EXploring Patterns of use and Effects of adult Day programs to Improve Trajectories of continuing care (EXPEDITE): Protocol of a retrospective cohort study

Matthias Hoben, Colleen J. Maxwell, Andrea Ubell, Malcolm B Doupe, Zahra Goodarzi, Saleema Allana, Ron Beleno, Whitney Berta, Jennifer Bethell, Tamara Daly, Liane Ginsburg, Atiqur Rahman, Hung Nguyen, Kaitlyn Tate, Kimberlyn McGrail

Submitted to: JMIR Research Protocols
on: June 02, 2024

Table of Contents

EXploring Patterns of use and Effects of adult Day programs to Improve Trajectories of continuing care (EXPEDITE): Protocol of a retrospective cohort study

Matthias Hoben[1, 2]; Colleen J. Maxwell[3, 4]; Andrea Ubell[5, 6]; Malcolm B Doupe[7, 8, 9]; Zahra Goodarzi[10]; Saleema Allana[11]; Ron Beleno[6]; Whitney Berta[12]; Jennifer Bethell[4, 12, 13]; Tamara Daly[1, 6]; Liane Ginsburg[1]; Atiqur Rahman[1]; Hung Nguyen[1]; Kaitlyn Tate[2]; Kimberlyn McGrail[14]

[1]School of Health Policy and Management Faculty of Health York University Toronto CA
[2]Faculty of Nursing College of Health Sciences University of Alberta Edmonton CA
[3]School of Pharmacy University of Waterloo Waterloo CA
[4]ICES Toronto CA
[5]Alzheimer Society of York Region Aurora CA
[6]Helen Carswell Chair in Dementia Care Advisory Board Faculty of Health York University Toronto CA
[7]Department of Community Health Sciences Max Rady College of Medicine, Rady Faculty of Health Sciences University of Manitoba Winnipeg CA
[8]Manitoba Centre for Health Policy Max Rady College of Medicine, Rady Faculty of Health Sciences University of Manitoba Winnipeg CA
[9]Department of Emergency Medicine Max Rady College of Medicine, Rady Faculty of Health Sciences University of Manitoba Winnipeg CA
[10]Cumming School of Medicine University of Calgary Calgary CA
[11]Arthur Labatt Family School of Nursing Faculty of Health Sciences Western University London CA
[12]Institute of Health Policy, Management and Evaluation Dalla Lana School of Public Health University of Toronto Toronto CA
[13]University Health Network Toronto CA
[14]Centre for Health Services and Policy Research School of Population and Public Health University of British Columbia CA

Corresponding Author:
Matthias Hoben
School of Health Policy and Management
Faculty of Health
York University
301E Strong College
4700 Keele Street
Toronto
CA

Abstract

Background: Adult day programs provide critical supports to older adults and their family/friend caregivers. High-quality care in the community for as long as possible, and minimizing facility-based continuing care are key priorities of older adults, their caregivers, and healthcare systems. While most older adults in need of care live in the community, about 10% of newly admitted care home residents have relatively low care needs that could be met in the community with the right supports. However, research on the effects of day programs is inconsistent. The methodological quality of studies is poor, and we especially lack robust, longitudinal research.

Objective: Our research objectives are to (1) compare patterns of day program use (including non-use) by province (Alberta, British Columbia, Manitoba), and time, (2) compare characteristics of older adults by day program use pattern (including non-use), province, and time, (3) assess effects of day programs on attendees, compared to a propensity score matched cohort of older non-attendees in the community.

Methods: In this population-based retrospective cohort study, we will use clinical and health administrative data of older adults (65+ years) who received publicly funded continuing care in the community in the Canadian provinces of Alberta, British Columbia, and Manitoba between January 01, 2012 and December 31, 2024. We will compare patterns of day program use between provinces and assess changes over time. We will then compare characteristics of older adults (e.g., age, sex, physical/cognitive disability, area-based deprivation indices, caregiver availability/distress) by pattern of day program use/ non-

use, province and time. Finally, we will create a propensity score matched comparison group of older adults in the community, who have not attended a day program. Using time-to-event models and general estimating equations, we will assess whether day program attendees compared to non-attendees enter care homes later; use emergency, acute, or primary care less frequently; experience less cognitive and physical decline; and have better mental health.

Results: This will be a 3-year study (July 1, 2024 – June 30, 2027). We received ethics approvals from the relevant ethics boards. Starting on July 1, 2024, we will work with the three provincial health systems on data access and linkage, and we expect data analyses to start in Early 2025.

Conclusions: This study will generate robust Canadian evidence on the effects of day programs on older adults and their caregivers. This will improve the quality of care provided to older adults in day programs, ultimately improving the quality of life of older adults and their caregivers. Clinical Trial: TBD

(JMIR Preprints 02/06/2024:60896)
DOI: https://doi.org/10.2196/preprints.60896

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

EXploring Patterns of use and Effects of adult Day programs to Improve Trajectories of continuing care (EXPEDITE): Protocol of a retrospective cohort study

Matthias Hoben,[1,2,*] Collen J Maxwell,[3,4] Andrea Ubell,[5,6] Malcolm B Doupe,[7,8,9] Zahra Goodarzi,[10] Saleema Allana,[11] Ron Beleno,[6] Whitney Berta,[12] Jennifer Bethell,[4,12,13] Tamara Daly,[1,6] Liane Ginsburg,[1] Atiqur Rahman,[1] Hung Nguyen,[1] Kaitlyn Tate,[2] Kimberlyn McGrail[14]

[1]School of Health Policy and Management, Faculty of Health, York University, Toronto, Ontario, Canada

[2]Faculty of Nursing, College of Health Sciences, University of Alberta, Edmonton, Alberta, Canada

[3]School of Pharmacy, University of Waterloo, Waterloo, Ontario, Canada

[4]ICES, Toronto, Ontario, Canada

[5]Alzheimer Society of York Region, Aurora, Ontario, Canada

[6]Helen Carswell Chair in Dementia Care Advisory Committee, Faculty of Health, York University, Toronto, Ontario, Canada

[7]Department of Community Health Sciences, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba, Ontario

[8]Manitoba Centre for Health Policy, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba, Ontario

[9]Department of Emergency Medicine, Max Rady College of Medicine, Rady Faculty of Health Sciences, University of Manitoba, Winnipeg, Manitoba, Ontario

[10]Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

[11]Arthur Labatt Family School of Nursing, Faculty of Health Sciences, Western University, London, Ontario, Canada

[12]Institute of Health Policy, Management and Evaluation, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada

[13]University Health Network, Toronto, Ontario, Canada

[14]Centre for Health Services and Policy Research, School of Population and Public Health, University of British Columbia, Vancouver, British Columbia, Canada

Abstract

Background: Adult day programs provide critical supports to older adults and their family/friend caregivers. High-quality care in the community for as long as possible, and minimizing facility-based continuing care are key priorities of older adults, their caregivers, and healthcare systems. While most older adults in need of care live in the community, about 10% of newly admitted care home residents have relatively low care needs that could be met in the community with the right supports. However, research on the effects of day programs is inconsistent. The methodological quality of studies is poor, and we especially lack robust, longitudinal research.

Objective: Our research objectives are to (1) compare patterns of day program use (including non-use) by province (Alberta, British Columbia, Manitoba), and time, (2) compare characteristics of older adults by day program use pattern (including non-use), province, and time, (3) assess effects of day programs on attendees, compared to a propensity score matched cohort of older non-attendees in the community.

Methods: In this population-based retrospective cohort study, we will use clinical and health administrative data of older adults (65+ years) who received publicly funded continuing care in the community in the Canadian provinces of Alberta, British Columbia, and Manitoba between January 01, 2012 and December 31, 2024. We will compare patterns of day program use between provinces and assess changes over time. We will then compare characteristics of older adults (e.g., age, sex, physical/cognitive disability, area-based deprivation indices, caregiver availability/distress) by pattern of day program use/ non-use, province and time. Finally, we will create a propensity score matched comparison group of older adults in the community, who have not attended a day program. Using time-to-event models and general estimating equations, we will assess whether day program attendees compared to non-attendees enter care homes later; use emergency, acute, or primary care less frequently; experience less cognitive and physical decline; and have better mental health.

Results: This will be a 3-year study (July 1, 2024 – June 30, 2027). We received ethics approvals from the relevant ethics boards. Starting on July 1, 2024, we will work with the three provincial health systems on data access and linkage, and we expect data analyses to start in Early 2025.

Conclusions: This study will generate robust Canadian evidence on the effects of day programs on older adults and their caregivers. This will improve the quality of care provided to older adults in day programs, ultimately improving the quality of life of older adults and their caregivers.

Trial Registration: ClinicalTrials.gov Identifier: NCT06440447

Keywords: Adult Day Care Centers; Aged; Program Evaluation; Cohort Studies; Routinely Collected Health Data

Introduction

Modern societies are struggling to meet the needs of an aging population [1–5]. The increasing prevalence of dementia [6–8] and co-morbid chronic conditions [9,10] lead to complex care needs [9,10] and to greater family/friend caregiver burden [11–14]. In response, health systems provide a range of ongoing care and supports to older adults and their caregivers – in Canada commonly referred to as continuing care [2,15]. Continuing care can be provided in an older adult's private home, in the community (e.g., an adult day program), or in a variety of congregate care settings including independent living, retirement homes, supportive/assisted living, or nursing homes (NHs) [16,17]. Governments have identified NHs as a major driver of public continuing care costs [16,18–20]. To mitigate pressures on public continuing care systems, and to meet aging in place preferences of older adults and their caregivers [21–23], reforms have implemented aging in place strategies. These strategies largely include (a) reserving NH care to those with the most complex care needs, and (b) improving access to an array of publicly funded continuing care options in the community [2].

Adult day programming is such a continuing care option to support aging in place [24–31]. Older adults in need of continuing care usually attend these programs for parts of the day, returning to their homes overnight (but overnight services are provided by some day programs). As the current literature illustrates [24–31], the number of days a person attends a day program can vary widely, depending on the program and health jurisdiction, from a couple of days/month to daily attendance. The amount of time an individual attends also varies, from a few hours/day to all-day, or sometimes during nights, and so do admission criteria, supports and services offered, and funding models.

Despite these variations, day programs have unique characteristics that set them apart from other continuing care options. Day programs employ care staff and admit people with a certain level of support needs [29,32]. This distinguishes them from senior or community centres [33] and creative arts programs [34], which are open to independent older adults, do not employ care staff, and are organized more informally. Unlike home care [35] or in-home respite [36], day programs serve groups of older adults in a setting external to the attendee's home [29,32], supporting social interactions and caregiver respite [31]. Unlike geriatric day hospitals, which provide medical, therapeutic, and rehabilitative care for a few weeks [37], day programs prioritize social and recreational activities, and they do so long-term (often for months or years) [29,32]. Day program services and supports usually include transportation; meals; recreational activities (e.g., playing games, musical activities, crafting, painting); socializing with other clients and day program staff; physical, cognitive and spiritual activities; social work counselling; and case management support. Personal, nursing, and medical care are often not provided, or only to a limited extent, depending on the on the program and health system.

Recent literature reviews [27–31,38] reveal a growing body of evidence that suggests day program attendance may be associated with attendees' improved mental health, cognition, loneliness, quality of life, perceived health, physical functioning, use of polypharmacy, and mortality. These reviews also suggest that attendance may be associated with older adults' delayed admissions to congregate care, reduced risk for hospitalization, and improved caregiver burden, caregivers' feelings of competence, mental health, and wellbeing. However, reviews point to inconsistent findings, methodological limitations, and substantial heterogeneity of included studies. For example, a Canadian one group pre-post study suggested that Geriatric Depression Scale scores decreased (fewer depressive symptoms) from 5.0 at admission to a day program to 3.3 at discharge (P=0.007).

A quasi-experimental study comparing depressive symptoms between day program attendees with dementia and non-attendees with dementia in the United States [39], found no group differences. However, on days of attendance, the proportion of attendees with depressive symptoms decreased over time (from 24% to 19%, $P<0.02$). A Canadian randomized controlled trial [40] found no difference in depressive symptoms between day program attendees and wait-listed non-attendees.

Across the literature, four key knowledge gaps persist: (1) We generally know little about the characteristics of day program attendees and non-attendees, or about those with different patterns of use. (2) We lack longitudinal data on changes in the aforementioned outcomes. (3) Generally, the methodological quality of available studies is poor [31], and we lack robust, large-scale, longitudinal evidence of older adult day programs on day program attendees – especially those living with dementia. With few notable exceptions [41,42], we especially lack current research on Canadian day programs with most research originating from the US or Canadian studies often dating back several decades [24,25,43]. (4) Differential effects of day programs on persons with multiple, intersecting vulnerabilities, are poorly understood, despite inequity concerns [38,44–46]. Advanced age puts individuals at risk of ageism; physical and cognitive disabilities may expose them to ableism; the majority of older adults and their caregivers are women, often experiencing gender-inequities; and giving and receiving care are associated with substantial healthcare costs, disproportionally affecting those with low income [47]. Racism or transphobia/homophobia can further increase these pressures, severely affecting older adults and their caregivers [48,49].

Our study will address these knowledge gaps comprehensively, rigorously, and simultaneously. We will address the following three research objectives:

1. Explore patterns of day program use (e.g., variations in time to first attendance, monthly hours of attendance, ongoing vs interrupted attendance, total time of day program exposure), using latent class analyses (LCA), and compare the frequency of each latent use class between provinces and over time.
2. Compare older adults' demographic, social, and health characteristics (e.g., age, sex, physical/cognitive disability, area-based deprivation indices, caregiver availability/distress) by day program use/non-use class, province, and time.
3. Assess whether, compared to a propensity score matched control group of non-attendees, day program attendees enter care homes at later points in time, use emergency, acute, or primary care less frequently, experience less cognitive and physical decline, have better mental health, and less distressed caregivers. We will assess potential modification of these effects by day program use/non-use class, age, sex, and social determinants of health (e.g., area-based deprivation indices).

Methods

Study Design

Using an integrated knowledge translation (iKT) approach [50,51], we partnered with a cross-Canadian team of experts to design this population-based retrospective cohort study (ClinicalTrials.gov Identifier: NCT06440447) covering the Canadian provinces of Alberta, British Columbia, and Manitoba, and we will collaborate with our experts throughout the study. Experts include older adults (some with dementia), their caregivers, Alzheimer societies, caregiver organizations, day program staff and managers, and government and health system decision makers. They will provided intimate knowledge of day programs, and the experience of attending them or caring for an attendee, which will help us interpret and contextualize our findings. We will use de-identified clinical and health administrative data from each of the three provinces. Our study will

follow the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) [52], and the REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) [53] guidelines. Provincial data policies require data to remain in each respective province, preventing linkage across provinces and analyses of all data in one place. Therefore, in-house data analysts with each provincial health system will carry out the analyses separately with shared protocols and programs.

Setting and Sample

Our study settings are community-based continuing care systems. Each province provides access to a range of publicly funded community-based continuing care services, including adult day programs [54–62]. Each provincial health system determines and enacts access criteria and provides services (directly or via contracted providers) [54–62]. Day program eligibility is assessed in each province, using comparable processes, criteria, and assessments (i.e., the Resident Assessment Instrument – Home Care, RAI-HC, a standardized, valid, reliable assessment tool [63]) [59,64,65]. To be eligible, attendees need to have some care dependency, but also the ability to cope to some extent with activities of daily living, ambulate/transfer with no or minimal assistance, be continent or independent in managing continence products, exhibit no or easily manageable responsive behaviours, and either be alone for extended periods, or have a caregiver who requires respite. Our study cohort will include all individuals aged 65 years or older with an initial RAI-HC assessment completed between January 1, 2012 and December 31, 2021. We will follow everyone until they either move into a care home, are lost to follow-up (e.g., because of death, moving out of province, loss of public insurance eligibility), or until December 31, 2024 (the end of the period covered by our data). That will allow for a care trajectory of at least 3 years (for those with an initial RAI-HC assessment in Dec 2021), enabling us to assess the number and characteristics of individuals with different day program use patterns, and compare them to those who were never exposed to a day program.

Sample Size Calculation

The yearly average number of completed RAI-HC assessments is ~20,000-30,000 in Alberta, ~34,000-39,000 in British Columbia, and ~10,000 in Manitoba [66]. About 50% of those assessed receive a re-assessment within 12 months and another 10%-30% receive a re-assessment after >15 months [67]. There are 89 publicly subsidized day programs in Alberta (~3,300 spaces/day), 95 in British Columbia (~1,500 spaces/day), and 70 in Manitoba (~1,000 spaces/day), for a total of 254 day programs with 5,800 spaces on any given day. Some day program users do not attend daily, but only one or a few days per week, so the number of unique attendees exceeds the number of spaces/day. This corresponds to >20,000 attendees/year (>200,000 within the study period), each with multiple assessments. Our study sample size will be large enough to detect small effects sizes. With Cox proportional hazard models, adjusted for covariates explaining an assumed 25% of effect variance (α=0.05, power=0.8) [68], we require a total sample of 1,327 participants to detect a hazard ratio for admissions to care homes of 0.6 (as can be expected based on a similar Canadian study [41]) in favor of day program attendees. Similarly, Kelly [42] was able to detect significantly fewer emergency department visits and hospital admissions/days among 812 day program attendees compared to 812 propensity score matched to non-attendees. Our expected sample size will be considerably larger than for those previous studies, allowing for complex statistical modeling.

Data Sources

For each individual in our cohort, designated provincial health system analysts will link all records available within the study time frame from the following databases: (1) Regional continuing care registries, documenting when an individual starts/stops receiving any community-based continuing care, including day programs, how these services change over time, and when an individual is admitted to a care home. (2) Population registries for each participant's demographic data. (3) RAI-HC assessments [63], completed annually for people receiving long-term home care (60+ days), and to determine day program eligibility. The RAI-HC will provide data on older adults' medical conditions, functional dependence, pain, cognitive impairment, mood, and behavioural problems. It also includes information on a person's marital/partnership status, caregiver availability, whether that caregiver lives with the older adult, and caregiver distress. Additional caregiver characteristics are not included in the available provincial databases, posing a limitation to our quantitative analyses. However, a related prospective cohort study that we are conducting in Ontario will allow us to link comprehensive caregiver and older adult data, and we are currently conducting additional qualitative research that will illuminate how caregiver characteristics may affect day program use and outcomes. (4) Discharge Abstract Database (DAD) for information on all inpatient hospital stays, including diagnoses and length of stay. (5) National Ambulatory Care Report System (NACRS) for all emergency department visits and diagnoses. In British Columbia we will use the physician payment file in addition, since NACRS is not collected in all emergency departments.[69] (6) Pharmaceutical information on out-patient prescription medications filled through a community pharmacy and covered by provincial drug formulary. (7) Care provider claims data for health service claims submitted for payment by healthcare providers (e.g., general practitioners, nurse practitioners, geriatricians, geriatric psychiatrists, neurologists, therapists), to obtain information on general and specialist health services used by participants.

Study Variables

Exposure

Our exposure will be different patterns of day program use/non-use, based on information from the provincial continuing care registries, documenting the dates a person starts/stops attending a day program, days of attendance, and the duration of each visit. Day program use patterns will be determined, using LCAs (see statistical analyses section below) [70]. We will categorize three continuous variables as low, low-moderate, high-moderate, or high use, using sample distribution quartiles: (1) Time between first RAI-HC assessment and first attendance of a day program, (2) average number of hours of day program attendance (i.e., total number of hours spent in a day program divided by the number of times attended), and (3) total number of days a person attended a day program. LCAs will also include a categorical variable, indicating whether a person consistently attended a day program or whether there were longer periods (several weeks) of non-attendance. Non-use will be defined as no day program exposure at any time during a person's continuing care trajectory.

Study Outcomes

The data sources noted above enable us to examine a range of important study outcomes. Data on the time between a person's first RAI-HC assessment and **admission to a care home** will come from provincial continuing care registries. **Symptoms of depression** will be assessed using the validated RAI-HC Depression Rating Scale (DRS) [71], with scores ranging from 0-14 and a cut-point of 3 or higher representing clinically meaningful depressive symptoms [71,72]. We will capture **physical**

and cognitive decline, using validated RAI-HC scales [63]: the Activities of Daily Living Hierarchy (ADLh) scale [73] and the Cognitive Performance Scale (CPS) [74]. Both scales range from 0 (no impairment) to 6 (maximum impairment), and our outcomes will be dichotomous, indicating any increase (versus no change or a decrease) between the previous and follow up measurement in each of these scales. Using care practitioner claims data, we will generate rates of **different types of primary and specialist care use** (e.g., family physician, specialists, nursing practitioner, allied health providers). We will use the DAD and NACRS databases to generate **rates of emergency room registrations, hospital admissions**, and **days in hospital** (including alternative level of care) [42]. Rates will be stratified by day program use/non-use pattern.

Demographic, Social and Health Characteristics

These will include older adults' age, sex, marital/partnership status (population registries and RAI-HC), physical disability (ADLh score >3), and cognitive impairment (CPS score >3). Available data sets only include a binary variable on biological sex (male/female) and no non-binary information on gender identity. We will also include RAI-HC measures of caregiver availability (item G1e) and burden (items G2a-c). Finally, we will include four publicly available area-level measures from the Canadian Index of Multiple Deprivation [75,76]: residential instability (e.g., housing insecurity, overcrowding, frequent moves), economic dependency (high number of older adults, children <15 years, persons receiving government transfers), ethno-cultural composition (e.g., immigrants, racialized individuals), and situational vulnerability (e.g., Indigenous Peoples, dwellings needing major repairs, low education). Using Statistics Canada data, each measure is derived for 54,775 geographical dissemination areas, using 17 variables. Quintile-based ranks for each of the indices (1=least deprived to 5=most deprived) will be assigned to individuals based on their home's postal code [76].

Propensity Score Matching Variables

To compare outcomes between day program attendees and non-attendees, we will use propensity score matching [77] (for details see statistical analyses). Propensity scores aim to ensure a similar distribution of baseline variables among treatment (day program attendees) and control (non-attendees) – akin to what random assignment aims to accomplish in randomized trials [77]. Since we lack evidence on differences between day program attendees and non-attendees, our objective 2 analyses, will be key to informing the selection of the exact covariates that will form the propensity score. We will derive covariates for day program attendees from the RAI-HC day program eligibility assessment (index date). For each day program attendee, we will identify potential matches as non-attendees whose first RAI-HC assessment was completed within ±3 months of the attendee's index date (i.e., admission to long-term home care at about the same time). This RAI-HC assessment will provide the relevant covariates to enable propensity score matching with day program attendees as of their index date.

Our **first set** of matching covariates will be RAI-HC variables used by health systems to determine day program eligibility [59,64,65]: physical functioning (ADLh scale), cognition (CPS), behavioural symptoms (Aggressive Behaviour Scale, ABS [78]), bladder/bowel continence (items I1, I3), availability of a caregiver (item G1e), and caregiver distress (items G2a-c). This will ensure that control participants are potentially eligible to a day program. Possible reasons for non-attendance include the lack of day program spaces, preference not to attend, inability to afford the required co-payments, or not receiving a day program referral. Our experts assure us that the pool of potential matches far exceeds that of attendees, supporting the feasibility of this study and underscoring the lack of day program spaces. This approach excludes individuals whose care needs are either too low

or too severe for day program eligibility, but it minimizes confounding by the matched variables and ensures comparable groups at baseline [79–81]. Finally, we will include a **second set** of matching covariates: health and social characteristics identified in objective 2 by which attendees and potentially eligible non-attendees differ and that overlap sufficiently between attendees and non-attendees (e.g., age, sex, type/duration of publicly funded community care received before the matching index date, deprivation indices).

Additional Covariates

Additional covariates for model adjustment will come from RAI-HC, DAD, NACRS, pharmaceutical, and claims records (e.g., geriatric syndromes, medical diagnoses, prescribed medications). We might also adjust for additional community care services (e.g., in-home respite, home care).

Statistical Analyses

Objective 1: Explore Patterns of Day Program Use

Using our day program cohort, we will conduct LCAs to determine the number of different day program use patterns, using the 4 variables described in the exposures section. LCAs are widely used to identify subgroups by clusters of characteristics (i.e., parameters of day program use) [70]. In collaboration with our experts and guided by relevant literature, we will pre-specify the expected number of classes. We will carry out LCAs separately in each province. We will run models with the pre-specified number of classes, and with 1, 2, and 3 more and fewer classes than the number pre-specified [70]. We will compare the fit between models, using bootstrap likelihood ratio tests [70], and select a final model that reflects the same number and types of classes in each province, balancing theoretical, conceptual, and statistical considerations. To assess temporal changes in the number of day program attendees within each use pattern, and differences between provinces, we will report and graphically plot the proportion (95% confidence interval, CI) of individuals within each latent class by quarter and province.

Objective 2: Compare Older Adults' Characteristics by Day Program Use, Province, Time

Using our full cohort of day program attendees and non-attendees, we will descriptively assess the distribution of sample characteristics over time and by province. In each province and quarter, we will report and plot graphically the proportion (95% CI) of individuals with each characteristic, stratified by day program use class vs non-use. Using general estimating equations (GEEs) [82], we will assess whether the number of persons with each characteristic has changed over time and whether characteristics are associated with older adults' day program use/non-use pattern. We will run a separate GEE model for each characteristic within each province, with the respective characteristic as individual-level outcome. We will run binary logistic regressions for dichotomous variables (e.g., sex) and ordinal regressions for categorical variables (e.g., residential instability quintile). Models will account for repeated measures within individuals and include the independent variables year of assessment (to assess change in social determinants over time), use/non-use class (to assess differences in social determinants by day program use), and an interaction between year and use/non-use (to assess how social determinants differed between use/non-use patterns by year). Using random effects mixed regression models, we will pool provincial effects statistically. Other pan-Canadian studies, such as the Canadian Network for Observational Drug Effect Studies [83], have successfully applied this approach and developed rigorous protocols to minimize bias and

maximize consistency of regional analyses.

Objective 3: Assess Effects of Day Programs

To create a propensity score, we will run a logistic regression for each province with day program attendance/non-attendance as the dependent variable and adding matching covariates. We will use one-to-one matching (one matched non-attendee for every attendee) [77]. We will use matching without replacement [84] and apply an optimal caliper matching algorithm [85]. As per best practice recommendations [86], we will use a caliper width of 0.2 of the standard deviation of the propensity score's logit. If this matching approach does not allow us to achieve a sufficient sample size, we will use propensity score quintiles for matching.

We will compare sample characteristics and study outcomes between attendees and non-attendees in every year and province, using bivariate statistical tests (e.g., chi^2 or Fisher's exact tests for categorical variables, t tests or ANOVAs for continuous variables, and their non-parametric equivalents if variables violate statistical assumptions). To assess the effect of day program exposure on time to care home admission, we will specify a multi-level time-to-event model with a health region-level random effect [87]. Health systems in each of the three provinces are divided into five health regions [88–90], and regional policies may cause clustering effects that our models must account for. Each model will include day program use/non-use class as independent variable and will be adjusted for time varying variables. These will include matching variables, if appropriate (i.e., in case of group differences in matching variables over time or due to missing data) [79–81], and, if needed, additional covariates (e.g., demographics, social determinants, medical/functional conditions, non-day program community care). Covariates that differ between attendees and non-attendees with a p value ≤0.15 in the bivariate analyses will be considered for inclusion. We will add covariates stepwise, one-by-one and remove those that cause collinearity issues or decrease model fit. As in objective 2, we will pool provincial effects statistically, using random effects mixed regression models.

Using GEEs and a similar approach as for the time-to-event models (including separate models in each province and statistical pooling of their effects), we will assess whether the other study outcomes differ by day program use/non-use pattern. Models will include each study outcome of interest as a dependent variable, day program use/non-use class and time of assessment as independent variables, and similar covariates (using the same stepwise approach) as the time-to-event models. Models will also include a random term to account for repeated measures within individuals. The choice of a link function will be informed by the nature of the variable, and theoretical and empirical considerations. For example, the number of hospital, emergency department, or physician visits has been shown to follow a zero-inflated negative binomial distribution, sometimes requiring an offset for the natural logarithm of person-time [91]. For continuous outcomes (e.g., days spent in hospitals), we will use an identity link function, and for dichotomous outcomes (e.g., presence/absence of depressive symptoms), we will use a logit link function. All models will apply multiple imputation in case of missing data, which we expect to be small based on our previous work with the administrative healthcare data sources used in this study.

Results

Funded by an endowed research chair, the Helen Carswell Chair in Dementia Care (July 1, 2022 – June 30, 2027), this will be a 3-year study (July 1, 2024 – June 30, 2027). We received ethics approvals from the York University Ethics Review Board, Human Participants Review Sub-

Committee (e2022-412) and from the University of Alberta Health Research Ethics Board – Health Panel (Pro00127850), and we are in the process of obtaining ethics approvals from the University of British Columbia Research Ethics Board, and from the University of Manitoba Health Research Ethics Board. Starting on July 1, 2024, we will work with the three provincial health systems on data access and linkage, and we expect data analyses to start in Early 2025.

Discussion

Older adults, caregivers, and health systems urgently need solutions to empower older adults to receive care at home for longer. There are few feasible solutions, but day programs are one of them. Despite the knowledge that day programs could fill an immense and costly care gap, we lack the research needed to inform policy and drive practice change to make day programs more available. This study will generate robust Canadian knowledge on the effects of day programs on outcomes that matter most to older adults, their caregivers, and health systems. We will identify essential elements of day programs, and how they can be improved. We will provide critical evidence for health systems to help them leverage the full potential of day programs to provide appropriate care, prevent inequities and mitigate the need for emergency, hospital, and congregate care. Ultimately, we will improve QoL of older adults (including those with dementia) and their caregivers, alleviate caregiver burden, and reduce social costs associated with health and wellbeing. Future studies will expand this research to additional provinces and territories.

Acknowledgements

MH is the lead investigator of this study, CJM, AU, MBD, ZG, and SA are co-leads. MH, CJM, AU, MBD, ZG, SA, RB, WB, JB, TD, LG, HN, AR, KT, and KMG helped conceptualize the study and to design the study methods. MH wrote the original draft, CJM. AU, MBD, ZG, SA, RB, WB, JB, TD, LG, HN, AR, KT, and KMG critically reviewed and edited various iterations of the manuscript. All authors approve of the manuscript in its current form and agree to be accountable for all of its contents.

This study is funded by the Carswell Family Foundation, which funds the Helen Carswell Chair in Dementia Care, held by MH. The funder has had no role in designing this study and preparing/approving this publication, and the funder will have no role in accessing and analyzing the administrative healthcare data, and in publishing/approving future manuscripts.

We would like to thank all members of the Helen Carswell Chair in Dementia Care Advisory Committee, who helped us identify important research priorities (including the population-based, retrospective cohort study proposed here), and in conceptualizing and designing this study.

Conflicts of Interest

None declared.

Abbreviations

ABS	Aggressive Behaviors Scale
ADLh	Activities of Daily Living Hierarchy Scale
CI	Confidence Interval

CPS	Cognitive Performance Scale
DAD	Discharge Abstract Database
EXPEDITE	EXploring Patterns of use and Effects of adult Day programs to Improve Trajectories of continuing care
GEE	General Estimating Equation
iKT	integrated Knowledge Translation
LCA	Latent Class Analysis
NACRS	National Ambulatory Care Report System
NH	Nursing Home
RAI-HC	Resident Assessment Instrument – Home Care
RECORD	REporting of studies Conducted using Observational Routinely-collected health Data
STROBE	Strengthening the Reporting of Observational Studies in Epidemiology

References

1. European Commission. The 2018 ageing report: Economic and budgetary projections for the 28 EU member states (2016-2070). Luxembourg: European Commission; 2018. Report No.: 79. Available from: https://economy-finance.ec.europa.eu/publications/2018-ageing-report-economic-and-budgetary-projections-eu-member-states-2016-2070_en#files [accessed Sep 2, 2022]

2. Federal/provincial/territorial ministers responsible for seniors. Core community supports to age in community. Ottawa: Government of Canada; 2019. Available from: https://www.canada.ca/en/employment-social-development/corporate/seniors/forum/core-community-supports.html [accessed Sep 2, 2022]

3. MacDonald B-J, Wolfson M, Hirdes JP. The future co$t of long-term care in Canada. Toronto, ON: National Institute on Aging; 2019. Available from: https://www.nia-ryerson.ca/reports [accessed Sep 2, 2022]

4. Thomas KS, Applebaum R. Long-term services and supports (LTSS): A growing challenge for an aging America. Public Policy & Aging Report 2015;25(2):56–62. doi: 10.1093/ppar/prv003

5. Whitman DB. Unsolved mysteries in aging policy. Public Policy & Aging Report 2015;25(2):67–73. doi: 10.1093/ppar/prv006

6. Alzheimer's Association. 2022 Alzheimer's disease facts and figures. Alzheimers & Dementia 2022;18(4):700–789. doi: 10.1002/alz.12638

7. Prince MJ, Wimo A, Guerchet MM, Ali GC, Wu Y-T, Prina M. World Alzheimer Report 2015 - The Global Impact of Dementia: An analysis of prevalence, incidence, cost and trends. London: Alzheimer's Disease International; 2015. Available from: https://www.alzint.org/resource/world-alzheimer-report-2015/ [accessed Sep 2, 2022]

8. Public Health Agency of Canada. Dementia in Canada. Ottawa: Public Health Agency of Canada; Available from: https://www.canada.ca/en/public-health/services/publications/diseases-conditions/dementia.html [accessed Sep 2, 2022]

9. Nguyen H, Manolova G, Daskalopoulou C, Vitoratou S, Prince M, Prina AM. Prevalence of multimorbidity in community settings: A systematic review and meta-analysis of observational studies. J Comorb 2019/09/07 ed 2019 Jan;9:2235042X19870934. doi: 10.1177/2235042X19870934

10. The Academy of Medical Sciences. Multimorbidity: a priority for global health research. London: The Academy of Medical Sciences; 2018. Available from: https://acmedsci.ac.uk/policy/policy-projects/multimorbidity [accessed Sep 2, 2022]

11. Canadian Institute for Health Information (CIHI). Quick stats - Home Care Reporting System (HCRS) profile of clients in home care 2020-2021. Available from: https://www.cihi.ca/en/quick-stats [accessed Sep 2, 2022]

12. Morgan T, Ann Williams L, Trussardi G, Gott M. Gender and family caregiving at the end-of-life in the context of old age: A systematic review. Palliative medicine 2016/01/28 ed 2016 Jul;30(7):616–24. doi: 10.1177/0269216315625857

13. Quesnel-Vallée A, Willson A, Reiter-Campeau S. Health inequalities among older adults in developed countries: Reconciling theories and policy approaches. In: George L, Ferraro K, editors. Handbook of aging – social sciences 8th ed. London: Elsevier; 2016.

14. Quesnel-Vallée A, Farrah J-S, Jenkins T. Population aging, health systems, and equity: Shared challenges for the United States and Canada. In: Settersten Jr. RA, Angel JL, editors. Handbook of sociology of aging New York, Dordrecht, Heidelberg, London: Springer; 2011.

15. McGrail K. Long-term care as part of the continuum. Healthc Pap 2011;10(4):39–43; discussion 58-62. PMID:21593615

16. Sinha S, Dunning J, Wong I, Nicin M, Nauth S. Enabling the future provision of long-term care in Canada. Toronto, ON: National Institute on Aging; 2019. Available from: https://www.nia-ryerson.ca/reports [accessed Sep 2, 2022]

17. Federal/provincial/territorial ministers responsible for seniors. Report on housing needs of seniors. Ottawa: Government of Canada; 2019. Available from: https://www.canada.ca/en/employment-social-development/corporate/seniors/forum/report-seniors-housing-needs.html [accessed Sep 2, 2022]

18. Spasova S, Baeten R, Coster S, Ghailani D, Peña-Casas R, Vanhercke art. Challenges in long-term care in Europe - A study of national policies 2018. Brussels: European Commission; 2018. Available from: https://ec.europa.eu/social/main.jsp?langId=en&catId=1135&newsId=9185&furtherNews=yes [accessed Sep 2, 2022]

19. Goncalves J, Weaver F, Konetzka RT. Measuring state medicaid home care participation and intensity using latent variables. J Appl Gerontol 2018/07/07 ed 2020 Jul;39(7):731–744. doi: 10.1177/0733464818786396

20. Wysocki A, Butler M, Kane RL, Kane RA, Shippee T, Sainfort F. Long-term services and supports for older adults: A review of home and community-based services versus institutional care. J Aging Soc Policy 2015/05/06 ed 2015;27(3):255–79. doi: 10.1080/08959420.2015.1024545

21. Royal Bank of Canada. 2013 RBC retirement myths & realities poll: most appealing living arrangements for boomers. 2013. Available from: http://www.rbc.com/newsroom/news/2013/20131024-myths-realities.html [accessed Sep 2, 2022]

22. American Association of Retired Persons (AARP). 2018 home and community preferences: A national survey of adults age 18-plus. Washington, DC: AARP Research; 2018. Available from: https://www.aarp.org/research/topics/community/info-2018/2018-home-community-preference.html [accessed Sep 2, 2022]

23. European Commission. Health and long-term care in the European Union. Luxembourg: European Commission; 2007. Available from: https://sid-inico.usal.es/idocs/F8/FDO22761/health_european_union.pdf [accessed Sep 2, 2022]

24. Gutman GM, Milstein S, Killam J, Lewis D, Hollander MJ. Adult Day Care centres in British Columbia: models, characteristics and services. Health Rep Canada; 1993;5(2):189–207. PMID:8292758

25. Gutman GM, Milstein S, Killam J, Lewis D, Hollander MJ. Adult day care centres in British Columbia: client characteristics, reasons for referral and reasons for non-attendance. Health Rep Canada; 1993;5(3):321–333. PMID:8199334

26. Mason A, Weatherly H, Spilsbury K, Arksey H, Golder S, Adamson J, Drummond M, Glendinning C. A systematic review of the effectiveness and cost-effectiveness of different models of community-based respite care for frail older people and their carers. Health Technol Assess 2007 Apr;11(15):1–157, iii. PMID:17459263

27. Fields NL, Anderson KA, Dabelko-Schoeny H. The effectiveness of adult day services for older adults: a review of the literature from 2000 to 2011. J Appl Gerontol United States; 2014 Mar;33(2):130–163. PMID:24652952

28. Tretteteig S, Vatne S, Rokstad AMM. The influence of day care centres for people with dementia on family caregivers: an integrative review of the literature. Aging Ment Health England; 2016;20(5):450–462. PMID:25815563

29. Ellen ME, Demaio P, Lange A, Wilson MG. Adult Day Center Programs and Their Associated Outcomes on Clients, Caregivers, and the Health System: A Scoping Review. Gerontologist United States; 2017 Nov 10;57(6):e85–e94. PMID:28329856

30. Orellana K, Manthorpe J, Tinker A. Day centres for older people: a systematically conducted scoping review of literature about their benefits, purposes and how they are perceived. Ageing Soc 2020 Jan;40(1):73–104. PMID:31798195

31. Lunt C, Dowrick C, Lloyd-Williams M. What is the impact of day care on older people with long-term conditions: A systematic review. Health Soc Care Community England; 2021 Sep;29(5):1201–1221. PMID:33332714

32. Symonds-Brown H, Ceci C, Duggleby W, Purkis ME. Re-thinking the nature of day programs for people with dementia: Implications for research. Dementia (London) 2021 Jan;20(1):326–347. PMID:31696730

33. Song M, Seo K, Choi S, Choi J, Ko H, Lee SJ. Seniors centre-based health intervention programmes in the United States and South Korea: A systematic review. Int J Nurs Pract 2017 Oct;23(5). PMID:28691357

34. Bellazzecca E, Teasdale S, Biosca O, Skelton DA. The health impacts of place-based creative programmes on older adults' health: A critical realist review. Health Place 2022 Jul;76:102839. PMID:35691142

35. Johnson S, Bacsu J, Abeykoon H, McIntosh T, Jeffery B, Novik N. No Place Like Home: A Systematic Review of Home Care for Older Adults in Canada. Can J Aging 2018 Dec;37(4):400–419. PMID:30176954

36. Vandepitte S, Van Den Noortgate N, Putman K, Verhaeghe S, Faes K, Annemans L. Effectiveness of Supporting Informal Caregivers of People with Dementia: A Systematic Review of Randomized and Non-Randomized Controlled Trials. Journal of Alzheimer's Disease IOS Press; 2016 Jan 1;52(3):929–965. doi: 10.3233/JAD-151011

37. Hoe J, Ashaye K, Orrell M. Don't seize the day hospital! Recent research on the effectiveness

of day hospitals for older people with mental health problems. Int J Geriatr Psychiatry England; 2005 Jul;20(7):694–698. PMID:16021660

38. Manthorpe J, Moriarty J. Examining day centre provision for older people in the UK using the Equality Act 2010: findings of a scoping review. Health Soc Care Community England; 2014 Jul;22(4):352–360. PMID:23952653

39. Femia EE, Zarit SH, Stephens MAP, Greene R. Impact of adult day services on behavioral and psychological symptoms of dementia. Gerontologist United States; 2007 Dec;47(6):775–788. PMID:18192631

40. Baumgarten M, Lebel P, Laprise H, Leclerc C, Quinn C. Adult day care for the frail elderly: outcomes, satisfaction, and cost. J Aging Health United States; 2002 May;14(2):237–259. PMID:11995742

41. Kelly R, Puurveen G, Gill R. The Effect of Adult Day Services on Delay to Institutional Placement. J Appl Gerontol United States; 2016 Aug;35(8):814–835. PMID:24717560

42. Kelly R. The Effect of Adult Day Program Attendance on Emergency Room Registrations, Hospital Admissions, and Days in Hospital: A Propensity-Matching Study. Gerontologist United States; 2017 Jun 1;57(3):552–562. PMID:26640154

43. Molzahn AE, Gallagher E, McNulty V. Quality of life associated with adult day centers. J Gerontol Nurs United States; 2009 Aug;35(8):37–46. PMID:19681562

44. Manthorpe J, Moriarty J. Opportunity Knocks: Exploring the Links Between Day Opportunities and Equal Opportunities. Practice Routledge; 2013 Dec 1;25(5):317–333. doi: 10.1080/09503153.2013.860093

45. Sadarangani TR, Murali KP. Service Use, Participation, Experiences, and Outcomes Among Older Adult Immigrants in American Adult Day Service Centers: An Integrative Review of the Literature. Res Gerontol Nurs United States; 2018 Nov 1;11(6):317–328. PMID:29989644

46. Li Y, Liu J, Sun F, Xu L. Adult Day Service Use Among Minority Older Adults: Facilitators, Barriers, and Outcomes From an Updated Integrative Literature Review Between 2010 to 2021. J Appl Gerontol 2022 Oct 1;41(10):2253–2263. doi: 10.1177/07334648221106772

47. Harvey NR and D. Dementia as a Disability and Human Rights Issue. HealthcarePapers 2016 Oct 8;16(2). Available from: https://www-longwoods-com.login.ezproxy.library.ualberta.ca/content/25003/healthcarepapers/dementia-as-a-disability-and-human-rights-issue [accessed Nov 25, 2023]

48. Forrester SN, Gallo JJ, Whitfield KE, Thorpe RJ. A Framework of Minority Stress: From Physiological Manifestations to Cognitive Outcomes. Gerontologist 2019 Nov;59(6):1017–1023. PMID:30169640

49. Fredriksen-Goldsen KI, Kim H-J. The Science of Conducting Research With LGBT Older Adults- An Introduction to Aging with Pride: National Health, Aging, and Sexuality/Gender Study (NHAS). The Gerontologist 2017 Feb 1;57(suppl_1):S1–S14. doi: 10.1093/geront/gnw212

50. Leggat FJ, Wadey R, Day MC, Winter S, Sanders P. Bridging the Know-Do Gap Using Integrated Knowledge Translation and Qualitative Inquiry: A Narrative Review. Qualitative Research in Sport, Exercise and Health Routledge; 2023 Mar 4;15(2):188–201. doi: 10.1080/2159676X.2021.1954074

51. Boyko JA, Riley BL, Willis CD, Stockton L, Zummach D, Kerner J, Robinson K, Chia M. Knowledge translation for realist reviews: a participatory approach for a review on scaling up complex interventions. Health Research Policy and Systems 2018 Oct 22;16(1):101. doi: 10.1186/s12961-018-0374-1

52. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet 2007 Oct 20;370(9596):1453–1457. PMID:18064739

53. Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, Sørensen HT, Elm E von, Langan SM, Committee RW. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. PLOS Medicine Public Library of Science; 2015 Oct 6;12(10):e1001885. doi: 10.1371/journal.pmed.1001885

54. Government of Manitoba. Home Care Services in Manitoba. Province of Manitoba - Health. Available from: https://www.gov.mb.ca/health/homecare/index.html [accessed Jun 28, 2023]

55. Winnipeg Regional Health Authority. Home Care. Winnipeg Regional Health Authority. Available from: https://wrha.mb.ca/home-care/ [accessed Jun 28, 2023]

56. Government of Alberta. Alberta Regulation 296/2003, Public Health Act, Co-ordinated Home Care Program Regulation. 2022. Available from: https://kings-printer.alberta.ca/570.cfm?frm_isbn=9780779830787&search_by=link [accessed Jun 28, 2023]

57. Government of Alberta. Continuing care – Overview. Available from: https://www.alberta.ca/about-continuing-care.aspx [accessed Jun 28, 2023]

58. Alberta Health Services. Home Care. Alberta Health Services. Available from: https://www.albertahealthservices.ca/cc/Page15488.aspx [accessed Jun 28, 2023]

59. Alberta Health Services. Adult Day Programs. Alberta Health Services. Available from: https://www.albertahealthservices.ca/cc/Page15504.aspx [accessed Jun 28, 2023]

60. Government of British Columbia. Continuing Care Act. Available from: https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/96070_01 [accessed Jun 28, 2023]

61. British Columbia Ministry of Health. Home & Community Care - Province of British Columbia. Province of British Columbia; Available from: https://www2.gov.bc.ca/gov/content/health/accessing-health-care/home-community-care [accessed Jun 28, 2023]

62. British Columbia Ministry of Health. Adult Day Services - Province of British Columbia. Province of British Columbia; Available from: https://www2.gov.bc.ca/gov/content/health/accessing-health-care/home-community-care/care-

options-and-cost/adult-day-services [accessed Jun 28, 2023]

63. Hogeveen SE, Chen J, Hirdes JP. Evaluation of data quality of interRAI assessments in home and community care. BMC Med Inform Decis Mak 2017 Oct 30;17(1):150. PMID:29084534

64. Ministry of Health, British Columbia. Adult Day Services - Province of British Columbia. Province of British Columbia; Available from: https://www2.gov.bc.ca/gov/content/health/accessing-health-care/home-community-care/care-options-and-cost/adult-day-services [accessed Nov 28, 2023]

65. Winnipeg Regional Health Authority. WRHA - Home Care Case Coordinator Procedures Manual. Winnipeg, MB: WRHA; 2016.

66. Canadian Insitute for Health Information (CIHI). Quick Stats | CIHI | Home Care Reporting System. Available from: https://www.cihi.ca/en/quick-stats [accessed Apr 27, 2023]

67. Canadian Insitute for Health Information (CIHI). Home Care Reporting System Data Users Guide 2020–2021. Ottawa, ON: CIHI; 2022.

68. Hsieh FY, Lavori PW. Sample-size calculations for the Cox proportional hazards regression model with nonbinary covariates. Control Clin Trials 2000 Dec;21(6):552–560. PMID:11146149

69. Peterson S, Wickham M, Lavergne R, Beaumier J, Ahuja M, Mooney D, McGrail K. Methods to comprehensively identify emergency department visits using administrative data in British Columbia. Vancouver, BC: Centre for Health Services and Policy Research, School of Population and Public Health, University of British Columbia; 2021.

70. Dziak JJ, Lanza ST, Tan X. Effect Size, Statistical Power and Sample Size Requirements for the Bootstrap Likelihood Ratio Test in Latent Class Analysis. Struct Equ Modeling 2014;21(4):534–552. doi: 10.1080/10705511.2014.919819

71. Burrows AB, Morris JN, Simon SE, Hirdes JP, Phillips C. Development of a minimum data set-based depression rating scale for use in nursing homes. Age Ageing 2000 Mar;29(2):165–172. PMID:10791452

72. Canadian Insitute for Health Information (CIHI). Depression among seniors in residential care. Toronto, ON: CIHI; 2010.

73. Morris JN, Fries BE, Morris SA. Scaling ADLs Within the MDS. The Journals of Gerontology: Series A 1999 Nov 1;54(11):M546–M553. doi: 10.1093/gerona/54.11.M546

74. Morris JN, Fries BE, Mehr DR, Hawes C, Phillips C, Mor V, Lipsitz LA. MDS Cognitive Performance Scale. J Gerontol 1994 Jul;49(4):M174-182. PMID:8014392

75. Matheson FI, Dunn JR, Smith KLW, Moineddin R, Glazier RH. Development of the Canadian Marginalization Index: a new tool for the study of inequality. Can J Public Health 2012 Apr 30;103(8 Suppl 2):S12-16. PMID:23618065

76. Statistics Canada. The Canadian Index of Multiple Deprivation: User Guide. Ottawa, Ontario; 2024. Available from: https://www150.statcan.gc.ca/n1/pub/45-20-0001/452000012019002-eng.htm [accessed Feb 9, 2024]

77. Austin PC. An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. Multivariate Behav Res 2011 May;46(3):399–424. PMID:21818162

78. Perlman CM, Hirdes JP. The aggressive behavior scale: a new scale to measure aggression based on the minimum data set. J Am Geriatr Soc 2008 Dec;56(12):2298–2303. PMID:19093929

79. Greenland S, Morgenstern H. Matching and efficiency in cohort studies. American Journal of Epidemiology 1990 Jan 1;131(1):151–159. doi: 10.1093/oxfordjournals.aje.a115469

80. Mansournia MA, Hernán MA, Greenland S. Matched designs and causal diagrams. Int J Epidemiol 2013 Jun;42(3):860–869. PMID:23918854

81. Sjölander A, Greenland S. Ignoring the matching variables in cohort studies – when is it valid and why? Statistics in Medicine 2013;32(27):4696–4708. doi: 10.1002/sim.5879

82. Stroup WW. Generalized Linear Mixed Models: Modern Concepts, Methods and Applications. Abingdon: Taylor and Francis; 2013.

83. Suissa S, Henry D, Caetano P, Dormuth CR, Ernst P, Hemmelgarn B, Lelorier J, Levy A, Martens PJ, Paterson JM, Platt RW, Sketris I, Teare G, Canadian Network for Observational Drug Effect Studies (CNODES). CNODES: the Canadian Network for Observational Drug Effect Studies. Open Med 2012;6(4):e134-140. PMID:23687528

84. Rosenbaum PR. Observational Studies. New York, NY: Springer; 2002. doi: 10.1007/978-1-4757-3692-2ISBN:978-1-4419-3191-7

85. Rosenbaum PR, Rubin DB. Constructing a Control Group Using Multivariate Matched Sampling Methods That Incorporate the Propensity Score. The American Statistician Taylor & Francis; 1985 Feb 1;39(1):33–38. doi: 10.1080/00031305.1985.10479383

86. Austin PC. Optimal caliper widths for propensity-score matching when estimating differences in means and differences in proportions in observational studies. Pharm Stat 2011;10(2):150–161. PMID:20925139

87. Groll A, Hastie T, Tutz G. Selection of effects in Cox frailty models by regularization methods. Biometrics 2017;73(3):846–856. doi: 10.1111/biom.12637

88. Manitoba Health. Regional Health Authorities in Manitoba. Province of Manitoba - Health. 2024. Available from: //www.gov.mb.ca/health/rha/index.html [accessed Feb 11, 2024]

89. Alberta Health Services. AHS In My Zone. 2024. Available from: https://www.albertahealthservices.ca/zones/zones.aspx [accessed Feb 11, 2024]

90. Ministry of Health, British Columbia. Regional health authorities - Province of British Columbia. Province of British Columbia; 2024. Available from: https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/partners/health-authorities/regional-health-authorities [accessed Feb 11, 2024]

91. Bronskill SE, Maclagan LC, Maxwell CJ, Iaboni A, Jaakkimainen RL, Marras C, Wang X, Guan J, Harris DA, Emdin A, Jones A, Sourial N, Godard-Sebillotte C, Vedel I, Austin PC,

Swartz RH. Trends in Health Service Use for Canadian Adults With Dementia and Parkinson Disease During the First Wave of the COVID-19 Pandemic. JAMA Health Forum United States; 2022 Jan;3(1):e214599. PMID:35977228