease surveillance mandate assigned to the Institut national de santé publique du Québec (INSPQ) by the Minister of Health and Social Services. All surveillance activities under this mandate are approved by the provincial Public Health Ethics Committee. No informed consent was required.

In PE, this work is part of ongoing and systematic chronic disease surveillance conducted by the Chief Public Health Office, under the authority of the Minister of Health and Wellness through sections 3 and 58 of the PE *Public Health Act*, and does not require review by a research ethics board.

Results

We identified 287 453 people aged 65 years and older with dementia living in the four

TABLE 2
Case ascertainment algorithms for chronic conditions based on CCDSS definitions

Chronic condition	Case definition	Case ascertainment date	ICD-9 codes	ICD-10 codes	Physician billing codes
Dementia	≥ 1 hospital separation records; or ≥ 3 physician claims within 2 years, with at least 30 days between qualifying claims; or ≥ 1 cholinesterase inhibitor drug prescription	Hospital separation record, last physician claim, or drug prescription date (whichever comes first)	046.1, 290.0, 290.1, 290.2, 290.3, 290.4, 294.1, 294.2, 331.0, 331.1, 331.5 (or 331.82 in ICD-9-CM)	G30, F00, F01, F02, F03	290, 331
Heart failure	≥ 1 hospital separation records or ≥ 2 physician claims within 1 year	Hospital separation record or last physician claim (whichever comes first)	428	I50	428
Hypertension (excluding gestational hypertension)	≥ 1 hospital separation records or ≥ 2 physician claims within 2 years	Hospital separation record or last physician claim (whichever comes first)	401, 402, 403, 404, 405	I10, I11, I12, I13, I15	401, 402, 403, 404, 405
Ischemic heart disease	≥ 1 hospital separation records or procedure codes, or ≥ 2 physician claims within 1 year	Hospital separation record or last physician claim (whichever comes first)	410, 411, 412, 413, 414[a]	I20, I21, I22, I23, I24, I25[a]	410, 411, 412, 413, 414
Diabetes (excluding gestational diabetes)	≥ 1 hospital separation records or ≥ 2 physician claims within 2 years	Hospital separation record or last physician claim (whichever came first)	250	E10, E11, E12, E13, E14	250
Stroke	≥ 1 hospital separation records or ≥ 2 physician claims within 1 year	Hospital separation record or last physician claim (whichever comes first)	325, 362.3x, 430, 431, 432.9, 433.x1, 434 (or 434.x1), 435.x, 436, 437.6[b]	G08, G45.x (excluding G45.4), H34.0, H34.1, I60.x, I61.x, I62.9, I63.x, I64, I67.6	325, 430, 431, 432.9, 434, 435, 436, 437.6
Traumatic brain injury[c]	≥ 1 hospital separation records	Date of hospital discharge or emergency department registration date (whichever came first)	310.2, 800.1, 800.3, 801.1, 801.3, 802.6, 802.7, 803.1, 803.3, 804.1, 804.3, 850, 851, 852, 853, 854, 907.0, 907.1, 925	F07.2, S02.0, S02.1, S02.3, S02.7, S02.8, S02.9, S06.0-S06.9, S07.1, T90.2, T90.5	Not applicable
Parkinsonism	≥ 2 physician claims within 1 year, with at least 30 days between qualifying claims	Last physician claim	Not applicable	Not applicable	332
Epilepsy	≥ 1 hospital separation records, or ≥ 3 physician claims within 2 years, with at least 30 days between qualifying claims	Hospital separation record or physician claim (whichever comes first)	345.0, 345.1, 345.4, 345.5, 345.6, 345.7, 345.8, 345.9	G40	345
Mental illness and alcohol- or drug-induced disorders (10-year look-back period)	≥ 1 hospital separation records or ≥ 1 physician claims within 1 year	Hospital separation record or physician claim (whichever comes first)	290.8, 290.9, 291–293, 294.0, 294.8, 294.9, 295–319	F04–F99	291–319 (50B in BC only)
Schizophrenia	≥ 1 hospital separation records, or ≥ 2 physician claims within 2 years, with at least 30 days between qualifying claims	Hospital separation record or physician claim (whichever comes first)	295	F20, F21, F23, F25	295

Continued on the following page

TABLE 2 (continued)
Case ascertainment algorithms for chronic conditions based on CCDSS definitions

Chronic condition	Case definition	Case ascertainment date	ICD-9 codes	ICD-10 codes	Physician billing codes
Osteoarthritis	≥ 1 hospital separation records, or ≥ 2 physician claims (separated by at least 1 day) within 5 years	Hospital admission or physician claim (whichever comes first)	715	M15–M19	715
Rheumatoid arthritis	≥ 1 hospital separation records, or ≥ 2 physician claims (> 8 weeks apart) within 2 years, with exclusion criterion[d]	730 days after hospital separation record or last physician claim (whichever comes first)	714	M05–M06	714
Osteoporosis	≥ 1 hospital separation records or ≥ 1 physician claims	Hospital separation record or last physician claim (whichever comes first)	733	M80, M81	733
Osteoporosis-related fractures (hip, forearm, pelvic, humerus and spine)	Hip: ≥ 1 hospital separation records (6-month episode) Forearm, pelvic and humerus: ≥ 1 hospital separation records or ≥ 2 physician claims within 3 months (6-month episode) Spine: ≥ 1 hospital separation records or ≥ 1 physician claims (6-month episode)[e]	Hip: Hospital admission Forearm, pelvic and humerus: Hospital admission or last physician claim (whichever comes first) Spine: Hospital admission or physician claim (whichever comes first)	Hip: 820 Forearm, pelvic and humerus: 813, 808, 805.6, 805.7, 812 Spine: 805.2–805.5	Hip: S72.0, S72.1, S72.2 Forearm, pelvic and humerus: S52, S32.1, S32.3, S32.4, S32.5, S42.2, S42.3, S42.4 Spine: S22.0, S22.1, S32.0	Hip: Not applicable Forearm, pelvic and humerus: 813, 814[f], 808, 812 Spine: 805
Asthma	≥ 1 hospital separation records or ≥ 2 physician claims within 2 years	Hospital separation record or last physician claim (whichever comes first)	493	J45, J46	493
COPD	≥ 1 hospital separation records or ≥ 1 physician claims	Hospital separation record or physician claim (whichever comes first)	491, 492, 496	J41, J42, J43, J44	491, 492, 496

Abbreviations: CCDSS, Canadian Chronic Disease Surveillance System; COPD, chronic obstructive pulmonary disease; ICD-9, *International Classification of Diseases, 9th Revision*; ICD-9-CM, *International Classification of Diseases, 9th Revision, Clinical Modification*; ICD-10, *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*; ICD-10-CA, *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada*.

[a] Percutaneous coronary intervention and coronary artery bypass graft coded in ICD-9-CM: 36.01, 36.02, 36.05, 36.10, 36.11, 36.12, 36.13, 36.14, 36.15, 36.16, 36.17, 36.19; the *Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures*: 48.02, 48.03, 48.11, 48.12, 48.13, 48.14, 48.15, 48.16, 48.17, 48.19; and the *Canadian Classification of Health Interventions*: 1.IJ.50, 1.IJ.57.GQ, 1.IJ.54, 1.IJ.76.

[b] ICD-9 code 432.9 and ICD-10 code I62.9 were used to code hemorrhagic stroke prior to fiscal year 2015 to 2016, and ICD-10 code I61.9 has been used since then.

[c] Traumatic brain injury is not included in the CCDSS, but because of its relevance to dementia, we included it in this study. The case definition was obtained from the literature[17-19] and does not include the emergency department visit criteria for case ascertainment as the data were not available for all jurisdictions.

[d] Subsequent to qualifying, cases with at least 2 physician claims (separated by at least 1 day) within 2 years with diagnoses of non-rheumatoid inflammatory arthritis including systemic autoimmune rheumatic diseases (ICD-9: 710; ICD-10-CA: M32.1, M32.8, M32.9, M33.x, M34.x, M35.1, M35.8, M35.9), polyarteritis nodosa and allied conditions (ICD-9: 446; ICD-10-CA: M30.x-M31.x), polymyalgia rheumatica (ICD-9: 725; ICD-10-CA: M35.3), psoriatic arthritis (ICD-9: 696; ICD-10-CA: L40.5, M07.0, M07.1 M07.2, M07.3), ankylosing spondylitis and other inflammatory spondylopathies (ICD-9: 720; ICD-10-CA: M45.x, M46.1, M46.8, M46.9) and arthropathy associated with other disorders classified elsewhere (ICD-9: 713; ICD-10-CA: M07.4, M07.5, M07.6) were excluded. People with psoriasis (ICD-9 code 696) were excluded because we cannot specifically exclude those with psoriatic arthritis given the number of digits required: the 2 physician claims must contain the same non-rheumatoid arthritis diagnostic codes at the 3-digit level for ICD-9(-CM) codes; the 2 physician claims must apply to all cases that qualified, i.e. those that qualified by way of a hospital separation or 2 physician claims; and excluded cases were excluded for the remainder of the study period.

[e] 6-month episode where any fracture codes during this period were considered part of the same event. The date of the first fracture code of a fracture event was used to establish the end point of the 6-month episode.

[f] One physician claim must include ICD-9 code 813 (or ICD-10-CA equivalent S52), but the other can include ICD-9 code 813 or 814 (or ICD-10-CA equivalent S52 or S62).

participating provinces on 1 April 2015, from 1390 in PE to 152 816 in ON. (For a flow diagram showing the process of identification, see Figure 1.)

Baseline demographics

The mean age of people with dementia was similar across the four provinces (from 83.0 years in PE to 84.3 years in BC) (Table 3). There were more females than males with the diagnosis in each province (from 61.8% in BC to 66.2% in QC). A large percentage of individuals were living in long-term care homes (from 39.5% in QC to 41.6% in BC) and in lower neighbourhood income quintiles 1 and 2 (from 47.7% in ON to 55.9% in PE). Fewer people with dementia were living in rural areas than in larger communities (from 10.5% in BC to 35.3% in PE). About one-fifth lived in areas with high situational vulnerability (from 15.1% in PE to 20.6% in ON).

Case ascertainment, health system use and comorbidity

Time since dementia case ascertainment was similar across the four provinces, from 2.8 years in PE to 4.3 years in ON (Table 3). Use of cholinesterase inhibitor drug prescriptions was the most common data source for dementia case ascertainment across the provinces, although the percentage of cases identified by this data source varied from 39.9% in BC to 66.5% in ON.

The proportion of individuals with at least one acute care hospitalization in the year prior to dementia ascertainment was similar across the provinces, from 21.0% in BC to 29.9% in PE (Table 3). Family physician visits in the year prior to the index date were least prevalent in PE (82.9%) and most prevalent in BC (97.2%). In contrast, visits to dementia specialists were least prevalent in BC (23.9%) and most prevalent in PE (33.5%).

Hypertension, mental illness and alcohol- or drug-induced disorders, and osteoarthritis were the most prevalent comorbid conditions (Figure 2; Table 4). The prevalence of mental illness and alcohol- or drug-induced disorders varied the most across the provinces, from 44.4% in QC to 91.2% in BC. The prevalence of ischemic heart disease, stroke, osteoporosis-related fractures, osteoarthritis, rheumatoid arthritis and osteoporosis also varied, but the relative ranking of prevalence was similar. Between 38.8% (PE) and 53.3% (ON) people with dementia had five or more comorbid chronic conditions.

A larger percentage of chronic conditions were apparent prior to rather than after dementia case ascertainment (Figure 3). Vascular-related conditions such as hypertension, ischemic heart disease, diabetes and stroke as well as mental illness and alcohol- or drug-induced disorders, osteoarthritis, rheumatoid arthritis, osteoporosis and asthma were often apparent prior to dementia ascertainment. Heart failure, traumatic brain injury, parkinsonism, osteoporosis-related fractures and epilepsy became apparent almost as often after dementia ascertainment as before. These patterns were generally consistent across provinces, with some variation in prevalence estimates.

Discussion

We compared the prevalence of comorbid chronic conditions among older adults with dementia across four Canadian provinces and examined their sequence of occurrence relative to dementia case ascertainment.

The COVID-19 pandemic revealed many issues in collecting, sharing, presenting and interpreting health data nationally.[20] Federal and provincial governments are collaborating to develop a pan-Canadian strategy on health data management[21] to which cross-provincial research contributes by consolidating the evidence base and refining methods to inform surveillance initiatives. Our methods may be used for other chronic conditions and in other jurisdictions.

Sociodemographic characteristics, prevalence of chronic conditions and sequence of condition occurrence were generally comparable across provinces, although we observed some important differences in both the prevalence of conditions and use of health services, such as services for mental health and addictions.

Several studies have reported that between 18% and 35% of people with dementia have five or more comorbid chronic conditions.[6,22-24] We found this prevalence to be higher (38.8%–53.3%) across the four provinces, which may be driven in part by the most prevalent conditions, that is, mental illness and alcohol- or drug-induced disorders, hypertension and osteoarthritis. However, it is difficult to compare estimates across studies as there is no single definition of comorbidity and various conditions are represented, including many we did not examine (such as retinal disorders, liver disease, thyroid disease, cardiac arrhythmia, prostatic hypertrophy and insomnia).[25-27]

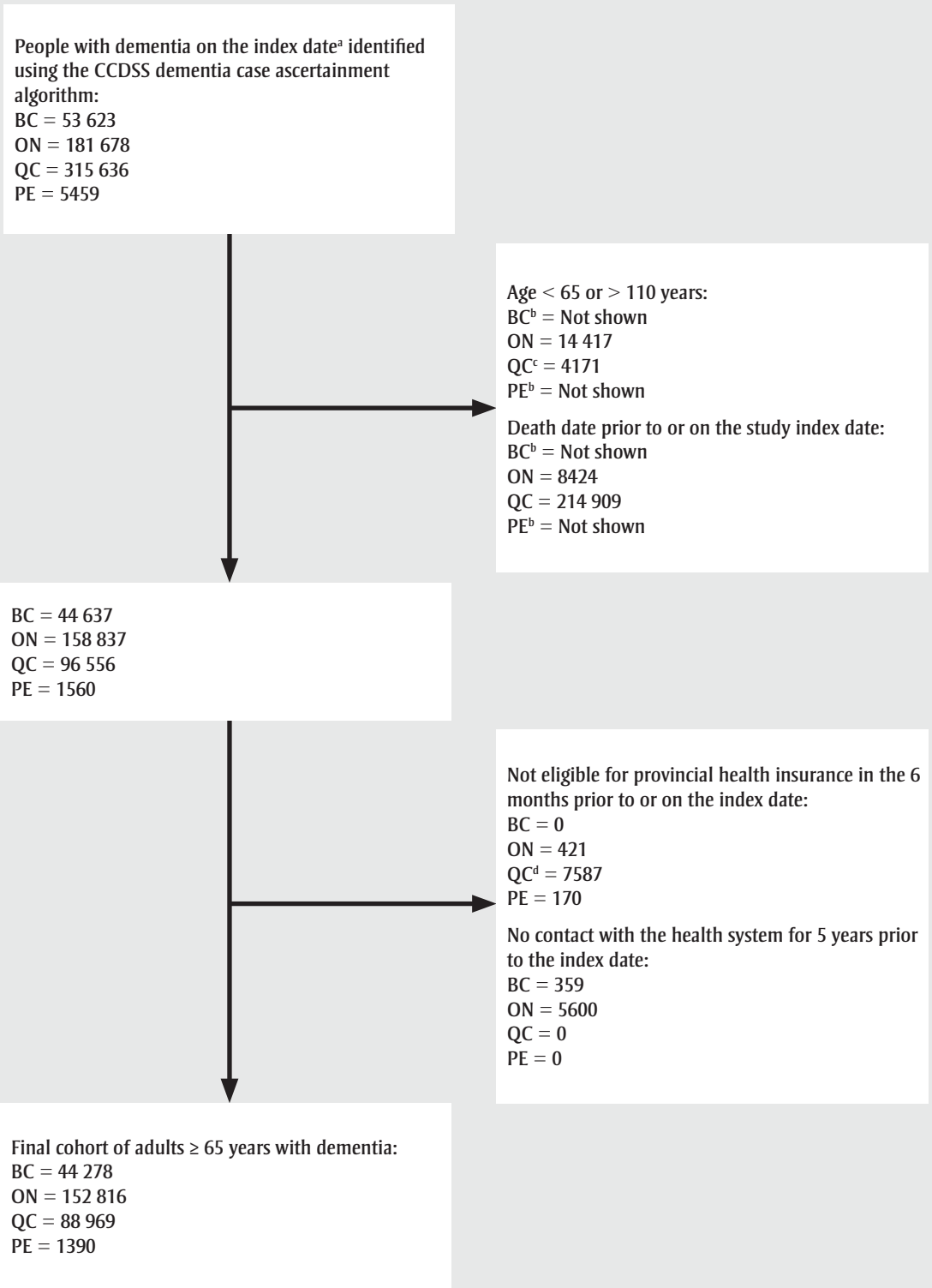
To our knowledge, few studies have examined the timing of occurrence of a broad set of chronic conditions relative to dementia. Most studies examine a narrower set of conditions and focus on vascular-related conditions as risk factors for incident dementia such as hypertension in mid-life,[28] diabetes[29] and stroke.[30] Recent studies have noted that neurodegenerative conditions[31] and hospitalization for traumatic brain injury[32] are associated with incident dementia. We observed similar patterns of sequencing for vascular-related conditions across the provinces (most were present before dementia was ascertained). However, we found traumatic brain injury and congestive heart failure to be detected nearly as often after dementia ascertainment as before. Traumatic brain injuries increase the risk of dementia mainly when they occur in mid-life,[14] which precedes the look-back period in our study and may explain this finding. Traumatic brain injury is also associated with falls by older people, including after the onset of dementia when mobility and coordination may be impaired.

As with other conditions measured, we could only capture data on mental illness (including depression), an established risk factor for dementia, through proxy measurement of health service use, which does not represent a clinical diagnosis. Parkinsonism, including Parkinson disease, was also more frequently ascertained prior to dementia. This is an expected pattern as Lewy body dementia can develop as Parkinson disease progresses. The increased burden of chronic conditions among people with dementia creates complex challenges in simultaneously managing health care needs for health care providers, patients and care partners.

Strengths and limitations

Our study presents insights from population-based data on persons living with dementia in four Canadian provinces.

FIGURE 1
Flow diagram showing identification of people (≥ 65 years) with dementia in participating provinces, Canada



Abbreviations: BC, British Columbia; CCDSS, Canadian Chronic Disease Surveillance System; ON, Ontario; PE, Prince Edward Island; QC, Quebec.

[a] The study index date was 1 April 2015.

[b] Exact values not shown due to small cell size suppression.

[c] Exclusion for age < 65 years in Quebec only.

[d] Exclusion for health insurance eligibility at index date only in Quebec.

TABLE 3
Baseline demographic and health service use characteristics of adults (≥ 65 years) with prevalent dementia on 1 April 2015, by province, Canada

Characteristics	BC N = 44 278		ON N = 152 816		QC N = 88 969		PE N = 1390	
Time since dementia case ascertainment, mean years (SD)	3.6	(3.2)	4.3	(3.7)	3.8	(3.2)	2.8	(2.8)
Mean age at index date,[a] years (SD)	84.3	(7.5)	83.3	(7.7)	83.4	(7.4)	83.0	(7.5)
Method of dementia case ascertainment, n (%)								
Hospitalization criterion	9087	20.5	6280	4.1	23 333	26.2	363	26.1
Physician claims criterion	17 543	39.6	44 964	29.4	18 452	20.7	381	27.4
Drug prescription criterion	17 648	39.9	101 572	66.5	47 184	53.0	646	46.3
Categorized age at index date, years								
65–69	1764	4.0	8309	5.4	3840	4.3	59	4.2
70–74	3736	8.4	13 949	9.1	7884	8.9	141	10.1
75–79	6558	14.8	23 176	15.2	13 542	15.2	241	17.3
80–84	10 300	23.3	35 208	23.0	21 761	24.5	324	23.3
85–89	11 416	25.8	38 312	25.1	23 311	26.2	355	25.5
≥ 90	10 504	23.7	33 862	22.2	18 631	20.9	270	19.4
Sex, n (%)								
Male	16 903	38.2	55 829	36.5	30 039	33.8	502	36.1
Female	27 375	61.8	96 987	63.5	58 930	66.2	888	63.9
Living in long-term care[a]	18 441	41.6	61 320	40.1	35 175	39.5	NA	NA
Neighbourhood income quintile								
Missing	284	0.6	816	0.5	NA	NA	6	0.4
Q1 (lowest)	12 846	29.0	39 295	25.7	NA	NA	360	25.9
Q2	8954	20.2	33 624	22.0	NA	NA	417	30.0
Q3	9199	20.8	28 705	18.8	NA	NA	272	19.6
Q4	6757	15.3	25 696	16.8	NA	NA	169	12.2
Q5 (highest)	6238	14.1	24 680	16.2	NA	NA	166	11.9
Community size, n								
Missing	281	0.6	779	0.5	252	0.3	6	0.4
≥ 1 500 000	21 358	48.2	59 490	38.9	41 942	47.1	0	NA
500 000–1 499 999	0	NA	25 753	16.9	17 927[b]	20.1	0	NA
100 000–499 999	11 431	25.8	35 222	23.0			0	NA
10 000–99 999	6542	14.8	15 331	10.0	11 765	13.2	893	64.2
< 10 000 (rural)	4666	10.5	16 241	10.6	17 083	19.2	491	35.3

Continued on the following page

TABLE 3 (continued)
Baseline demographic and health service use characteristics of adults (≥ 65 years) with prevalent dementia on 1 April 2015, by province, Canada

Characteristics	BC N = 44 278		ON N = 152 816		QC N = 88 969		PE N = 1390	
Situational vulnerability[c]								
Missing	88	0.2	1742	1.1	25 738	28.9	265	19.1
Q1 (least deprived)	9146	20.7	30 252	19.8	9399	10.6	153	11.0
Q2	9207	20.8	30 215	19.8	11 341	12.7	236	16.9
Q3	8448	19.1	29 154	19.1	11 869	13.3	188	13.5
Q4	9511	21.5	29 929	19.6	14 336	16.1	338	24.3
Q5 (most deprived)	7878	17.8	31 524	20.6	16 286	18.3	210	15.1
Economic dependency[c]								
Missing	88	0.2	1742	1.1	25 738	28.9	265	19.1
Q1 (least deprived)	5595	12.6	15 989	10.5	10 726	12.1	219	15.8
Q2	7008	15.8	20 005	13.1	10 582	11.9	117	8.4
Q3	7020	15.9	22 610	14.8	13 090	14.7	131	9.4
Q4	9322	21.1	27 395	17.9	14 052	15.8	343	24.7
Q5 (most deprived)	15 245	34.4	65 075	42.6	14 781	16.6	315	22.7
Previous health service use (at least once in the previous year)								
Acute care hospitalization	9294	21.0	37 322	24.4	23 140	26.0	415	29.9
Family physician visit	43 046	97.2	142 922	93.5	78 112	87.8	1153	82.9
Dementia specialist visit (including neurology, geriatrics and psychiatry)	10 580	23.9	44 296	29.0	23 307	26.2	465	33.5
Specialist visit, other	27 839	62.9	83 749	54.8	61 158	68.7	656	47.2

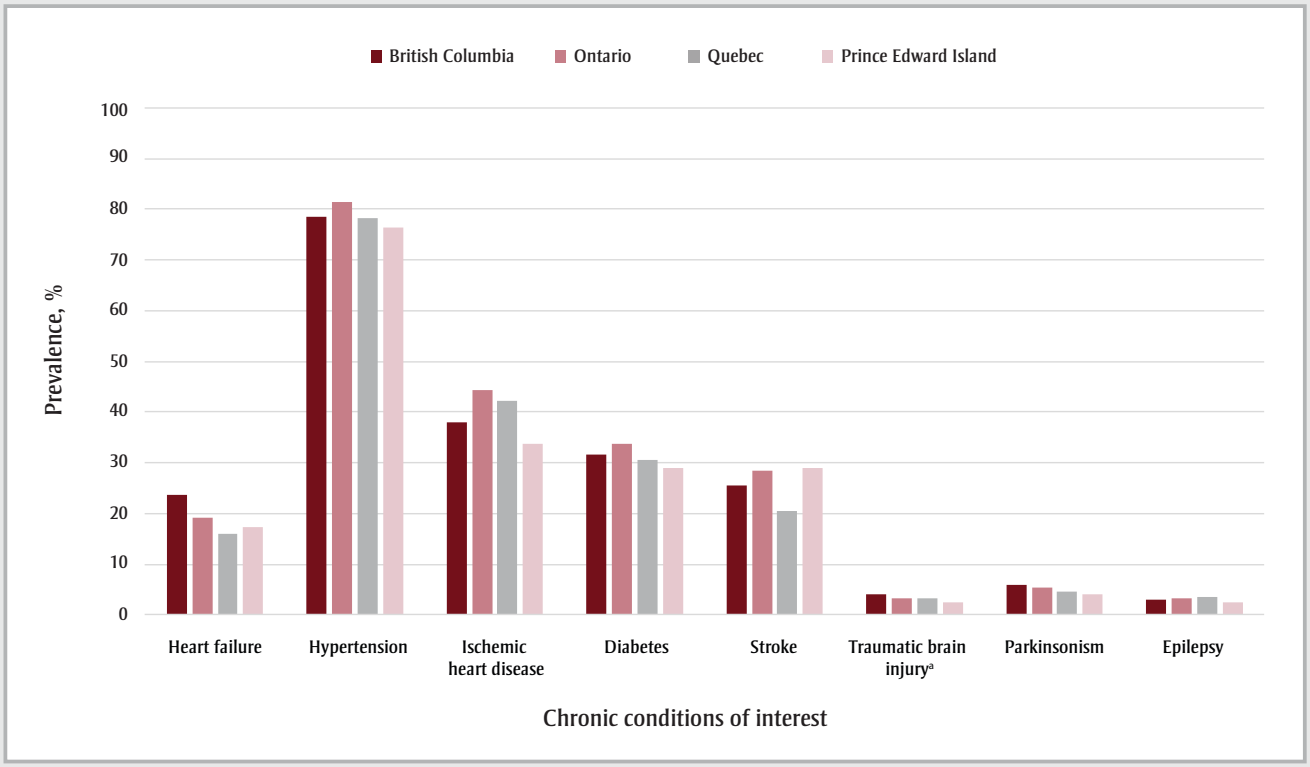
Abbreviations: BC, British Columbia; INSPQ, Institut national de santé publique du Québec; ON, Ontario; Q, quintile; QC, Quebec; PE, Prince Edward Island; SD, standard deviation; NA, not available.

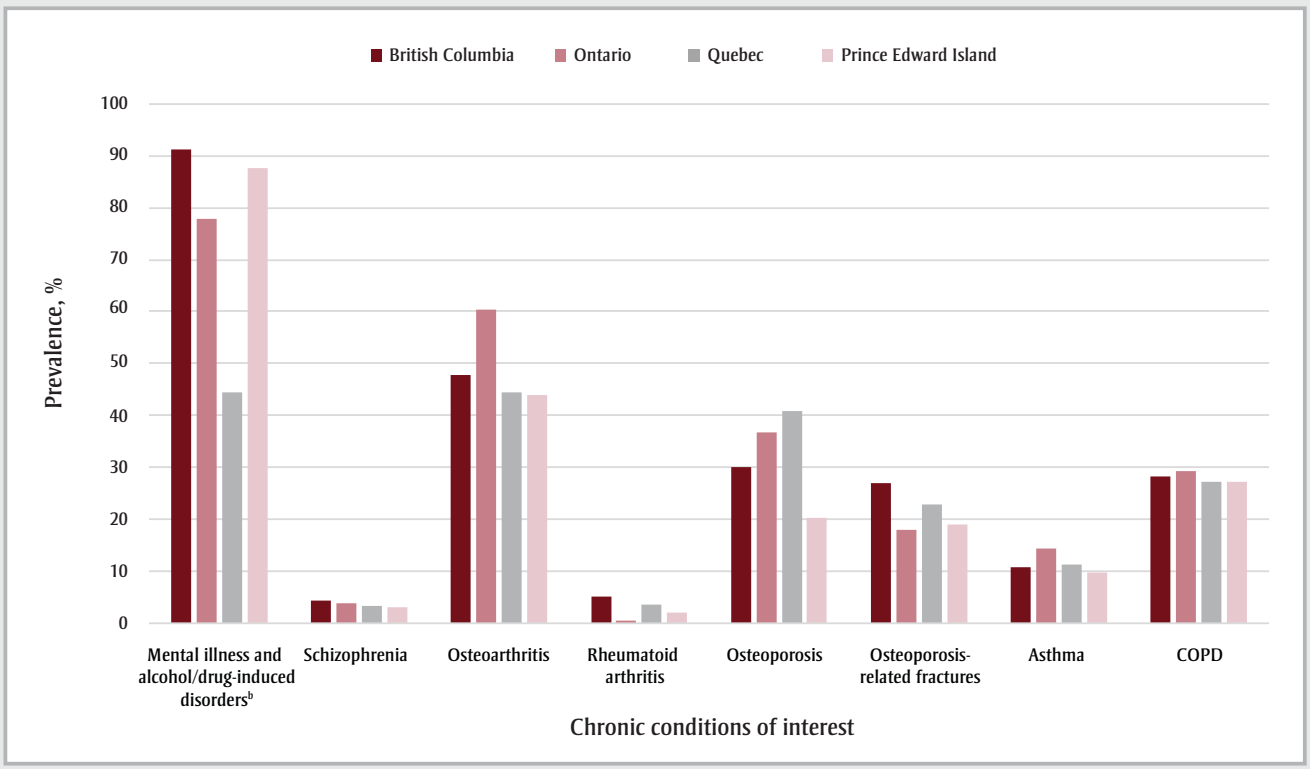
[a] Data availability varies across the participating provinces. For BC and ON, data were available from the Continuing Care Reporting System – Long-term care; for QC, information was derived from other health administrative databases using a validated algorithm; for PE, the data are not available.

[b] Community size is not available for less populous areas.

[c] Situational vulnerability quintiles and economic dependency quintiles for BC are from the Canadian Index of Multiple Deprivation (CIMD), for ON are from the Ontario Marginalization Index (ON-MARG) and for QC and PE are from the INSPQ Material and Social Deprivation Index.

FIGURE 2
Prevalent chronic conditions among adults (≥ 65 years) with prevalent dementia on 1 April 2015, by province, Canada





Abbreviations: CCDSS, Canadian Chronic Disease Surveillance System; COPD, chronic obstructive pulmonary disease.

[a] Traumatic brain injury data reported using hospitalization data alone (not a CCDSS case definition).

[b] A 10-year look-back period from 1 April 2015 (the index date) was used to report use of health care services for mental illness and alcohol- or drug-induced disorders.

TABLE 4
Prevalent chronic conditions among older adults (≥ 65 years) with prevalent dementia on 1 April 2015, by province, Canada

Characteristics, n (%)	BC N = 44 278		ON N = 152 816		QC N = 88 969		PE N = 1390	
Number of chronic conditions								
≥ 5	21 900	49.5	81 492	53.3	42 440	47.7	539	38.8
Specific chronic conditions								
Heart failure	10 440	23.6	29 323	19.2	14 282	16.1	241	17.3
Hypertension	34 757	78.5	124 376	81.4	69 589	78.2	1062	76.4
Ischemic heart disease	16 801	37.9	67 660	44.3	37 620	42.3	468	33.7
Diabetes	13 965	31.5	51 560	33.7	27 114	30.5	402	28.9
Stroke	11 286	25.5	43 599	28.5	18 209	20.5	402	28.9
Traumatic brain injury	1766	4	5094	3.3	3016	3.4	33	2.4
Parkinsonism	2609	5.9	8428	5.5	4140	4.7	59	4.2
Epilepsy	1305	2.9	5018	3.3	3151	3.5	35	2.5
Mental illness and alcohol- or drug-induced disorders	40 382	91.2	119 083	77.9	39 532	44.4	1218	87.6
Schizophrenia	1842	4.2	5795	3.8	2824	3.2	42	3
Osteoarthritis	21 170	47.8	92 368	60.4	39 613	44.5	609	43.8
Rheumatoid arthritis	2258	5.1	753	0.5	3055	3.4	28	2
Osteoporosis	13 293	30	55 967	36.6	36 275	40.8	281	20.2
Osteoporosis-related fractures (hip, forearm, pelvic, humerus and spine)	11 957	27	27 342	17.9	20 369	22.9	262	18.9
Asthma	4728	10.7	21 842	14.3	9876	11.1	135	9.7
COPD	12 447	28.1	44 815	29.3	24 321	27.3	380	27.3

Abbreviations: BC, British Columbia; COPD, chronic obstructive pulmonary disease; ON, Ontario; PE, Prince Edward Island; QC, Quebec.

These data can serve as robust comparators to data from other regions.

This study has certain limitations. At a broad level, differences in the availability and structure of provincial administrative databases make comparative research across provinces and territories difficult. However, we leveraged standardized case definitions used in national disease surveillance to enhance comparisons.[1]

More specifically, while we focussed on a comprehensive set of chronic conditions with standardized definitions, we did not include other important conditions and risk factors such as smoking, alcohol consumption and physical inactivity. Second, variability in methods and database availability and completeness (e.g. differences in coding, spaces for multiple diagnoses on health claims and unobtainable emergency department data in some provinces) may have contributed to the differences observed between provinces. In addition, differences in the organization of health and social care services across provinces may explain some of the differences in prevalence of chronic conditions observed, for example, psychosocial care in QC may be more frequently provided outside of medical settings, potentially resulting in our underestimating mental illness and alcohol- or drug-induced disorders in this study. Data availability also impacted case definitions for some conditions, for example, the prevalence of traumatic brain injury may have been underreported because of a lack of available emergency department data in the participating provinces.

Third, we were limited to the case ascertainment date according to administrative databases, but administrative data case definitions do not represent formal diagnoses, and individuals may have first experienced the condition much earlier than identified. Fourth, the dementia case ascertainment algorithm, as with other health administrative data case definitions, is imperfect and may misclassify some individuals. For example, those with earlier stage dementia may be missed because of a lack of a formal diagnosis. Individuals who have not presented to the health system will also not be captured. Future studies should explore differences in comorbid chronic conditions among people with dementia across age, sex, indicators of socioeconomic status and rurality.

Conclusion

Using national, standardized definitions for chronic conditions and a minimum common dataset approach, we compared the prevalence and sequence of occurrence of comorbid chronic conditions among people aged 65 years and older with dementia in four Canadian provinces. Our study found generally similar patterns of comorbid conditions across the provinces, suggesting that strategies for care management, resource planning and health system access could be shared across regions.

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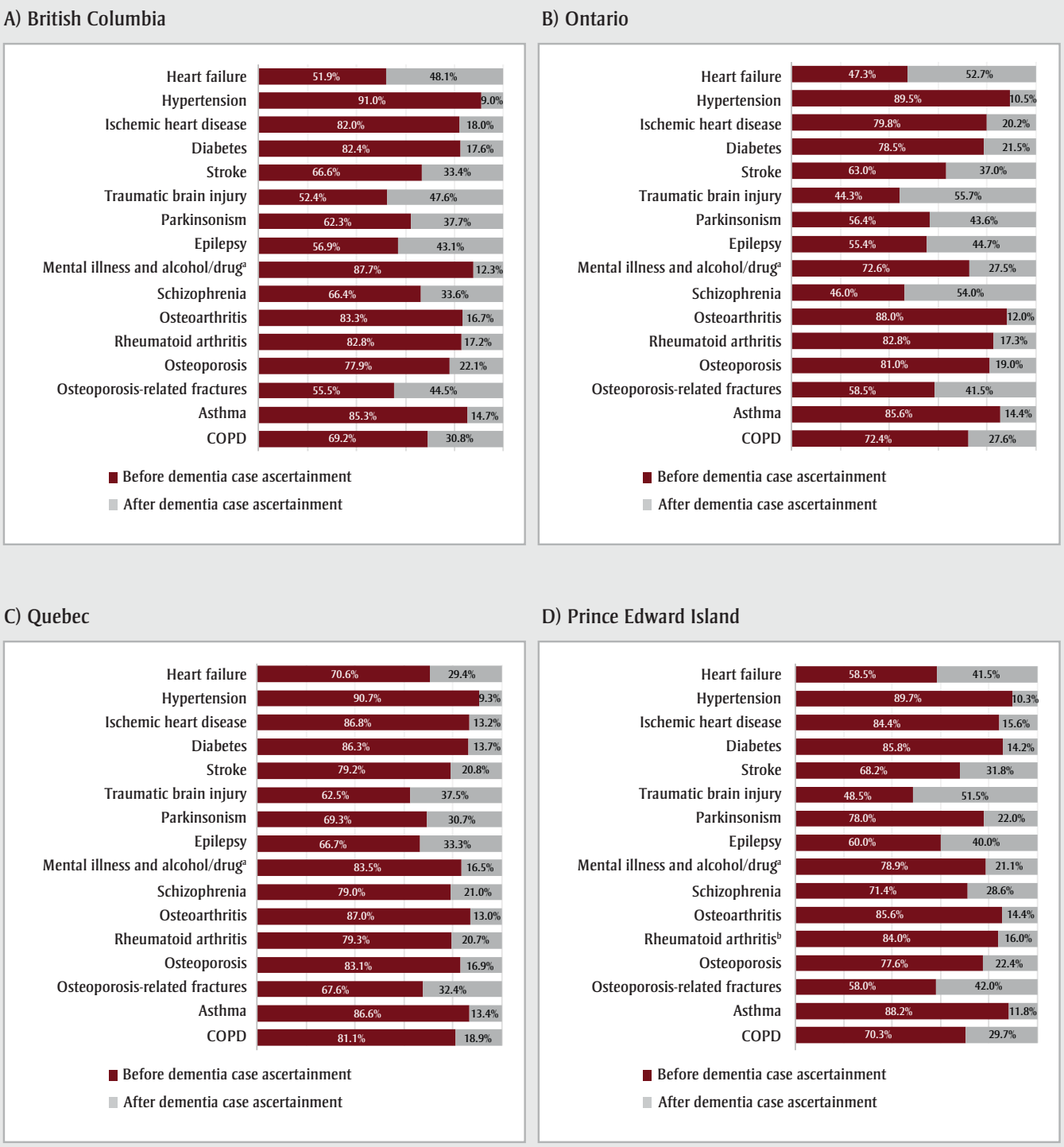
FIGURE 3
Sequence of chronic conditions apparent before and after dementia case ascertainment of adults (≥ 65 years) with prevalent dementia on 1 April 2015, by province, Canada



Abbreviations: COPD, chronic obstructive pulmonary disease; PE, Prince Edward Island.

[a] Mental illness and alcohol/drug-induced disorders.

[b] A range of values is provided for rheumatoid arthritis in PE because of small cell size suppression for values of 1–5.

IQVIA Solutions Canada Inc., the Ontario Ministry of Health, the Ontario Ministry of Long-Term Care and Health PEI. This study used data adapted from the Statistics Canada Postal Code^{OM} Conversion File, which is based on data licensed from Canada Post Corporation, and/or data adapted from the Ontario Ministry of Health Postal Code Conversion File, which contains data copied under licence from Canada Post Corporation and Statistics Canada.

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Conflicts of interest

Susan E. Bronskill receives funding from the Public Health Agency of Canada (PHAC), the Canadian Institutes of Health Research (CIHR) and the Ontario Brain Institute (OBI) and support from ICES, which is funded by the Ontario Ministry of Health and the Ontario Ministry of Long-Term Care.

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Original quantitative research

Coping and positive mental health in Canada among youth and adults: findings from a population-based nationally representative survey

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This article has been peer reviewed.

Abstract

Introduction: Coping is a protective factor for positive mental health (PMH) and an asset for population health. While there is evidence demonstrating a strong association between coping and PMH, less is known about how coping patterns differ across age groups. Given that age can impact coping ability, addressing this knowledge gap is warranted.

Methods: We analyzed data from the 2019 Canadian Community Health Survey on the self-rated ability of adults and youth (N = 60 643; 12 + years) to cope with unexpected or difficult problems and day-to-day demands along with three PMH outcomes: self-rated mental health (SRMH), happiness and life satisfaction. All estimates were disaggregated by sociodemographic variables (sex, gender, household income quintile, immigration status, ethnocultural background, place of residence), stratified by five age groups, and age-specific regression analyses were conducted.

Results: Prevalence of high coping varied by sex, gender, income, place of residence, immigration status and ethnocultural background. High coping was significantly associated with the three PMH outcomes across all age groups. Those with high coping were 4 to 6 times more likely to report high SRMH and high levels of happiness than those with lower coping. Individuals with high coping had a life satisfaction score between 0.84 and 1.32 units greater than individuals with lower coping.

Conclusion: The consistent, positive relationship between high coping and PMH across all age groups provides valuable information for developing public health messaging and promotion efforts for adaptive coping to enhance population mental health.

Keywords: *self-rated mental health, happiness, life satisfaction*

Highlights

- In 2019, the prevalence of high coping was 69.6% to 86.3% across five age groups of youth and adults.
- The prevalence of high coping varied by sex, gender, income, immigration status, ethnocultural background and place (rural area or population centre) of residence.
- Of people with high coping, about three out of four reported high self-rated mental health and about four out of five reported high levels of happiness.
- The mean life satisfaction score was 8.3 (out of 10) for people with high coping.
- High coping increased the odds of high SRMH and happiness and was associated with higher mean life satisfaction for all groups.

Introduction

The Public Health Agency of Canada (PHAC) defines positive mental health (PMH) as "the capacity of each and all of us to feel, think, act in ways that enhance our ability to enjoy life and deal with the challenges we face."[1] PMH has been recognized as contributing to Canada's social and economic prosperity[2] and alleviating risk factors for mental disorders; it can be associated with greater physical and mental health even in the presence of mental health problems.[3,4] PMH is associated with reduced risk of mood and anxiety disorders,[5] decreased symptom severity and better remission for patients with mental disorders[6,7] and improved health and longevity in healthy populations.[8]

PHAC has been monitoring the PMH of adults (18 + years) and youth (12–17 years) in Canada through the Positive Mental Health Surveillance Indicator Framework (PMHSIF) since 2016.[9,10] The PMHSIF provides routine estimates on a core set of PMH outcomes including self-rated mental health (SRMH), happiness, life satisfaction, psychological well-being and social well-being. The PMHSIF also provides

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information on risk and protective factors at the individual, family, community and societal levels.[9,10]

In order to identify populations and determinants that mental health promotion activities could target, PHAC also examines how patterns of PMH may vary across certain populations[3,11-13] and explores relationships between PMH and different risk or protective factors.[14-16]

One individual-level protective factor is the ability to cope.[9,10] Coping is defined as the cognitive and behavioural efforts to manage the internal and external demands of situations that are appraised as stressful.[17,18] Coping can be active, where people try to modify the nature of stressful events through problem-solving, or it can be adaptive, where people regulate their emotional responses to these stressful events.[17,19] According to the broaden-and-build theory,[20] positive emotions can increase the capacity to engage in a variety of coping strategies in response to stress, which in turn build lasting social, physical and psychological resources that help to enhance well-being.[19-22] Indeed, there is a considerable body of Canadian research that describes a significant association between coping and PMH outcomes, including psychological[23,24] and emotional well-being.[3,25]

Studies identify age as a critical factor in the ability of individuals to cope with individual demands, pressures and challenges.[26,27] Such coping requires adaptive skills that strengthen over time based on lived experience.[26,27] In 2019, three out of four youth aged 12 to 17 years (75.5%) and four out of five adults (82.2%) in Canada reported having high levels of coping (or "high coping").[10] Further examination by age group reveals greater nuance. In 2019, the proportion of adults in Canada who reported high coping was highest among those aged 65 years and older (86.3%) and lowest among those aged 18 to 24 years (69.6%).[10] Moreover, the extent to which adolescents and older adults use active coping to handle daily stressors has distinct implications for mental health outcomes.[28] However, there is insufficient research examining coping patterns across different age groups and other pertinent sociodemographic variables in Canada.

For both youth and adults in Canada, coping varies by sociodemographic characteristics, including sex, income, place of residence and racialized population status.[10] As such, monitoring PMH and coping across sociodemographic variables for each age group is crucial for understanding the health of the population and for identifying population groups that may benefit the most from public health interventions. In an effort to better describe and understand patterns of coping and associations with PMH, the objectives of this study were to:

- generate age group–specific national prevalence estimates of high coping among youth and adults, disaggregated by sociodemographic variables;
- provide prevalence estimates of three PMH outcomes, that is, high SRMH, high levels of happiness (or "high happiness") and mean life satisfaction, among those with high coping; and
- examine age group–specific associations between coping and the three PMH outcomes.

Methods

Data and participants

We analyzed data from the 2019 Canadian Community Health Survey (CCHS), which was designed to be a nationally representative, cross-sectional survey of people aged 12 or older across the 10 provinces in Canada.[29] Excluded from this survey are individuals living on reserves or other Indigenous settlements, full-time members of the Canadian Armed Forces and individuals living in institutions, youth aged 12 to 17 years living in foster care and people living in the Région du Nunavik and Région des Terres-Cries-de-la-Baie-James Quebec health regions. The excluded populations represent less than 3% of the total population in Canada.

Respondents voluntarily completed the survey through computer-assisted personal interviews and computer-assisted telephone interviews.[29] The response rate was 54.4%.[29] Of the 65 970 survey respondents, 91.9% (n = 60 643) agreed to their data being shared with PHAC.[29]

Measuring coping

CCHS respondents were asked two questions:

(1) "In general, how would you rate your ability to handle unexpected and difficult problems, for example, a family or personal crisis?"

(2) "In general, how would you rate your ability to handle the day-to-day demands in your life, for example, handling work, family and volunteer responsibilities?"

There were four response options for each question: "excellent," "good," "fair" or "poor." To align with the PMHSIF,[10] participants were rated as having a high level of coping if they chose "excellent" for both questions, "excellent" for one question and "good" for the other, "good" for both questions or "excellent" for one and "fair" for the other. All other response options were classified as a lower level of coping. Statistics Canada has shown that reporting high levels of coping in response to these two questions is positively associated with other established, comprehensive measures of positive coping, such as the Ways of Coping scale,[30] which was derived and modified from three coping scales.[31]

Measuring PMH outcomes

Three PMH outcomes (SRMH, happiness and life satisfaction) were included in this study and harmonized with the PMHSIF.[10] To measure SRMH, CCHS respondents were asked if their mental health was "excellent," "very good," "good," "fair" or "poor." Those who chose "excellent" and "very good" were rated as having high SRMH.

To measure happiness, CCHS respondents were asked if they would usually describe themselves as "happy and interested in life," "somewhat happy," "somewhat unhappy," "unhappy with little interest in life" or "so unhappy that life is not worthwhile." Participants who chose "happy and interested in life" were categorized as having high happiness.

To measure life satisfaction, CCHS respondents were asked how they felt about their life "as a whole right now" on a scale of 0 (meaning "very dissatisfied") to 10 (meaning "very satisfied"). Life satisfaction was treated as a numerical variable.

Sociodemographic variables

The data were stratified according to the following five age groups, in years: 12 to

17, 18 to 24, 25 to 44, 45 to 64 and 65 and older.[10] We chose to use the following sociodemographic variables because they have been previously associated with coping or with PMH and could be potential confounders: sex, gender, household income distribution, immigration status, ethnocultural background and place of residence.[3,23,26]

Sex and gender

CCHS respondents were asked to report their sex at birth and their current gender using the response options "male" or "female" (or "please specify") for both questions. We report on gender using the CCHS response options to maintain statistical rigour and for ethical purposes, despite these options being inconsistent with commonly accepted gender categories.[32]

Household income

Household income distribution was calculated using the adjusted ratio of total household income to low-income cut-off corresponding to the household and community size and categorized into quintiles.[29]

Immigration status

Immigration status was assessed using the derived immigrant flag variable that indicated whether a respondent was an immigrant or not. The immigrant category includes landed immigrants and non-permanent residents. Those who declared being born in Canada are considered non-immigrants.[29]

Ethnocultural background

We modified the "visible minority" variable developed by Statistics Canada to report on ethnocultural background. The variable used by Statistics Canada is based on the *Employment Equity Act*, which defines visible minorities as "persons, other than Aboriginal, who are non-Caucasian in race or non-white in colour."[33] The ethnocultural background categories used are "Arab/West Asian," "Black," "East/Southeast Asian," "Indigenous," "Latin American," "South Asian" and "White." Detailed information is available elsewhere.[29,33]

Place of residence

Respondents' places of residence were derived from their postal code. Individuals living in continuously built-up areas with populations of at least 1000 and population densities of at least 400 per km^2 were classified as living in population centres.[29] The remaining respondents were classified as living in rural areas.

Analysis

We conducted descriptive and inferential analyses using statistical package SAS EG version 7.1 (SAS Institute Inc., Cary, NC, US). We estimated prevalence of high coping disaggregated across sociodemographic characteristics. We also estimated the prevalence of high SRMH and high happiness and the mean life satisfaction score among those with high coping.

All analyses were stratified by the five age groups. We estimated coefficients of variation and 95% confidence intervals (CIs) using bootstrap weights (1000 replicates) provided by Statistics Canada. Age group–specific differences in sociodemographic breakdowns were established using unadjusted logistic regression ($p < 0.05$). To examine age group–specific associations between coping and PMH outcomes, we conducted regression analyses (unadjusted and adjusted for sociodemographic variables) for each age group. As the gender and sex variables were highly correlated with each other (i.e. multicollinearity), only sex was adjusted for in the regression models.

Logistic regression was conducted for high SRMH and high happiness, while linear regression was used for life satisfaction. For the regression analyses only, we used listwise deletion to address missing data. We chose this commonly used approach because the frequency of missing data was low and the sample sizes were large. For the logistic regression, odds ratios with 95% CIs that did not include 1.00 were considered statistically significant. For the linear regression, beta coefficients with 95% CIs that did not include 0 were considered statistically significant.

Results

Most of the individuals in each age group lived in a population centre, were Canadian born and identified as White. The proportion of males and females was equally distributed across the five age groups (Table 1).

Over four out of five (81.4%) respondents reported having high coping (Table 2). The 18- to 44-year cohorts had significantly lower prevalence of high coping than the 45- to 64-year and older cohorts, from 69.6% for the 18- to 24-year cohort to 86.3% for the 65 years and older cohort. A similar pattern was seen across PMH outcomes, where we saw lower PMH among the younger cohorts than the older ones. Most of the respondents also reported high SRMH (from 55.6% to 72.4%) and high happiness (from 66.7% to 77.8%). Mean life satisfaction scores ranged from 8.0 to 8.7, with similar scores across all the adult age groups and the highest score in the 12- to 17-year cohort.

Across all age groups except the 45- to 64-year age group, there were significant sex and gender differences in the prevalence of high coping (Table 3). Compared with females, males reported a significantly greater prevalence of high coping. Adults aged 25 years and older in the highest household income adequacy quintiles had significantly greater prevalence of high coping than those in the lowest income group. There were no significant differences in coping associated with income among youth (12–17 years) and young adults (18–24 years).

Adults aged 18 to 44 years (but none of the other age groups) living in rural areas had a significantly greater prevalence of high coping than those living in population centres. Immigrants aged 25 to 44 years reported a significantly greater prevalence of high coping than non-immigrants in the same age group (82.0% vs. 78.4%). The reverse occurred among adults aged 65 years and older, with non-immigrants reporting a significantly greater prevalence of high coping than immigrants (87.2% vs. 84.0%). Indigenous youth (12–17 years) and adults (25–64 years) reported a significantly lower prevalence of high coping than non-Indigenous people in the same age groups. Young adults (18–24 years) and older adults (65+ years) who identified as White (71.4% and 87.0%, respectively) had a significantly greater prevalence of high coping than those who identified as East or Southeast Asian (59.8% and 81.2%, respectively). Youth (12–17 years) who identified as Latin American (86.4%) or South Asian (84.5%) had a significantly greater prevalence of high coping than those who identified as White. There were no other significant differences in the prevalence of high coping in racialized populations within the age groups.

Approximately three out of four individuals with high coping reported having high SRMH and about four out of five reported having high levels of happiness (Figures 1A and 1B). Mean life satisfaction score

TABLE 1
Sociodemographic characteristics of the overall population and stratified by age group, Canada (excluding territories), 2019

Sociodemographic characteristic	Proportion, %[a]					
	Overall (N = 60 643)	12–17 years (n = 3609)	18–24 years (n = 2999)	25–44 years (n = 13 572)	45–64 years (n = 15 549)	65+ years (n = 24 914)
Sex						
Male	49.4	51.2	53.3	49.6	49.4	46.5
Female	50.6	48.8	46.7	50.4	50.6	53.5
Gender						
Male	49.4	51.3	53.0	49.6	49.4	46.4
Female	50.6	48.7	47.0	50.4	50.6	53.6
Household income adequacy quintile						
Q1 (lowest)	20.2	20.0	28.5	19.5	15.2	25.2
Q2	19.9	21.9	19.4	20.1	16.2	24.8
Q3	20.8	22.0	19.7	22.5	19.6	19.9
Q4	19.1	21.0	17.1	19.3	21.8	15.1
Q5 (highest)	20.0	15.1	15.3	18.5	27.3	15.1
Place of residence						
Population centre	82.8	81.4	86.7	86.3	80.8	78.9
Rural area	17.2	18.6	13.3	13.7	19.2	21.1
Immigration status						
Yes	27.8	15.4	23.6	31.7	27.4	28.6
No	72.2	84.6	76.4	68.3	72.6	71.4
Ethnocultural background						
White	72.3	62.4	58.0	65.9	77.4	85.1
South Asian	5.6	7.1	8.1	7.8	4.0	2.6
East/Southeast Asian	8.5	11.7	13.9	9.8	7.0	5.0
Black	3.5	5.8	5.7	4.4	2.9	1.4
Arab/West Asian	2.3	3.0[E]	3.3[E]	3.1	2.0	1.0[E]
Latin American	1.6	1.5[E]	2.9[E]	2.6	1.0	0.5[E]
Indigenous	3.6	6.0	4.7	3.9	3.5	1.7

Source: Canadian Community Health Survey – Annual Component.[29]

Abbreviation: Q, quintile.

[a] All estimates are weighted.

[E] Estimate should be interpreted with caution due to high sampling variability (coefficient of variation between 15.1% and 35%).

among those with high coping varied between 8.2 (for adults aged 45–64 years) and 8.9 (for youth aged 12–17 years). In age groups with high coping, youth (12–17 years) had the highest prevalence of high SRMH (80.3%) and adults aged 45 to 64 years had the highest prevalence of high happiness (83.1%). Young adults aged 18 to 24 years had the lowest prevalence of high happiness (77.4%) and high SRMH (68.2%).

Coping was robustly associated with all three PMH outcomes in both the unadjusted and adjusted analyses across all age groups (see Table 4). Individuals who reported having high coping were between four and six times more likely to report high SRMH (adjusted odds ratio [aOR] between 4.2 and 6.5) and high happiness (aOR between 3.8 to 5.3) than those with lower coping. Similarly, individuals with high coping had a mean life satisfaction score between 0.8 and 1.32 units greater than individuals with lower coping. There were minimal differences in the PMH effect estimates across the age groups. The percentage change between the unadjusted and adjusted analyses was less than 10% for all three PMH outcomes.

Discussion

Coping is a critical determinant of PMH. It influences people's emotional responses and ability to manage stress in challenging situations. Although there is evidence of a relationship between coping and PMH,[23,24] no studies have investigated this association across different age and sociodemographic groups in Canada.

Overall and age group–specific prevalence of high coping and by sociodemographic variables

Older adults (65+ years) had the highest prevalence of coping while youth (12–17 years) and young adults (18–24 years) had the lowest prevalence. A possible explanation is that coping skills take time to develop. Transitioning into adulthood is

TABLE 2
Coping and PMH outcomes[a] in the overall population and stratified by age group, Canada (excluding territories), 2019

Coping and PMH outcomes	Overall (N = 60 643)	12–17 years (n = 3609)	18–24 years (n = 2999)	25–44 years (n = 13 572)	45–64 years (n = 15 549)	65+ years (n = 24 914)
Coping, % (95% CI)						
High	81.4 (80.9–82.0)	75.5 (73.4–77.5)	69.6 (66.9–72.3)	79.5 (78.5–80.6)	85.5 (84.6–86.4)	86.3 (85.5–87.1)
Low	18.6 (18.0–19.1)	24.5 (22.5–26.6)	30.4 (27.7–33.1)	20.5 (19.4–21.5)	14.5 (13.6–15.4)	13.7 (12.9–14.5)
Self-rated mental health, % (95% CI)						
High	67.1 (66.4–67.8)	72.4 (70.1–74.6)	55.6 (52.7–58.5)	64.4 (63.2–65.7)	69.8 (68.6–71.0)	71.2 (70.2–72.2)
Low	32.9 (32.2–33.6)	27.6 (25.4–29.9)	44.4 (41.5–47.3)	35.6 (34.3–36.8)	30.2 (29.0–31.4)	28.8 (27.8–29.8)
Happiness, % (95% CI)						
High	75.5 (74.9–76.0)	75.6 (73.6–77.6)	66.7 (64.0–69.3)	74.7 (73.5–75.8)	77.5 (76.5–78.6)	77.8 (76.9–78.8)
Low	24.5 (24.0–25.1)	24.4 (22.4–26.4)	33.3 (30.7–36.0)	25.3 (24.2–26.5)	22.5 (21.4–23.5)	22.2 (21.2–23.1)
Mean life satisfaction score[b]	8.1 (8.1–8.1)	8.7 (8.6–8.8)	8.0 (7.9–8.0)	8.1 (8.1–8.2)	8.0 (8.0–8.1)	8.2 (8.1–8.2)

Source: Canadian Community Health Survey – Annual Component.[29]

Abbreviations: CI, confidence interval; PMH, positive mental health.

Note: Some percentages may not sum to the exact total due to rounding.

[a] All estimates are weighted.

[b] Life satisfaction was rated on a scale from 0 (very dissatisfied) to 10 (very satisfied).

accompanied by major uncertainty and life-changing decisions involving education, career development, family formation, relocation and more.[34] These novel obstacles help develop the enhanced coping skills seen in older adults.

Across all age groups, except the 45- to 64-year cohort, more males than females reported high coping, with the difference widest among young adults aged 18 to 24 years. The literature also reports that, compared with males, females tend to experience higher rates of chronic stress and daily stressors that can negatively impact their sense of control and adaptive coping capacity.[35] However, caution is warranted before drawing firm conclusions as these results could potentially be explained by sex differences in stress appraisal. Indeed, findings from a meta-analysis suggest that women tend to appraise stress more severely than men.[36] As the coping measure used in this study focussed on perceived ability to handle stress, the observed differences could be due to how males and females appraised the question, rather than true differences in coping. Exploring this further would be worthwhile.

Among adults aged 25 years and over, the prevalence of high coping was significantly greater for those in the highest household income adequacy quintile. The ability to adopt effective and healthy coping strategies is associated with socioeconomic status, which determines the availability of resources and expectations of control a person has when navigating daily stressors.[37] Of note, our findings indicate no significant differences in the prevalence of high coping between those in the highest household income quintile and those in the lowest quintiles in the youngest cohorts (aged 12–17 and 18–24 years). This suggests that income is not a major influence on coping for younger populations as much as it is for older age groups. One reason that could be that the stressors associated with income and associated expectations of control may be felt differently by adolescents and young adults.[38]

Adults aged 18 to 44 years and living in rural areas reported a significantly greater prevalence of high coping than those living in population centres. This may be indicative of differences in sense of community belonging, which has a significant relationship with mental health.[39] For example, in Ontario, rural residents reported a stronger sense of community belonging than did residents of population centres; sense of community belonging is associated with better coping and resiliency when faced with unfavourable circumstances.[40] This finding is also consistent with national estimates examining inequalities in high community belonging.[10]

Compared with non-immigrants, immigrants aged between 25 and 44 years reported higher levels of coping, whereas immigrants aged 65 years and older reported lower levels of coping. A potential explanation for these mixed results is suggested by the decline in the healthy immigrant effect and in immigrants' mental health with more time spent in the destination country.[41] The greater prevalence of high coping among older non-immigrants compared to immigrants could also be attributed to migration-related stressors such as social isolation, lack of English or French language proficiency and limited access to culturally sensitive health care.[42,43] These, in turn, can lead to older adult immigrants experiencing greater difficulties coping with familial, societal and personal changes from pre-migration contexts.[44]

Our study found that youth aged 12 to 17 years and adults aged 25 to 44 years who identify as Indigenous had a significantly lower prevalence of high coping than those who did not identify as Indigenous. These findings are supported by other evidence of discrepancies in PMH outcomes.[45] These discrepancies may be due to the disproportionately high number of barriers Indigenous people encounter in accessing mental health care services,[46] which make it difficult to acquire the tools and support individuals may need to cope. These systemic barriers are rooted in cultural discontinuity, discrimination and the intergenerational cycle of trauma perpetuated

TABLE 3
Overall and age group–specific prevalence estimates of high coping disaggregated by sociodemographic variables, Canada (excluding territories), 2019

Sociodemographic characteristic	Proportion of respondents with high levels of coping, % (95% CI)[a]					
	Overall (N = 60 643)	12–17 years (n = 3609)	18–24 years (n = 2999)	25–44 years (n = 13 572)	45–64 years (n = 15 549)	65+ years (n = 24 914)
Sex						
Male (reference)	83.2 (82.4–84.0)	78.8 (75.9–81.8)	73.8 (70.0–77.6)	81.5 (80.0–83.1)	86.3 (85.1–87.5)	88.1 (87.0–89.2)
Female	79.7* (78.9–80.6)	72.0* (68.9–75.0)	64.9* (61.1–68.6)	77.6* (76.1–79.2)	84.7 (83.4–86.0)	84.8* (83.7–85.9)
Gender						
Male (reference)	83.2* (82.4–84.0)	78.7 (75.8–81.7)	74.0 (70.3–77.8)	81.5 (80.0–83.1)	86.3 (85.1–87.6)	88.1 (87.0–89.2)
Female	79.8* (79.0–80.6)	72.2* (69.2–75.2)	65.0* (61.2–68.8)	77.6* (76.1–79.2)	84.7 (83.4–86.0)	84.8* (83.7–85.9)
Household income quintile adequacy						
Q1 (lowest) (reference)	76.6* (75.3–78.0)	74.8 (69.6–80.1)	68.3 (63.0–73.6)	75.0 (72.5–77.6)	78.3 (75.9–80.8)	82.5 (80.8–84.2)
Q2	80.5 (79.2–81.9)	74.9 (69.8–80.0)	67.9 (61.3–74.5)	80.7* (78.5–82.9)	83.0* (80.6–85.5)	84.6 (82.8–86.3)
Q3	82.4 (81.1–83.6)	75.3 (70.9–79.8)	68.3 (62.0–74.7)	80.7* (78.3–83.1)	86.9* (85.0–88.8)	88.2* (86.6–89.9)
Q4	83.2 (82.0–84.4)	76.6 (72.3–80.9)	69.9 (63.6–76.2)	80.9* (78.5–83.3)	87.4* (85.5–89.2)	89.4* (87.6–91.1)
Q5 (highest)	84.4* (83.2–85.5)	73.8 (68.4–79.3)	75.3 (69.9–80.6)	80.3* (77.8–82.7)	88.4* (86.8–89.9)	89.6* (87.7–91.4)
Place of residence						
Population centre	81.0* (80.4–81.7)	75.2 (72.7–77.6)	68.8* (65.8–71.7)	79.2* (78.0–80.3)	85.5 (84.5–86.6)	86.1 (85.2–87.1)
Rural area (reference)	83.3 (82.4–84.3)	76.9 (73.3–80.5)	74.9 (70.1–79.7)	81.9 (79.9–83.9)	85.3 (83.8–86.8)	86.8 (85.5–88.1)
Immigration status						
Yes (reference)	82.0 (80.7–83.3)	75.8 (69.1–82.4)	68.6 (62.6–74.6)	82.0 (80.0–84.1)	85.3 (83.3–87.4)	84.0 (82.0–86.1)
No	81.2 (80.6–81.9)	75.7 (73.4–77.9)	70.0 (67.0–73.1)	78.4* (77.2–79.7)	85.5 (84.5–86.4)	87.2* (86.4–87.9)
Ethnocultural background						
White (reference)	82.4 (81.8–83.0)	74.8 (72.3–77.3)	71.4 (68.3–74.5)	79.6 (78.4–80.7)	85.8 (84.8–86.7)	87.0 (86.2–87.7)
South Asian	81.1 (78.4–83.8)	84.5* (77.0–92.0)	69.1 (59.2–79.0)	81.4 (77.0–85.7)	87.1 (81.9–92.3)	80.6 (71.9–89.4)
East/Southeast Asian	76.1* (73.3–78.9)	76.9 (70.2–83.6)	59.8* (50.5–69.1)	76.4 (71.6–81.1)	83.9 (79.7–88.1)	81.2*(75.1–87.2)
Black	81.8 (78.2–85.4)	80.2 (70.5–90.0)	72.2 (60.5–83.9)	84.0 (78.8–89.1)	83.3 (75.4–91.1)	87.7 (79.1–96.4)
Arab/West Asian	80.0 (75.3–84.6)	68.6 (53.5–83.6)	70.8 (56.5–85.2)	83.0 (77.1–89.0)	87.2 (77.7–96.7)	68.6[E] (47.3–89.8)
Latin American	81.5 (75.7–87.4)	86.4* (75.3–97.5)	60.9 (40.2–81.5)[E]	87.8 (81.5–94.2)	81.6 (70.1–93.1)	81.1 (60.2–100.0)
Indigenous	74.6* (71.8–77.3)	60.4* (52.0–68.9)	74.5 (66.2–82.9)	70.8* (65.8–75.8)	80.9* (76.8–85.0)	86.4 (82.4–90.3)

Source: Canadian Community Health Survey – Annual Component.[29]

Abbreviations: CI, confidence interval; Q, quintile.

[a] All estimates are weighted.

[E] Interpret with caution due to high sampling variability (coefficient of variation between 15.1% and 35%).

* Significantly different from the reference group, at $p < 0.05$.

by colonization that continues to affect the Indigenous peoples' healing and coping.[47,48] What was unexpected was that this discrepancy did not occur among young adults aged 18 to 24 years or adults aged 45 years and older. Further investigation of age-associated stressors is needed to fully capture the complexity of coping among Indigenous youth and adults.

Of note, the only difference in prevalence of high coping in racialized populations was among those aged 25 to 44 years. This finding could be due to the heterogeneity of the sample and differences in how individuals with diverse ethnocultural backgrounds conceptualize coping and daily stressors.[49,50]

Prevalence of PMH indicators among those with high coping

Overall, those who reported high levels of coping had a substantially greater prevalence of high PMH. The prevalence of high SRMH and mean life satisfaction was highest among youth aged 12 to 17 years, while the prevalence of high happiness was highest among adults 45 years and older. Young adults (18–24 years) had the lowest prevalence of high SRMH and high happiness.

These findings are not surprising and conform with those shown in the PMHSIF.[10] The age group–related variations in PMH may, in part, be due to differences in developmental stage coping mechanisms when solving everyday problems.[51] For instance, a measurement burst study of participants aged 20 to 79 years found that older adults were more likely than younger ones to report particular events as less unpleasant or severe.[28] Our findings supports the socioemotional selectivity theory,

FIGURE 1A
Overall and age-specific estimates of mean life satisfaction[a] among those with high levels of coping, Canada (excluding territories), 2019

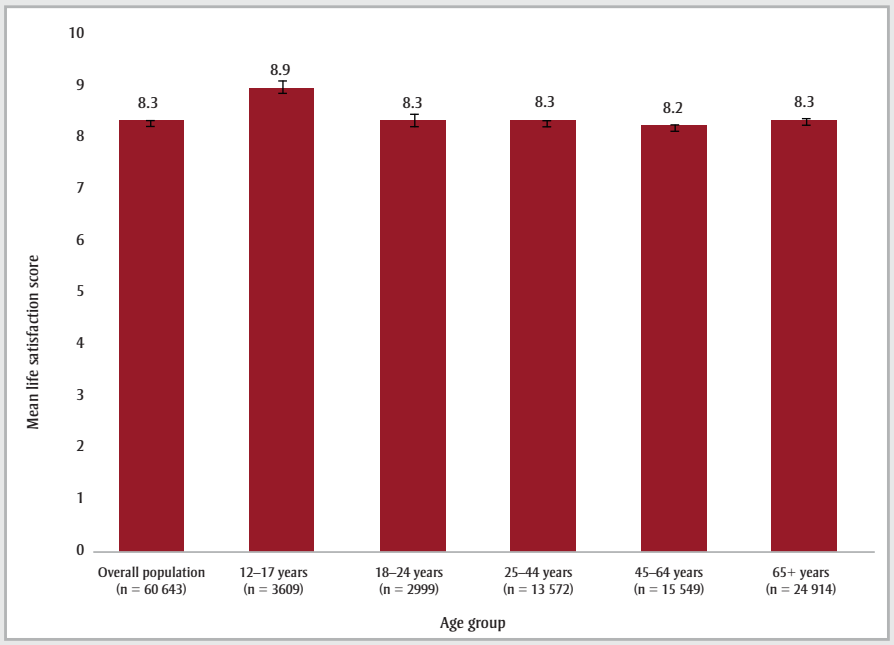
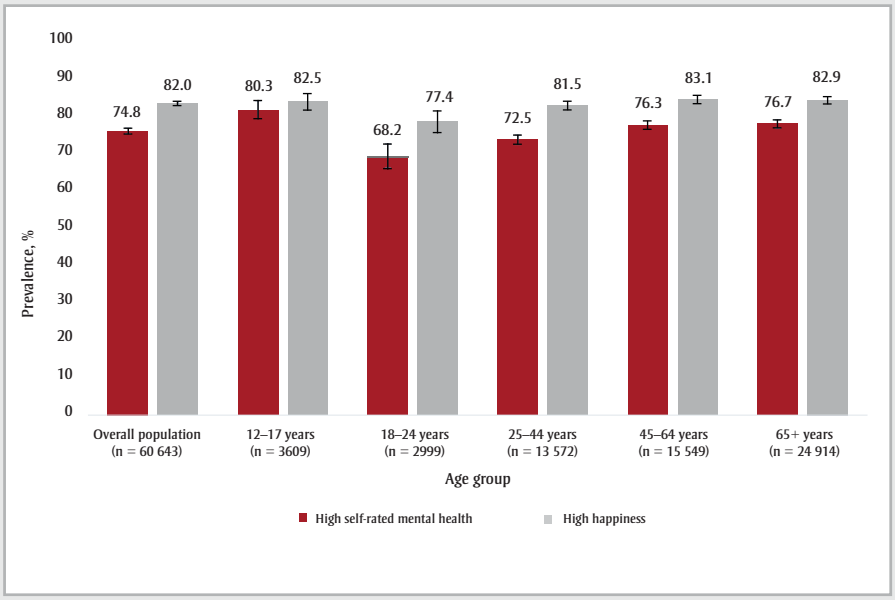


FIGURE 1B
Overall and age-specific estimates of high SRMH and happiness among those with high levels of coping, Canada (excluding territories), 2019



Source: Canadian Community Health Survey – Annual Component.[29]

Abbreviations: CI, confidence interval; SRMH, self-rated mental health.

Notes: Error bars represent 95% CIs. Prevalence estimates for positive mental health (high vs. low) add up to 100% among individuals with high coping.

[a] Life satisfaction was rated on a scale from 0 (very dissatisfied) to 10 (very satisfied).

which asserts that older adults are more motivated to engage in positive, emotionally meaningful experiences and implement proactive coping to minimize exposure to adverse stressors.[28,52]

It is important to take into account the unique challenges associated with transitioning from adolescence to adulthood that requires distinct coping strategies and resources. The current study results could help support the promotion of targeted public health strategies, such as public health messaging and development of stress-management resources in various settings (e.g. educational institutions, workplaces, households, etc.) to foster positive coping across the developmental stages.[53]

Age group–specific associations between coping and three PMH measures

Our findings show a strong relationship between coping and the three PMH outcomes across the five age groups. Our results provide support for the broaden-and-build theory[20] and are consistent with previous cross-sectional[3] and longitudinal[24] Canadian research that demonstrated a prominent association between coping and PMH. As decreases in population-level PMH were documented during the COVID-19 pandemic,[54,55] it will be important to continue monitoring coping to assess if it continues to be impacted.

Strengths and limitations

To our knowledge, this is the first study to report age group–specific prevalence estimates of coping across different sociodemographic variables and to examine age group–specific associations between coping and PMH. This type of stratification enabled us to detect similarities and differences between subgroups that would not have been captured by analyzing the overall sample. Because the survey data were collected over 12 months, seasonality is not a concern in terms of effects on participant responses.

Coping is a complex construct that encompasses a variety of behaviours and strategies (e.g. active coping, disengagement, restraint coping, emotion-focussed coping and others).[56] The coping measure used in this study was high level and could not capture those nuances. To better identify the distinctions between the different coping behaviours and strategies, future studies could replicate this analysis using

TABLE 4
Age group–specific logistic and linear regression models of the association between high levels of coping and PMH outcomes, Canada (excluding territories), 2019

Age group, years	High SRMH		High happiness		Life satisfaction score	
	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)	β (95% CI)	aβ (95% CI)
Overall	5.71 (5.28–6.18)	5.54 (5.11–6.01)	4.72 (4.36–5.11)	4.57 (4.20–4.96)	1.16 (1.10–1.22)	1.16 (1.10–1.22)
12–17	4.43 (3.42–5.73)	4.23 (3.20–5.57)	3.79 (2.91–4.93)	3.80 (2.87–5.04)	0.87 (0.72–1.02)	0.85 (0.71–0.98)
18–24	5.82 (4.50–7.54)	5.99 (4.55–7.90)	4.27 (3.26–5.60)	4.60 (3.44–6.16)	1.07 (0.90–1.25)	1.06 (0.89–1.23)
25–44	5.22 (4.55–5.99)	5.09 (4.42–5.85)	4.67 (4.08–5.35)	4.61 (4.00–5.31)	1.10 (1.00–1.19)	1.06 (0.97–1.15)
45–64	6.58 (5.64–7.67)	6.54 (5.56–7.68)	5.46 (4.68–6.37)	5.29 (4.49–6.23)	1.36 (1.22–1.50)	1.28 (1.14–1.41)
65+	5.58 (4.85–6.43)	5.39 (4.68–6.21)	3.93 (3.43–4.51)	3.93 (3.41–4.53)	1.37 (1.24–1.49)	1.32 (1.19–1.45)

Source: Canadian Community Health Survey – Annual Component.[29]

Abbreviations: aOR, adjusted odds ratio; aβ, adjusted beta coefficient; β, beta coefficient; CI, confidence interval; OR, odds ratio; PMH, positive mental health; SRMH, self-rated mental health.

Notes: The reference group were individuals who reported having a low level of coping. All associations were statistically significant at $p < 0.05$. Covariates adjusted for included sex, age group (only for the overall population), household income adequacy quintile, place of residence, immigrant status and ethnocultural background.

more detailed coping scales (such as the Ways of Coping scale).[30,31]

Due to the cross-sectional nature of data collection, causality and temporality between any of the variables cannot be established. The response rate to the 2019 CCHS was only 54.4%, which increases the likelihood of sampling bias. It is possible that certain populations (e.g. those experiencing mental ill-health) were less likely to opt in. In addition, it is likely that the sociodemographic characteristics of individuals who did not opt into the survey differ from those who did, resulting in non-response bias. While we tried to address this through survey weighting, it is an important limitation to note. Evidence from the National Household Survey suggests that there is a higher risk of non-response bias for immigrants, Indigenous people, some racialized groups and educational status (non-response bias indicators from −3.4 to +7.3 for these groups).[57] While we were unable to find non-response bias indicator estimates for the CCHS, we expect similar estimates given the analogous methodology.

There could also be methodological differences in how different age groups interpret and respond to the coping and PMH measures. As we did not conduct measurement invariance analyses across age groups, caution is warranted when interpreting our findings. It should also be noted that the study sample and results are not inclusive of individuals living in the territories or on First Nations reserves and other Indigenous communities. Moreover, the survey was available to respondents who speak English or French, which limits the representation of some populations. Lastly, all data in the analysis were self-reported and are subject to social desirability bias.

Conclusion

The current study reveals that, depending on the age group, the prevalence of high coping varies by sex, gender, income, place of residence, immigration status and ethnocultural background. Moreover, high coping substantially increased the likelihood of reporting high SRMH, happiness and life satisfaction for every age group. These findings address a gap in the current public health surveillance evidence by providing empirical support linking an individual-level determinant (coping) and PMH, offering insights for policy makers promoting the mental well-being of people in Canada. As our study did not examine indicators of psychological and social well-being, further exploration of the relationship between coping and different PMH outcomes among children, youth and adults is encouraged.

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Conflicts of interest

The authors have no conflicts of interest to disclose.

Authors' contributions and statement

MJ: Formal analysis, methodology, project administration, visualization, writing – original draft, writing – review and editing.

LLO: Conceptualization, methodology, writing – review and editing.

KCR: Writing – review and editing.

MV: Conceptualization, formal analysis, methodology, validation, project administration, writing – review and editing.

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At-a-glance

The contribution of active transportation to population physical activity levels

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This article has been peer reviewed.

Abstract

We explored the contribution of active (nonmotorized) transportation, including walking and cycling, to physical activity (PA) levels and its association with PA recommendations adherence (youth: ≥ 60 min/day; adults: ≥ 150 min/week) using self-reported domain-specific and accelerometer-measured PA from Cycles 4 to 6 (2014–2019) of the Canadian Health Measures Survey (N = 8620). Recreation and household or occupational PA were similar for users and non-users, but accelerometer-measured PA was significantly higher among active transportation users (12–17 years: 56.6 vs. 47.7 min/day; 18–64 years: 33.4 vs. 22.8 min/day, 65–79 years: 21.5 vs. 13.7 min/day). Active transportation was not associated with meeting the PA recommendation for youth after adjusting for confounders (adjusted odds ratio [aOR] = 1.39; 95% confidence interval [CI]: 0.91–2.11), but it was for adults (18–64 years: aOR = 2.71, 95% CI: 2.18–3.37; 65–79 years: aOR = 2.26, 95% CI: 1.39–3.69). Given its contribution to population PA levels, supporting active transportation should be considered an important tool for health promotion.

Keywords: *exercise, transportation, public health surveillance*

Highlights

- Recreation and household or occupational physical activity were similar for active transportation users and non-users.
- Accelerometer-measured physical activity was higher among active transportation users across all age groups.
- Participating in active transportation increases the likelihood of achieving the physical activity recommendation for adults and is important for health promotion.

Introduction

Physical activity (PA) is protective against many chronic conditions and all-cause mortality and promotes positive mental health and well-being.[1-3] Measuring PA across several domains, including recreational, occupational or school, household and transportation domains, is important for population surveillance.[4,5] Although PA promotion often prioritizes leisure PA, largely because most of the earlier evidence showing the benefits of PA for health based on studies with self-reported leisure PA,[6-8] examination of all domains provides critical information to informing PA promotion activities.

Active transportation, or self-powered or nonmotorized travel, involves walking, cycling or other means of getting to destinations like work or school, running errands or shopping for groceries, visiting friends, going to places of entertainment and various other trips.[9] Data from the 2021 Canadian Community Health Survey show that 61.0% of youth and 41.7% of adults engage in some form of active transportation to get to destinations.[5] The 2021 Canadian Census (collected during the COVID-19 pandemic) recorded that 6.2% of working Canadians reported using active transportation as their main mode of commuting to work (down from 6.9% in 2016).[10] An additional 1.7% and 1.3% reported walking and cycling, respectively, when they used multiple modes of transportation to commute.[10]

Active transportation is a valuable and often overlooked tool for achieving the PA recommendations identified in Canada's 24-Hour Movement Guidelines.[11] Specifically, the guidelines recommend that adults achieve 150 minutes of weekly moderate-to-vigorous intensity physical activity (MVPA) and children and youth engage in an average of 60 minutes of MVPA per day. Active transportation is associated with higher levels of PA and an increased likelihood of achieving PA recommendations.[12] Further, it is likely that active transportation promotes additional PA rather than replacing other forms of PA.[12] Previous studies conducted in Canada (largely using nonrepresentative samples) also suggested that active transportation, including walking to and from public transit, results in a greater likelihood of meeting the PA recommendations,[13-15] but with

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some evidence of compensation among older adults.[16] Transportation-related PA (especially cycling) is associated with better cardiometabolic health[17] and reduced risk of cardiovascular disease,[18-21] type 2 diabetes,[21,22] cancer-related mortality[18] and all-cause mortality.[18-21]

Most of the research exploring the association between active transportation and PA has emerged from Australia, Europe and the United States.[12] The objective of this study was to determine the association between active transportation and PA recommendations and to understand the contribution of active transportation to Canadians' overall PA levels.

Methods

This study combined data from Cycles 4 to 6 (2014–2019) of the Canadian Health Measures Survey (CHMS). The CHMS is an ongoing cross-sectional survey, conducted by Statistics Canada, that collects self-reported and directly measured health information from a nationally representative sample of the household-dwelling population aged 3 to 79 years in Canada.[23] Excluded are people living in the three territories and certain remote regions, on reserves and other Indigenous settlements, and in institutions, which equates to approximately 4% of the target population.[23] The CHMS is collected year-round across all seasons.

The analyzed sample included 8620 youth and adults (aged 12–79 years) with complete and valid self-reported and accelerometer-measured PA.

Youth respondents were asked about the number of minutes per day they spent doing different types of MVPA over the previous 7 days. Adult respondents were asked about the number of minutes they spent doing different types of MVPA in the previous 7 days for a minimum of 10 continuous minutes. Self-reported average minutes per day spent in total and domain-specific MVPA was estimated for transportation, recreational and occupational or household PA. "Active transportation users" were defined as those people who used nonmotorized ways, such as walking or cycling, to get to school, work, the bus stop, and so on, or for running errands, going shopping or visiting friends.

After completing the household section of the CHMS questionnaire, respondents who attended a clinic visit were asked to wear an Actical accelerometer (Philips Respironics, Oregon, US) over their right hip during waking hours for 7 consecutive days. A minimum of 4 days with 10 hours or more of wear time per day was required. Previously validated movement intensity thresholds[24,25] were applied to derive time spent being sedentary and being physically active at light, moderate and vigorous intensity PA. PA recommendation adherence was defined as an average of 60 or more minutes per day and 150 or more minutes per week of accelerometer-measured MVPA for youth and adults, respectively.[11]

Adherence to the PA recommendation was estimated using proportions and 95% confidence intervals (CIs) and compared between active transportation users and non-users using the Rao-Scott chi-square (χ^2) test. We used multivariate logistic regression to determine the association between self-reported active transportation use and PA recommendation adherence for youth (12–17 years) and adults (18–64 and 65–79 years) while adjusting for age, sex, income quintile and ethnicity (not racialized, racialized, Indigenous Peoples).

T tests compared time spent in self-reported PA domains and accelerometer-measured MVPA among active transportation users and non-users. All measures of PA were log-transformed after adding a constant to address the high number of zeroes. All analyses were weighted using combined cycle accelerometer subsample survey weights. Degrees of freedom were set at 33. To account for survey design effects, 95% CIs were estimated using the bootstrap-balanced repeated replication technique with 500 replicate weights. Statistical significance was set at $p < 0.05$. Statistical analyses were performed using SAS Enterprise Guide version 7.1 (SAS Institute Inc., Cary, NC, US).

The CHMS protocol was approved by the Health Canada–Public Health Agency of Canada Research Ethics Board.

Results

Almost three-quarters (70.5%) of youth, less than half (44.2%) of adults aged 18 to 64 years and one-third (33.8%) of adults aged 65 to 79 years used active means of transportation. Across all ages, adherence to the PA recommendation was significantly higher among active transportation users than non-users (12–17 years: 33.3 vs. 25.1%; 18–64 years: 62.5 vs. 37.6%; 65–79 years: 35.5 vs. 20.5%) (see Figure 1).

While the PA recommendation adherence point estimate was higher among active transportation–using youth, active transportation was not associated with meeting the PA recommendation after adjusting for confounders (adjusted odds ratio [aOR] = 1.39, 95% confidence interval [CI]: 0.91–2.11). Adult active transportation users were significantly more likely than adult non-users to meet the PA recommendation, even after adjusting for confounders (18–64 years: aOR = 2.71, 95% CI: 2.18–3.37; 65–79 years: aOR = 2.26, 95% CI: 1.39–3.69). Further adjustment for season of response had little effect on the effect estimates, and season was not a significant predictor in the models (results not shown).

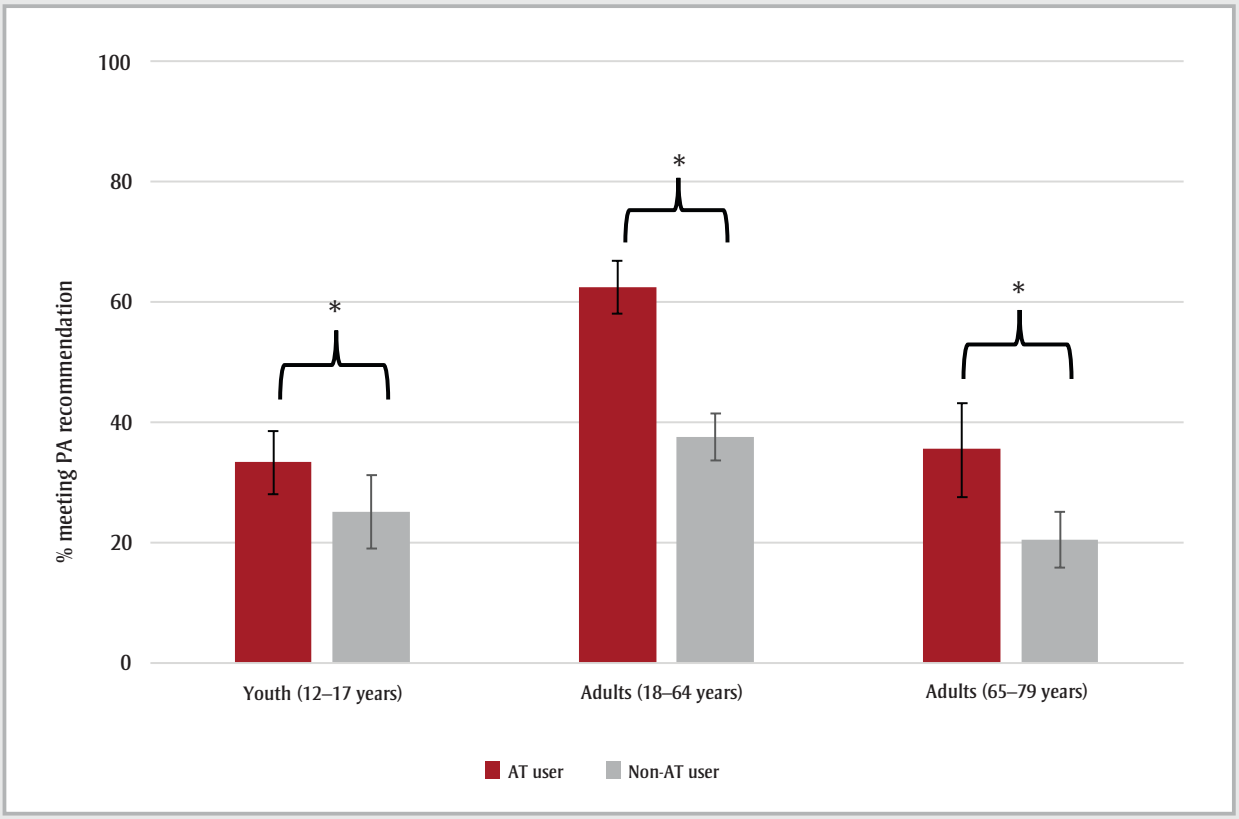
Average time spent in recreation and occupational or household PA did not differ statistically between active transportation users and non-users, while time spent in accelerometer-measured MVPA was significantly higher for active transportation users than non-users across all age groups (12–17 years: 56.6 vs. 47.7 min/day; 18–64 years: 33.4 vs. 22.8 min/day; 65–79 years: 21.5 vs 13.7 min/day) (see Figure 2).

Discussion

The results of this study suggest that participating in active transportation increases the likelihood of achieving the PA recommendations of the 24-Hour Movement Guidelines among adults. Canadians that engaged in active transportation had similar levels of occupational or household and recreational PA, but higher levels of accelerometer-measured MVPA. As such, active transportation appears to be additive rather than substitutive across PA domains.

Recent estimates show that only 49.2% of adults and 35.6% of youth in Canada, adhere to the PA recommendations.[5] Walking is generally more prevalent than cycling, males report more time spent in active transportation than do females, and active transportation use declines with age.[9] Our findings are similar to recent systematic reviews that suggested that those who engage in active transportation

FIGURE 1
Adherence to the PA recommendation (≥ 150 min/week of accelerometer-measured MVPA) by active transportation–using and non-using youth (12–17 years) and adults (18–64 and 65–79 years), Canada (excluding territories)



Source: Canadian Health Measures Survey, Cycles 4 to 6 (2014–2019).

Abbreviations: AT, active transportation; CI, confidence interval; MVPA, moderate-to-vigorous intensity physical activity; PA, physical activity.

Note: Error bars represent 95% CIs.

* $p < 0.05$.

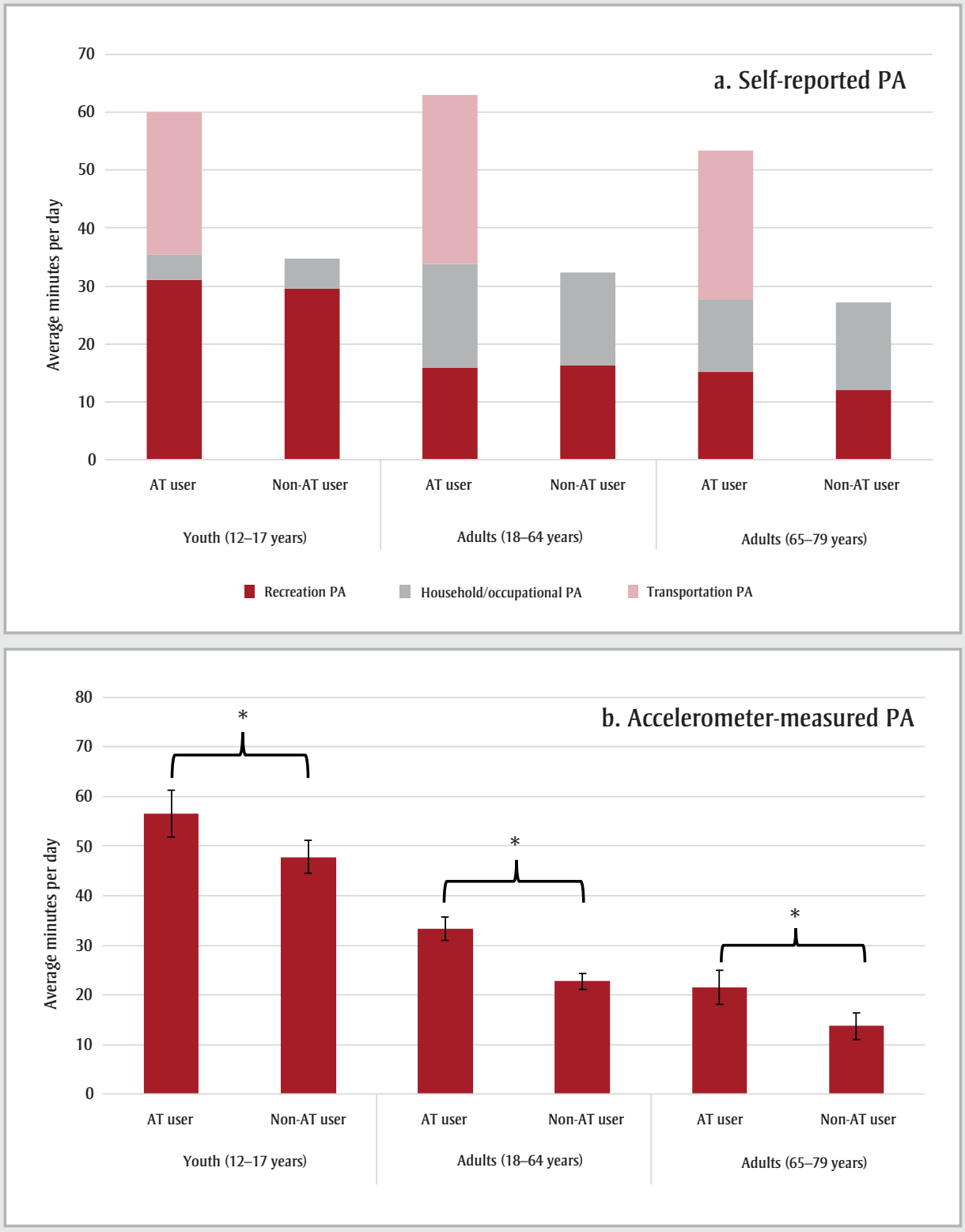
also engage in more device-measured total PA and that active transportation does not generally displace other activity.[12,26,27]

The World Health Organization's Global Action Plan on Physical Activity 2018–2030 has a target reduction of 15% in the global prevalence of physical inactivity among adolescents and adults by 2030.[28] The plan calls for investments in policies and urban and transport planning to promote walking and cycling and other forms of active transportation.[28] *A Common Vision for Increasing Physical Activity and Reducing Sedentary Living in Canada: Let's Get Moving*[29] and the 2017 Chief Public Health Officer of Canada's Report[30] recognized the importance of the physical environment for providing supportive and accessible opportunities to integrate PA into the daily lives of Canadians. One of the strategic imperatives of the *Common Vision* identifies supporting active transportation and transit solutions (e.g. enhancing bike routes, integrating public transportation systems).[29] Canadian research has shown that the active living friendliness or walkability of a neighbourhood is positively associated with accelerometer-measured MVPA and active transportation–based PA by youth and adults.[31] Systematic review evidence has also shown that the creation and improvement of infrastructure that supports pedestrians and cyclists (e.g. sidewalks, street connectivity, bike paths, traffic calming zones) is positively associated with active transportation.[32-34]

The literature showing causal effects of supportive infrastructure on active transportation suggests that investments in sidewalks and cycling infrastructure, for example, by the transportation or infrastructure sectors, could also be viewed as public health investments.[32] The National Active Transportation Strategy[35] outlines a vision for advancing active transportation through evidence-based investments in new and existing infrastructure that supports active transportation.

The perceived comfort and safety of infrastructure is a key consideration for promoting active transportation.[36,37] The Canadian Bikeway Comfort and Safety (Can-BICS) classification system provides a standard naming convention for cycling infrastructure across cities in Canada and a three-tier classification system based on the safety and comfort of people using bicycle facilities.[38] Research using 2022 OpenStreetMap data found that 34% of Canadian neighbourhoods had no cycling infrastructure, 40% had no medium- or high-comfort cycling infrastructure and only 5% (for 6% of the population) had the highest category of Can-BICS.[39] Improving the safety and comfort of walking and cycling infrastructure in Canada is likely an important way of promoting active transportation and

FIGURE 2
Average minutes per day spent in (a) different self-reported PA domains and (b) accelerometer-measured MVPA by active transportation–using and non-using youth (12–17 years) and adults (18–64 and 65–79 years), Canada (excluding territories)



Source: Canadian Health Measures Survey, Cycles 4 to 6 (2014–2019).

Abbreviations: AT, active transportation; MVPA, moderate-to-vigorous intensity physical activity; PA, physical activity.

Note: Error bars represent 95% confidence intervals.

* $p < 0.05$.

contributing to the daily PA of Canadians and hence their health.

Strengths and limitations

This study includes data from a nationally representative sample of Canadians with measured and self-reported PA. In our assessment of the association between active transportation and PA recommendation adherence, we adjusted for important sociodemographics that have shown to be associated with PA and active transportation (i.e. age, sex, income quintile and ethnicity). In addition, a sensitivity analysis assessed whether season of data collection affected the estimates. It is possible, however, that the results could be affected by residual confounding from variables not included in the models.

Important limitations of this work need to be acknowledged. There is a discordance between the self-reported and accelerometer-measured PA data; the self-reported PA data reflect a 7-day recall in the week before the household questionnaire, while the accelerometer data are collected the week after the visit to the clinic. It is also possible that those who wore an accelerometer changed their PA habits as a result of being monitored. In addition, comparisons of self-reported and accelerometer-measured total PA levels (Figure 2) indicate that participants who engaged in active transportation may overreport their PA levels. Previous work has also found that self-reported and accelerometer-measured levels of PA differ.[40,41] Future work could explore whether engaging in certain types of PA biases this discordance.

Finally, the survey questions group walking, cycling and other forms of active transportation together. It would be important for future work, if possible, to explore the separate contributions of walking, cycling and other modes of active transportation to population PA levels.

Conclusion

Active transportation is an important domain for health promotion and provides important health benefits. Canadians, and especially adults, who engaged in active forms of transportation were more likely to adhere to the PA recommendations and engaged in more PA than those who do not. Policy and programs developed to promote PA should include active transportation as a core component.

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Conflicts of interest

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Authors' contributions and statement

SAP: Conceptualization, formal analysis, methodology, validation, writing – original draft, writing – review and editing.

GPB: Conceptualization, methodology, validation, writing – original draft, writing – review and editing.

Both authors read and approved the final version of the manuscript.

The content and views expressed in this article are those of the authors and do not necessarily reflect those of the Government of Canada.

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At-a-glance

Primary caregivers of individuals with developmental disabilities or disorders in Canada: highlights from the 2018 General Social Survey – Caregiving and Care Receiving

Sarah Palmeter, MPH; Siobhan O'Donnell, MSc; Sienna Smith, MPH

This article has been peer reviewed.

Abstract

Using data from the 2018 General Social Survey – Caregiving and Care Receiving, we examined the characteristics of caregivers of people with developmental disabilities or disorders (DD) and the impacts of caregiving on these caregivers. The proportion of DD caregivers with optimal general and mental health was smaller than the proportion of non-caregivers. About two-thirds of DD caregivers reported feeling worried or anxious, or tired and almost half reported unmet support needs. However, compared with caregivers of individuals with other conditions, a significantly higher proportion of DD caregivers described their caregiving experiences as rewarding.

Keywords: *developmental disorders, developmental disabilities, General Social Survey, caregivers, neurodevelopmental disorders, population surveillance, surveys and questionnaires*

Highlights

- Characteristics of caregivers of individuals with developmental disabilities or disorders ("DD caregivers") were compared with those of caregivers of individuals with other conditions and with those of non-caregivers.
- A smaller proportion of DD caregivers than non-caregivers reported optimal general and mental health.
- Many DD caregivers reported feeling worried or anxious, feeling tired and spending less time taking care of themselves due to their caregiving responsibilities.
- Almost half of DD caregivers reported unmet support needs, particularly financial support, government assistance or tax credits, occasional relief or respite care, and home care or support.
- Despite these challenges, a significantly higher proportion of DD caregivers described their caregiving experiences as rewarding or very rewarding compared with other caregivers.

Introduction

Unpaid caregiving is increasingly common in Canada, driven by an aging population, the rising prevalence of disabilities and a growing emphasis on community- and home-based care.[1,2] In 2018, about one in four people aged 15 years and older provided unpaid care to a friend or family member with a long-term health condition, disability or age-related issue in Canada.[3]

While all caregivers face unique challenges, those supporting individuals with developmental disabilities or disorders (DD) have distinct experiences. These caregivers (referred to as "DD caregivers") often provide ongoing support that evolves throughout the care receiver's lifespan.[4,5] Their roles are important and wide-ranging, impacting the lives of children, youth and adults with DD.[4,6,7]

DD encompass a group of conditions characterized by differences in physical development, learning, language or behaviour, which can affect daily functioning.[8] DD become apparent early in life and last throughout a person's life. Common examples include intellectual disabilities, autism, attention-deficit/hyperactivity disorder, fetal alcohol spectrum disorder, Down syndrome and cerebral palsy.

Population-based studies in Canada have found that caregivers of children with DD report more health problems and poorer mental health than those caring for children without DD.[9,10] Population-based studies from other countries also report poorer health outcomes, mental health challenges, increased financial struggles and lower well-being among DD caregivers.[5,11]

To better understand these aspects, we used data from the 2018 General Social Survey (GSS) – Caregiving and Care Receiving[12] to examine the characteristics of caregivers of children, youth and adults with DD living in Canada and to describe the impacts of caregiving on caregivers.

Methods

Data source and study population

The GSS – Caregiving and Care Receiving is a national survey of people aged 15 years

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and older living in Canada's 10 provinces.[12] The 2018 survey collected information on primary caregivers, that is, people who provided help or care to family members, friends or neighbours with a long-term health condition, physical or mental disability or aging-related problem in the past 12 months. Paid help or help provided on behalf of an organization were not within the scope of this survey.

Our study focus was on primary caregivers of people whose "main health condition or problem for which they have received help" was a "developmental disability or disorder."[12]

The full unweighted sample of the 2018 GSS was 20258, of whom 248 self-identified as DD caregivers, 7416 as caregivers of individuals with conditions other than DD (referred to as "other caregivers") and 12594 as non-caregivers. About 1% of caregiver interviews and 2% of non-caregiver interviews were conducted by proxy when the respondent did not speak English or French or could not participate in the survey for health reasons.[12]

Statistical analysis

Descriptive analyses were conducted to examine DD caregivers' and care receivers' sociodemographic characteristics, the type of care provided, caregivers' health status, the impacts of caregiving on caregivers, caregiver supports and unmet support needs.

All estimates were weighted to be representative of all non-institutionalized persons aged 15 years and older, living in the 10 provinces of Canada, using sample weights provided by Statistics Canada for this survey.[12] Bootstrap methods were used to calculate variance estimates, including 95% confidence intervals (CI) and coefficients of variation. The estimates for DD caregivers were compared with estimates for other caregivers or for GSS respondents who were not caregivers, where appropriate. The associated 95% CIs were also compared and non-overlapping 95% CIs were considered statistically significantly different.

Analyses were carried out using statistical package SAS Enterprise Guide version 8.1 (SAS Institute Inc., Cary, NC, US).

Results

Based on data from the 2018 GSS, 4.5% (95% CI: 3.6%–5.3%) of caregivers provided care to a family member or friend with DD. DD were ranked as the seventh most common condition cared for, while aging or frailty (22.7%; 21.2%–24.3%), cancer (9.9%; 8.8%–10.9%) and mental illness (9.7%; 8.5%–11.0%) were the three most common in the survey (data not shown).

Sociodemographic characteristics

The mean age of DD caregivers at the time of the survey was 45.7 years, and 58.9% were female. About one-fifth identified as a visible minority, 55.7% had a postsecondary education and 59.1% were employed (Table 1).

The mean age of the care receivers with DD was 22.5 years (Table 1). Almost two-thirds were male (64.2%) and the children of the caregivers (62.2%) versus another relationship. More than three-quarters lived in the same household as the caregiver (79.2%) and had at least one other caregiver, paid or unpaid (83.9%). Compared with care receivers with other conditions, those with DD were significantly younger and significantly more likely to be male, children of the caregiver, living in the same household as the caregiver and have at least one other caregiver.

Care provided

DD caregivers provided an average of 29 hours of care per week (Table 1), most commonly help with transportation (86.2%); meal preparation, meal clean-up, house cleaning, laundry or sewing (80.0%); and scheduling or coordinating care-related tasks (60.5%). Compared with other caregivers, DD caregivers provided significantly more hours of care per week (29.1 vs. 13.4 hours) and were significantly more likely to provide each type of care.

Health status

Less than half of DD caregivers described their general health and mental health as excellent or very good (40.5% and 45.7%, respectively), and only one-quarter reported that most days were not at all or not very stressful (Table 1). However, more than three-quarters reported that they were satisfied or very satisfied with life (77.2%), and about half indicated that they were happy and interested in life (50.9%). Compared with non-caregivers, DD caregivers reported less optimal general and mental health, more stress, and less life satisfaction and happiness.

Impacts of caregiving

DD caregivers most commonly described feeling worried or anxious as a result of their caregiving responsibilities (70.1%); having rewarding or very rewarding caregiving experiences (68.3%); feeling tired as a result of their caregiving duties (68.0%); and spending less time relaxing or taking care of themselves due to their caregiving (67.0%) (Table 1). While other caregivers experienced similar impacts, a significantly higher proportion of DD caregivers reported feeling overwhelmed (57.8% vs. 42.5%). Conversely, a significantly smaller proportion of DD caregivers reported feeling resentful (15.1% vs. 25.2% for other caregivers), and a significantly higher proportion found caregiving to be very rewarding or rewarding (68.3% vs. 54.2% for other caregivers).

Supports and unmet support needs

Almost three-quarters (73.9%) of care receivers with DD who did not live in an institution also received help from professionals (i.e. paid workers or organizations), and most (87.4%) DD caregivers received some type of support to accommodate their caregiving duties (Table 1). Despite this, almost half (46.8%) of DD caregivers reported unmet support needs, with the most common being financial support, government assistance or tax credit, occasional relief or respite care, home care or support, and emotional support or counselling (Figure 1). Compared with other caregivers, a significantly higher proportion of DD caregivers received help from professionals and some type of support in their caregiving duties, yet still had unmet support needs (Table 1).

Discussion

This is the first study to use data from the GSS to report on the characteristics of DD caregivers in Canada and the impacts of their caregiving experiences. We found the proportion of DD caregivers with optimal health to be smaller than the proportion of non-caregivers with optimal health; more than two-thirds of DD caregivers felt

TABLE 1
Sociodemographic characteristics, care provided, health status, impacts of caregiving, supports and unmet support needs of DD caregivers,[a] other caregivers[b] and non-caregivers,[c] Canada (excluding territories), 2018

Variable	DD caregivers,[a] % (95% CI)	Other caregivers,[b] % (95% CI)	Non-caregivers,[c] % (95% CI)
Sociodemographic characteristics			
Mean age, years	45.7 (42.3–49.2)	49.2 (48.4–49.9)	46.1 (45.9–46.3)
Sex			
Female	58.9 (48.6–69.2)	53.8 (52.0–55.5)	49.5 (48.9–50.1)
Male	41.1 (30.8–51.4)	46.2 (44.5–48.0)	50.5 (49.9–51.1)
Ethnicity[d]			
Visible minority	20.8 (12.3–29.2)[E]	16.7 (15.0–18.4)	25.0 (23.8–26.1)
Not visible minority	79.2 (70.8–87.7)	83.3 (81.6–85.0)	75.0 (73.9–76.2)
Highest level of education			
High school or less than high school	44.3 (33.8–54.9)	36.6 (34.7–38.5)	42.2 (41.0–43.3)
Postsecondary	55.7 (45.1–66.2)	63.4 (61.5–65.3)	57.8 (56.7–59.0)
Employment			
Employed (worked or absent from a job in the previous week)	59.1 (48.6–69.6)	61.2 (59.5–63.0)	61.3 (60.2–62.4)
Unemployed (did not have a job in the previous week)	40.9 (30.4–51.4)	38.8 (37.0–40.5)	38.7 (37.6–39.8)
Mean age of care receiver, years	22.5 (19.5–25.4)	68.9 (68.0–69.8)	NA
Sex of care receiver			
Female	35.8 (26.0–45.6)	63.3 (61.5–65.1)	NA
Male	64.2 (54.4–74.0)	36.7 (34.9–38.5)	NA
Relationship of care receiver to caregiver			
Child of caregiver	62.2 (52.8–71.7)	5.5 (4.7–6.2)	NA
Sibling of caregiver	20.8 (11.5–30.0)[E]	4.7 (3.9–5.5)	NA
Grandchild of caregiver	5.6 (2.4–8.8)[E]	F	NA
Other[e]	11.4 (6.4–16.4)[E]	89.2 (88.1–90.4)	NA
Living situation			
Caregiver living in same household as care receiver	79.2 (72.3–86.1)	33.6 (31.7–35.5)	NA
Caregiver and care receiver living in different households	20.8 (13.9–27.7)[E]	66.4 (64.5–68.3)	NA
Care provided			
Care receiver has at least one other caregiver (paid or unpaid)			
Yes	83.9 (76.3–91.6)	71.1 (69.3–73.0)	NA
No or don't know	16.1 (8.4–23.7)[E]	28.9 (27.0–30.7)	NA
Mean hours of caregiving per week	29.1 (22.7–35.5)	13.4 (12.5–14.2)	NA
Help with transportation			
Yes	86.2 (79.1–93.3)	72.7 (70.9–74.4)	NA
No	13.8 (6.7–20.9)[E]	27.3 (25.6–29.1)	NA
Help with meal preparation, meal clean-up, house cleaning, laundry or sewing			
Yes	80.0 (72.4–87.5)	55.3 (53.5–57.1)	NA
No	20.0 (12.5–27.6)[E]	44.7 (42.9–46.5)	NA
Help with scheduling/coordinating care-related tasks			
Yes	60.5 (50.2–70.8)	39.9 (38.2–41.7)	NA
No	39.5 (29.2–49.8)	60.1 (58.3–61.8)	NA
Help with personal care			
Yes	58.8 (49.0–68.6)	27.7 (26.2–29.3)	NA
No	41.2 (31.4–51.0)	72.3 (70.7–73.8)	NA

Continued on the following page

TABLE 1 (continued)
Sociodemographic characteristics, care provided, health status, impacts of caregiving, supports and unmet support needs of DD caregivers,[a] other caregivers[b] and non-caregivers,[c] Canada (excluding territories), 2018

Variable	DD caregivers,[a] % (95% CI)	Other caregivers,[b] % (95% CI)	Non-caregivers,[c] % (95% CI)
Help with managing finances			
Yes	44.5 (34.9–54.2)	32.0 (30.3–33.7)	NA
No	55.5 (45.8–65.1)	68.0 (66.3–69.7)	NA
Help with medical treatments/procedures			
Yes	37.5 (28.5–46.4)	26.0 (24.5–27.5)	NA
No	62.5 (53.6–71.5)	74.0 (72.5–75.5)	NA
Health status			
General health			
Excellent/very good	40.5 (30.7–50.4)	48.5 (46.6–50.3)	58.6 (57.3–59.9)
Good	41.9 (32.0–51.8)	34.4 (32.7–36.1)	30.1 (28.9–31.3)
Fair/poor	17.5 (11.1–24.0)[E]	17.1 (15.8–18.5)	11.3 (10.6–12.1)
Mental health			
Excellent/very good	45.7 (36.1–55.3)	51.9 (50.1–53.7)	64.1 (62.7–65.4)
Good	32.8 (24.1–41.5)	32.5 (30.8–34.2)	26.5 (25.3–27.7)
Fair/poor	21.5 (13.0–29.9)[E]	15.6 (14.2–17.0)	9.4 (8.6–10.2)
Stress			
Most days not at all/not very stressful	25.8 (16.1–35.5)[E]	28.1 (26.5–29.6)	37.4 (36.2–38.6)
Most days a bit stressful	46.9 (37.2–56.5)	47.2 (45.4–49.0)	42.4 (41.2–43.6)
Most days quite a bit/extremely stressful	27.3 (19.4–35.2)	24.7 (23.2–26.3)	20.1 (19.1–21.2)
Life satisfaction[f]			
Satisfied/very satisfied	77.2 (69.9–84.5)	80.5 (79.0–82.0)	86.9 (86.0–87.8)
Neither satisfied or dissatisfied	15.0 (8.4–21.7)[E]	10.2 (9.0–11.3)	7.2 (6.6–7.9)
Very dissatisfied/dissatisfied	7.8 (3.7–11.8)[E]	9.3 (8.2–10.5)	5.9 (5.2–6.5)
Happiness[f]			
Happy and interested in life	50.9 (40.6–61.1)	58.4 (56.5–60.3)	64.4 (63.2–65.7)
Somewhat happy	42.1 (31.9–52.4)	33.8 (31.9–35.7)	29.9 (28.7–31.1)
Somewhat unhappy / unhappy with little interest in life / so unhappy life is not worthwhile	7.0 (2.7–11.3)[E]	7.8 (6.7–8.9)	5.6 (5.1–6.2)
Impacts of caregiving[g]			
Feel worried or anxious[f]			
Yes	70.1 (59.0–81.2)	62.5 (60.3–64.7)	NA
No	29.9 (18.8–41.0)[E]	37.5 (35.3–39.7)	NA
Feel tired			
Yes	68.0 (57.3–78.6)	59.4 (57.2–61.7)	NA
No	32.0 (21.4–42.7)[E]	40.6 (38.3–42.8)	NA
Feel overwhelmed[f]			
Yes	57.8 (46.8–68.8)	42.5 (40.3–44.7)	NA
No	42.2 (31.2–53.2)	57.5 (55.3–59.7)	NA
Experience disturbed sleep[f]			
Yes	48.6 (37.9–59.2)	41.1 (38.8–43.3)	NA
No	51.4 (40.8–62.1)	58.9 (56.7–61.2)	NA
Feel short-tempered or irritable[f]			
Yes	45.3 (34.8–55.8)	42.7 (40.5–44.9)	NA
No	54.7 (44.2–65.2)	57.3 (55.1–59.5)	NA

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TABLE 1 (continued)
Sociodemographic characteristics, care provided, health status, impacts of caregiving, supports and unmet support needs of DD caregivers,[a] other caregivers[b] and non-caregivers,[c] Canada (excluding territories), 2018

Variable	DD caregivers,[a] % (95% CI)	Other caregivers,[b] % (95% CI)	Non-caregivers,[c] % (95% CI)
Feel depressed[f]			
Yes	28.7 (20.2–37.3)	26.1 (24.3–28.0)	NA
No	71.3 (62.7–79.8)	73.9 (72.0–75.7)	NA
Feel lonely or isolated[f]			
Yes	24.5 (16.3–32.7)[E]	24.3 (22.5–26.2)	NA
No	75.5 (67.3–83.7)	75.7 (73.8–77.5)	NA
Experience loss of appetite[f]			
Yes	15.6 (8.9–22.3)[E]	13.8 (12.4–15.2)	NA
No	84.4 (77.7–91.1)	86.2 (84.8–87.6)	NA
Feel resentful[f]			
Yes	15.1 (8.6–21.6)[E]	25.2 (23.5–27.0)	NA
No	84.9 (78.4–91.4)	74.8 (73.0–76.5)	NA
How rewarding have caregiving experiences been[f]			
Very rewarding/rewarding	68.3 (58.5–78.1)	54.2 (52.0–56.5)	NA
Somewhat/not at all rewarding	31.7 (21.9–41.5)	45.8 (43.5–48.0)	NA
Spend less time relaxing or taking care of self due to caregiving			
Yes	67.0 (56.7–77.3)	58.7 (56.4–61.0)	NA
No	33.0 (22.7–43.3)	41.3 (39.0–43.6)	NA
Supports and unmet support needs			
Care receiver also received help from professionals[h]			
Yes	73.9 (64.0–83.7)	60.0 (58.0–62.1)	NA
No or don't know	26.1 (16.3–36.0)[E]	40.0 (37.9–42.0)	NA
Caregiver received support in caregiving duties[i]			
Yes	87.4 (81.3–93.6)	70.7 (69.1–72.2)	NA
No	12.6 (6.4–18.7)[E]	29.3 (27.8–30.9)	NA
Unmet support needs[j]			
Yes	46.8 (37.0–56.6)	29.6 (27.8–31.5)	NA
No	53.2 (43.4–63.0)	70.4 (68.5–72.2)	NA

Source: 2018 General Social Survey – Caregiving and Care Receiving.[12]

Abbreviations: CI, confidence interval; DD, developmental disabilities or disorders; NA, not applicable.

Notes: Percentages and 95% CIs are based on weighted data. The 95% CI shows an estimated range of values that is likely to include the true value 19 times out of 20.

[a] "DD caregivers" are caregivers of individuals with developmental disabilities or disorders. Unweighted n = 248; weighted n = 333 869.

[b] "Other caregivers" are caregivers of individuals with conditions other than developmental disabilities or disorders. Unweighted n = 7416; weighted n = 7 438 728.

[c] "Non-caregivers" are individuals who were not caregivers. Unweighted n = 12 594; weighted n = 22 982 588.

[d] The *Employment Equity Act* defines members of visible minorities as "persons, other than Aboriginal peoples, who are non-Caucasian in race or non-white in colour."[13] Accordingly, population groups were categorized as "visible minorities" or "not visible minorities." "Not visible minority" includes those who identified as White, Indigenous, and multiple origin White/Latin American and White/Arab-West Asian.[14] The "visible minority" group includes South Asian, Chinese, Black, Filipino, Latin American, Arab, Southeast Asian, West Asian, Korean, Japanese, and other.[14]

[e] Includes spouse/partner, ex-spouse/ex-partner, father, mother, grandfather, grandmother, son-in-law, daughter-in-law, father-in-law, mother-in-law, brother-in-law, sister-in-law, nephew, niece, uncle, aunt, cousin, close friend, neighbour, co-worker and other.

[f] Only asked of respondents who were interviewed by non-proxy.

[g] Asked of caregivers who provided at least 2 hours of care per week.

[h] Only asked of caregivers with care receivers who did not live in an institution.

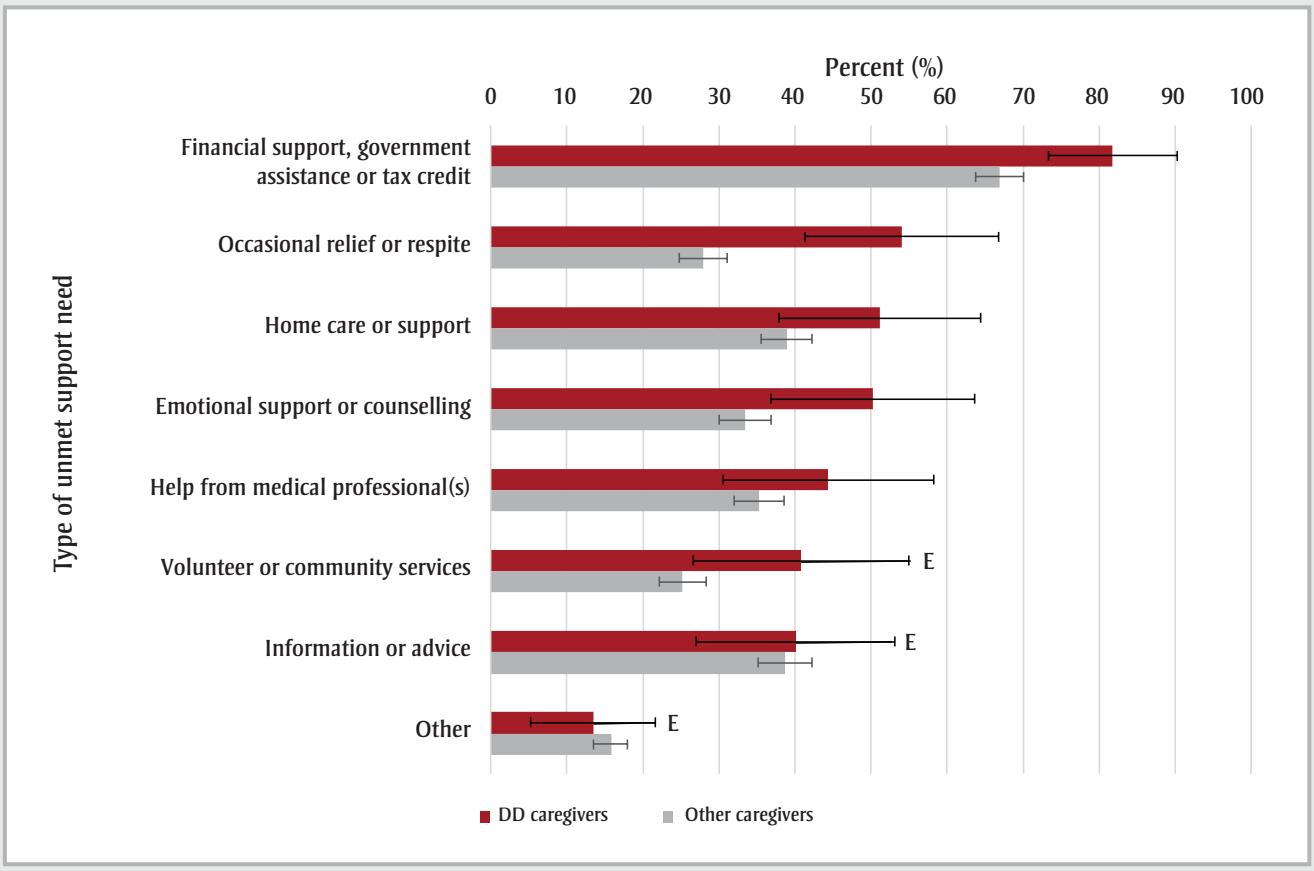
[i] Included if caregivers received support in any of the following ways: spouse or partner modified their life or work arrangements; children, extended family members, close friends or neighbours, or community, spiritual community or cultural or ethnic groups provided help; occasional relief or respite care; family or friends provided financial support, received money from government programs, or received federal tax credits.

[j] Included if caregivers responded "yes" to the following question: "Is there any other type of support that you would like to have to help with your caregiving duties?"

[E] Use with caution.

[F] Too unreliable to be published due to high sampling variability (coefficient of variation > 33.3%).

FIGURE 1
Types of unmet support needs among caregivers, Canada (excluding territories), 2018



Source: 2018 General Social Survey – Caregiving and Care Receiving.[12]

Abbreviations: CI, confidence interval; DD, developmental disabilities or disorders.

Notes: Percentages and 95% CIs are based on weighted data. Error bars represent the associated 95% CIs, defined as an estimated range of values that is likely to include the true value 19 times out of 20. "DD caregivers" are caregivers of individuals with DD, and "other caregivers" are caregivers of individuals with conditions other than DD.

[E] Use with caution.

worried or anxious and felt tired as a result of their caregiving roles. Almost half also reported various unmet support needs, with financial support, occasional relief or respite care, and home care or support the most common. Despite these challenges, many DD caregivers found their caregiving experiences rewarding.

Previous Canadian and international studies have also shown that caregiving for individuals with DD can negatively affect caregivers' mental and physical health, with effects varying with the caregiver, care receiver, family characteristics and circumstances such as caregiver income, the care receiver's age and the number of care receivers with disabilities being looked after by each caregiver, and barriers to accessing services and supports.[5,9,10,11,15,16] We found that DD caregivers were more likely than other caregivers to care for their own children and for younger individuals, to live in the same household as the care recipient and to have the support of at least one additional caregiver. DD caregivers also provided more hours of care per week than other caregivers. These differences in demographics and circumstances may have important implications on the experience and impacts of caregiving.[15] However, exploring the specific factors associated with the effects of caregiving was beyond the scope of this study.

Prior investigations have identified unmet support needs for both individuals with DD and their caregivers, with inadequate support partly explaining why families are often negatively affected as a result of their children's disabilities.[17,18] A recent survey of caregivers found the most frequently reported support needs to be related to mental health and finances, with variations across sociodemographic groups.[1] Our study also found that financial support was the most commonly reported unmet need, followed by occasional relief or respite care, home care or support, as well as emotional support or counselling. Financial credits[19-21] and organizations that offer education and training, peer support, advocacy and counselling opportunities for caregivers are available in Canada, although eligibility and availability vary depending on the caregiver's situation.

Although research often focuses on the burdens of caregiving, previous studies have shown that parents of children with DD report positive aspects of their caregiving experiences, seeing their child as a source of happiness, personal strength and growth, and family closeness.[22,23]

These perceptions, which mirror our findings of more rewarding caregiving experiences among DD caregivers, have been linked to caregivers' healthy coping strategies and access to caregiving supports.[23]

Strengths and limitations

This study used data from the 2018 GSS, a large, population-based survey with weighted estimates representative of the target population; however, some limitations are worth noting. First, the survey did not include the territories, limiting the generalizability of the findings. Second, the study sample size prevented us from disaggregating some sociodemographic characteristics such as ethnicity and Indigeneity. Third, the survey did not capture specific types of DD; it was therefore not possible to examine the differential impacts of specific DD on caregivers' experiences. Lastly, while non-overlapping CIs indicate significant differences, overlapping CIs do not necessarily imply a lack of difference. However, the use of this conservative approach minimizes drawing erroneous conclusions of significance. Further, the small sample of DD caregivers resulted in wider CIs, potentially limiting our ability to detect significant differences.

The findings from this study reflect the experiences of DD caregivers prior to the COVID-19 pandemic. The pandemic, particularly early on, frequently exacerbated caregiving challenges through disruptions to routines, education, services or supports.[24-28]

Conclusion

Despite the negative impacts of caregiving, such as worse general and mental health, a higher proportion of DD caregivers than of other caregivers described their caregiving experiences as rewarding. Still, a large proportion of DD caregivers had unmet support needs. These findings underscore the importance of supports and services for DD caregivers to manage the challenges and enhance the positive aspects of caregiving.

Future cycles of the GSS will allow for monitoring of the burden of caregiving on this population over time. Additional research could examine the varied impacts on caregivers of individuals with different types of DD and explore differences in experiences by caregiver, care receiver and family demographics and circumstances.

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Conflicts of interest

The authors have no conflicts of interest.

Authors' contributions and statement

SP: Conceptualization, formal analysis, writing – original draft, writing – review and editing.

SO: Conceptualization, writing – original draft, writing – review and editing.

SS: Visualization, writing – original draft, writing – review and editing.

All authors approved the final version of this manuscript.

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