Canadian Journal on Aging / La Revue canadienne du vieillissement

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A Cost-Benefit Analysis of a Group Memory Intervention for Healthy Older Adults with Memory Concerns

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Article

Cite this article: Baker S, Vandermorris S, Verhoeff NPLG, & Troyer AK. (2022). A Cost-Benefit Analysis of a Group Memory Intervention for Healthy Older Adults with Memory Concerns. *Canadian Journal on Aging / La Revue canadienne du vieillissement* **41**(4), 531–539.
https://doi.org/10.1017/S0714980821000726

Received: 27 December 2020
Accepted: 24 October 2021

Mots-clés :
vieillissement; analyse coûts-bénéfices; démence; vieillissement en santé; intervention visant la mémoire; déficit cognitif léger; plaintes subjectives concernant la mémoire

Keywords:
aging; cost-benefit analysis; dementia; healthy aging; memory intervention; mild cognitive impairment; subjective memory complaints

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Résumé

Cette étude examine si les programmes d'intervention visant la mémoire peuvent amener une réduction des coûts de soins de santé. Des recherches ont suggéré que ces programmes contribuent à diminuer la propension des personnes âgées à se tourner vers les services médicaux ou psychiatriques traditionnels lorsqu'elles s'inquiètent de changements normaux de leur mémoire qui sont liés à l'âge. Nous avons utilisé une approche d'analyse coûts-bénéfices pour évaluer l'efficacité d'un programme d'intervention visant la mémoire en Ontario. Une estimation de la baisse des intentions pour la consultation d'un médecin suivant une telle intervention offerte dans la communauté et les profils de facturation des médecins ont été utilisés pour calculer les économies potentielles pour le système de santé de la province. L'intervention étudiée a permis de réduire les dépenses provinciales en soins de santé de 6 094 $ par grouper au programme. Ce montant dépasse les coûts directs de 121,25 $/participant associés à la mise en place de cinq séances du programme. La présente analyse appuiera les recherches à venir sur les programmes communautaires visant la mémoire et le vieillissement, et illustre leur potentiel en tant que solutions peu coûteuses pour les personnes ayant des plaintes subjectives relatives à leur mémoire, en vue d'améliorer la priorisation des soins offerts aux patients plus âgés dans le système de santé.

Abstract

This study examines whether memory intervention programs can mitigate health care costs. Research suggests these programs translate to a decreased intention of older adults who are worried about age-normal memory changes to seek traditional outlets for medical/psychiatric help. We employed a cost-benefit analysis approach to analyze the effectiveness of a memory intervention program within Ontario. We leveraged estimates of decreased intentionality to seek physician care following a community-based memory intervention with physician billing profiles to calculate the potential cost savings to the province's health care system. The intervention studied was found to reduce provincial health care spending by $6,094 per program group. This amount exceeds $121.25 in direct costs per attendee associated with administering five program sessions. This analysis justifies further research on how community-based memory and aging programs can offer low-cost solutions to help individuals cope with subjective memory complaints and assist the health care system in prioritizing care for aging patients.

Older adults are the fastest-growing age group in Canada. Their numbers are forecast to grow from 6.2 million in 2017 to 10.4 million in 2037 (*Aging with Confidence: Ontario's Action Plan for Seniors*, 2017; "Infographic," 2019). Although these older Canadians live longer and healthier than in previous generations (Bushnik, Tjepkema, & Martel, 2018), their proportionate demand for health care services outstrips younger cohorts (Gibbard, 2018; Maddocks, Stewart, Fortin, & Glazier, 2020; Vegda et al., 2009). In response, politicians and policy makers are searching for ways to contain health care costs incurred by seniors, including expenditures related to common disorders, such as Alzheimer's disease dementia (Public Health Agency of Canada, 2019; Smetanin et al., 2009). Overlooked are the costs incurred by healthy older adults presenting

to physicians with subjective memory complaints,[1] which may simply be signs of normal or healthy aging (Burke & Barnes, 2006; Jessen, Wolfsgruber, et al., 2014; Stewart, 2012).

Subjective memory complaints, such as forgetting names or one's intention when walking into a room, are common in older adults (Ossher, Flegal, & Lustig, 2013), with prevalence estimates ranging from 25–50 per cent (Jonker, Geerlings, & Schmand, 2000). Although help-seeking related to subjective memory complaints is relatively unstudied (Stewart, 2012), a nationwide poll by the Centers for Disease Control and Prevention in the United States found that 11 per cent of older adults ages 65 and older reported subjective cognitive decline in the preceding 12 months over the 2015–2017 period (Centers for Disease Control and Prevention [CDC], n.d.). Of these older adults, 40 per cent reported visiting a health care professional to discuss their symptoms (Centers for Disease Control and Prevention [CDC], n.d.). If this percentage of visits were applied to just the projected increase in the number of Ontario seniors in 2021 over 2020 (97,189 older adults), it would translate to approximately 4,400 physician visits and an estimated cost of $4,062,102.[2] Such money could be well spent, as some research has found that consultations for subjective memory complaints can inform objective determinations of mild cognitive impairment (MCI) and Alzheimer's disease in prodromal stages (Crumley, Stetler, & Horhota, 2014; Jessen, Amariglio, et al., 2014; Pakzad et al., 2017; Petersen et al., 2001; Reisberg & Gauthier, 2008). Yet, other studies find little diagnostic value of these complaints if they are not associated with objective functional decline, as far as their ability to predict cognitive impairment (Comijs, Deeg, Dik, Twisk, & Jonker, 2002; Eichler et al., 2015; Geerlings, Jonker, Bouter, Ader, & Schmand, 1999; Harwood, Barker, Ownby, Mullan, & Duara, 2004; Howieson et al., 2015; Jonker et al., 2000; Jorm et al., 2004, 1997; Menon & Larner, 2010; Mitchell, 2008; Schofield et al., 1997). A critical factor in the relationship between subjective memory complaints and progressive cognitive decline may be the multimorbidity of chronic (e.g., two or more) conditions (Hill et al., 2021). However, those most at risk of eventual neurodegenerative decline may not even report their subjective memory complaints to family members or physicians (Graham, Kunik, Doody, & Snow, 2005; Jonker et al., 2000; Lavery, Lu, Chang, Saxton, & Ganguli, 2007; Mitchell, 2008; Pakzad et al., 2017; Waldorff, Rishøj, & Waldemar, 2008).

In light of demographic trends, options for helping older adults effectively manage their subjective memory concerns in the community before they reach the clinic could significantly reduce Canadian health care costs (Verity, Kirk, O'Connell, Karunanayake, & Morgan, 2018; Wiegand, Troyer, Gojmerac, & Murphy, 2013). One proven option is memory intervention programs that provide education about typical versus atypical memory changes in aging, strategy training to maximize everyday memory, and coaching to optimize brain-healthy lifestyle behaviours (Frankenmolen et al., 2018; Hudes, Rich, Troyer, Yusupov, & Vandermorris, 2019). An outcome of these interventions is a decreased intentionality of healthy older adults to seek medical help for subjective memory complaints (Wiegand et al., 2013), possibly because they help normalize common memory complaints, increase overall health literacy, and reduce anxiety about more serious concerns such as Alzheimer's disease (Hudes et al., 2019; Norman et al., 2020). By reducing unnecessary physician visits, such programs may also deliver cost savings to Canada's health care system and help ensure that those who see a physician for subjective memory complaints are educated about normal age-related memory loss.

From a public health perspective, this study highlights how memory interventions could be cost-effective and how innovative options help address older adults' greater interaction with and dependence upon the health care system in Ontario (Vegda et al., 2009). As cognitive intervention exercises undergo greater scrutiny and study (Jaeggi, Pahor, & Seitz, 2020), there is little objective evidence about the costs and potential paybacks of related community-based healthy aging programs. Our goal was to report the understudied financial benefits of healthy aging programs delivered in a health care outpatient or community setting. We quantified these savings using a cost-benefit analysis (Evers, Van Wijk, & Ament, 1997) of an intervention based in Ontario (in order to maintain an alignment with one province's physician schedule-of-benefits). Since physicians throughout Canada earn fees on a similar per patient/per fee basis, the model could be adopted throughout the country. However, specific regional/provincial factors would have to be taken into account, including the relative rates of subjective memory complaints and local variations in physician help-seeking rates for these complaints (e.g., Pakzad et al., 2017; Verity et al., 2018).

Methods

Cost-Benefit Analysis

We used the core steps of a cost-benefit analysis, one of the four generally accepted economic evaluations for health care interventions (Drummond, 2015; Snell, 2011). These analyses estimate the costs and benefits in the same unit of money, so that decision makers can have objective evidence on which to base decisions on the efficiencies of a program (Drummond, 2015; Evers et al., 1997). The costs are straightforward in the present analysis: estimated administrative and program expenses related to presenting the intervention. The benefits are dollars saved (Prigatano & Pliskin, 2003), specifically those pertaining to physician billings and related direct diagnostic fees. These benefits are predicted to be expenditures averted by older adults who do not present to physicians with normal subjective memory concerns. In terms of a cost analysis using physician billings within Canada, a precedent can be found in the examination done by Trachtenberg and Manns (2017). These physician-researchers tabulated physician input costs related to end-of-life care to "calculate a predicted range of savings associated with the implementation of medical assistance in dying" (Trachtenberg & Manns, 2017, p. E101).

Costs: intervention considered

The intervention considered for this analysis is a 10-hour, five-week group initiative, the Memory and Aging Program (Troyer & Vandermorris, 2012). It was developed and implemented at a tertiary geriatric care centre in Toronto. In recent years, it has also been offered in other health care settings by providing

[1]Various terms are used to describe subjective memory complaints, including subjective memory impairment and subjective cognitive decline. However, the latter term is often used in conjunction with pre-clinical Alzheimer's Disease. See Abdulrab & Heun (2008), for an attempt to provide a standardized definition for subjective memory complaints.

[2]Estimates based upon an increase of 97,189 individuals aged 65 or older from 2020 to 2021 multiplied by an average billing of $914 related to physician consultations for subjective memory complaints. The rationale for physician billing estimates is provided within this document. Demographic sources: Statistics Canada estimates, 2018, and Ontario Ministry of Finance projections.

https://doi.org/10.1017/S0714980821000726 Published online by Cambridge University Press

train-the-trainer workshops and disseminating resource materials to community-based facilitators. A hands-on, multidimensional intervention, the program targets older adults with age-normal memory changes and no functional decline (Troyer, 2001). Evidence has found that this intervention leads to behavioural changes in participants (Vandermorris, Au, Gardner, & Troyer, 2020; Wiegand et al., 2013). These behaviours orient participants to "brain healthy" ways of dealing with everyday situations and environments. Throughout the intervention, an emphasis is placed on the initiation and maintenance of proven memory strategies (Vandermorris et al., 2020). Typical program graduates – ages 60 to 79, university-educated, cognitively normal, and self- or physician-referred – report increased knowledge and confidence regarding their cognitive abilities (Wiegand et al., 2013). Perhaps due to the knowledge they gain about normal age-related memory changes, participants declare less intentionality to visit a physician to discuss subjective memory concerns; this evidence comes from a randomized controlled trial (RCT) using a waitlist control group (Wiegand et al., 2013). In light of the evidence that it takes 3.3 attendees to find a significant disinclination of one healthy older adult to seek unnecessary medical care (Wiegand et al., 2013), we used this value (rounded to three) as the number needed to treat (NNT) to realize the benefits described below.

Sensitivity analysis. In order to test the general parameter sensitivity of the memory intervention using plausible values for a critical parameter (Levin, McEwan, Belfield, Bowden, & Shand, 2018), we also ran additional testing using NNTs of 5 and 7. The higher NNT (7) was based on recent findings from an RCT conducted by Vandermorris et al. (2022, unpublished raw data). We also selected a midpoint number (5) between the lower NNT of 3 and the higher NNT of 7.

Benefits: Potential Savings Pathways

For this cost-benefit analysis, we considered four different screening scenarios (I, II, III, IV) for the baseline cost savings (i.e., benefits). These scenarios were developed with reference to practice guidelines and in consultation with clinician-scientists and specialists in internal medicine and geriatric medicine at Baycrest Health Sciences. The physicians featured in these scenarios are those expected to treat older adults with possible dementia and/or neurodegenerative diseases (The Diagnostic Process: Assessments and Tests/Alzheimer Society of Canada, n.d.; Feldman et al., 2008; Moore, Patterson, Lee, Vedel, & Bergman, 2014; Wimo et al., 2013). We assigned an estimated number of patients (out of 100) proceeding along the four pathways. Following recommended best practices for decision-analytic modeling, the time horizon of this cost-benefit analysis is the lifetime of the hypothetical patients (Karnon, Brennan, & Akehurst, 2007; Weinstein et al., 2003). Similar cost-effectiveness analyses, where data are unknown or are estimated, have been done to examine a range of mental health initiatives (Evers et al., 1997), including those related to dementia caregiving (Brodaty, 1991). Cost-benefit analyses using simulations of different intervention scenarios have also been used within North America to estimate broad health care costs associated with dementia in older adults (Smetanin et al., 2009).

Pathway I, family physicians. All pathways start with visits to family physicians. These doctors are the first to hear from patients or their family members about memory issues (Sadowsky & Galvin, 2012). Although family physicians may not routinely diagnose cognitive impairments (Ahmad, Orrell, Iliffe, & Gracie, 2010; Boustani, Peterson, Hanson, Harris, & Lohr, 2003; Bradford, Kunik, Schulz, Williams, & Singh, 2009; Feldman et al., 2008; Koch, Iliffe, & the EVIDEM-ED project, 2010; Menon & Larner, 2010; Turner et al., 2004), most Canadian family physicians "strongly agree" that cognitive assessment, using such tools as the Montreal Cognitive Assessment or Mini-Mental Status Exam, is within their purview (Iracleous et al., 2009). As patients with no functional impairments and normal cognitive ability can often be managed by family physicians using these tools – as well as family histories, patient blood work, and neuroimaging results (Moore, Frank, & Chambers, 2018; Moore et al., 2014; Rockwood & Keren, 2010) – we estimated that 40 per cent of our sample would stay within this pathway. Therefore, we considered that the majority (60%) of patients with subjective memory complaints would first visit their family physicians and then receive additional consultations from one of three specialties: neurology, geriatric medicine, or geriatric psychiatry (Rockwood & Keren, 2010). Such a consideration is supported by a U.S. study that found fewer than 50 per cent of family physicians make diagnoses of dementia (Boustani et al., 2003), preferring to use their discretion to refer suspected dementia cases (including those with subjective memory complaints) to secondary care specialists (Boustani et al., 2003).

Pathway II, neurologists. Neurologists are the most frequent recipients of referrals from Canadian family physicians for patients with subjective memory complaints or suspicion of dementia (Chow, Binder, Smyth, Cohen, & Robillard, 2009; Feldman, 2009). Furthermore, in a multinational survey of caregivers of patients with Alzheimer's disease dementia in five countries (Australia, France, Italy, Spain, and the United Kingdom), neurologists were found to be the diagnosing physician 52 per cent of the time (Wilkinson, Stave, Keohane, & Vincenzino, 2004). We estimated that 50 per cent of our cases would be seen within the neurology pathway. Additional assessment tools used by neurologists and the specialists discussed below include the Toronto Cognitive Assessment (Freedman et al., 2018) and the Dementia Rating Scale (Bellak, Karasu, & Birenbaum, 1976).

Pathways III and IV, geriatricians and geriatric psychiatrists. We modelled the remaining 10 per cent of our cases being assessed by geriatricians or geriatric psychiatrists (Canadian Academy of Geriatric Psychiatry – Definition of Geriatric Psychiatry, n.d.).

Structural neuroimaging. Costs for structural neuroimaging are challenging to estimate due to the lack of consensus within Canada on whether computed tomography (CT) or magnetic resonance imaging (MRI) neuroimaging is required to rule dementia in or out (Gauthier et al., 2012). Still, it is commonly found that structural neuroimaging is indicated in most individuals with cognitive impairment in Canada (Gauthier et al., 2012). A study of outpatient evaluation and treatment of dementia in an academic medical centre in Texas also found that 70 per cent of patients received MRI or CT imaging of the brain (Kalkonde et al., 2010). We assumed that 50 per cent of patients would get a referral for CT imaging from a family physician. In contrast, almost every visit to a neurologist, geriatrician, or geriatric psychiatrist would receive a referral for either structural neuroimaging or neuropsychological testing (Gauthier et al., 2012).

Results

Costs

Administrative and supervisory costs for the intervention program we studied vary from site to site. In outpatient health care settings, it

https://doi.org/10.1017/S0714980821000726 Published online by Cambridge University Press

Table 1 (a). *Revenue and expenses for a group memory intervention (full group)*

Revenue	Units	Fee	Amount
Registration fees	17 people[a]	140	2,380
Total revenue			2,380
Expenses	**Units**	**x**	**Cost**
Hourly cost of facilitator (salary and benefits)	15 hours	80	1,200
Advertisement	1 item	500	500
Participant workbooks	20 books	20	400
Catering	5 sessions	40	200
Hourly cost of administrative assistant (salary and benefits)	5 hours	25	125
Total expenses			2,425

Notes. Revenue and expenses as implemented at Baycrest Health Sciences.
[a]Not all participants are able to pay the registration fee. We have estimate that 17 out of 20 would be able to pay the full fee, although this percentage varies across sessions.

Table 1 (b). *Revenue and expenses for a group memory intervention (half group)*

Revenue	Units	Fee	Amount
Registration fees	9 people[a]	140	1,260
Total revenue			1,260
Expenses	**Units**	**x**	**Cost**
Hourly cost of facilitator (salary and benefits)	15 hours	80	1,200
Room rental	5 sessions	60	300
Advertisement	1 item	500	500
Participant workbooks	10 books	20	200
Catering	5 sessions	20	100
Hourly cost of administrative assistant (salary and benefits)	5 hours	25	125
Total expenses			2,425

Notes. Potential revenue and expenses as implemented at non-Baycrest sites.
[a]Not all participants are able to pay the registration fee. We have estimate that 9 out of 10 would be able to pay the full fee, although this percentage might vary across sessions.

is estimated that approximately $2,425 is spent per 20-person session (a "full group") in staffing, advertising, materials, and catering (Table 1a). These expenses, which are almost offset by participant program fees of $140 per attendee (as not every attendee can afford to pay the full fee, we modelled fees paid for 17 of the participants), acknowledge the direct costs related to the organization, supervision, and presentation of these programs. Because the program has been run with fewer than 20 participants and at sites where room rental fees must also be costed, we have included expenses for 10-person sessions (a "half group"; see Table 1b). For half-group sessions, we anticipated receiving registration fees for nine participants. This additional modelling, which is also applied to the sensitivity analysis, helps test parameter uncertainties associated with cost inputs.

Benefits

Table 2 presents the benefits (estimated costs) of a hypothetical population of 100 Ontarians presenting with subjective memory complaints to primary and secondary care physicians along four diagnostic pathways. These estimates are based on Canadian best practices for treating older adults with possible dementia or neurodegenerative diseases (Feldman et al., 2008; Feldman, 2009; Gauthier et al., 2012) and align with similar costing exercises in Sweden (Jedenius, Wimo, Strömqvist, Jönsson, & Andreasen, 2010; Wimo et al., 2013). Under the four scenarios outlined in Table 2, the estimated total cost for these 100 patients is $91,417.10 ($13,229.60 + $64,461.50 + $7,251.95 + $6,474.05). The average cost per patient being evaluated for subjective memory complaints in this simulation would be $914.17. In light of the evidence that it takes approximately three program attendees to find a significant disinclination of one healthy older adult to seek unnecessary medical care for normal age-related memory changes (Wiegand et al., 2013), we calculate that the intervention provides a benefit to the health care system of approximately $914.17 for every three individuals enrolled. Following this calculation, a typical group of 20 attendees saves approximately $6,094.47 [(20 ÷ 3) × 914.17].

Benefit-to-Cost Ratio

A calculation of the benefit-to-cost ratio of the Memory and Aging Program is detailed in Table 6. Two ratios are presented: one for a typical, full-group session of 20 participants and another for a half-group session of 10 participants. The full-group calculation shows that the estimated benefit-to-cost ratio for a typical session is 135.43. The half-group analysis results in a benefit-to-cost ratio of 2.62. In either case, the ratios are greater than 1.0, meaning the benefits outweigh the costs, and the program is efficient (Fuguitt, 1999).

Sensitivity Analysis

Table 7 provides calculations of the benefit-to-cost ratio using the higher NNT values relating to memory strategy use for program participants (Vandermorris et al., 2020). Again, two ratios are presented: one for a full group and another for a smaller half-group. The full-group calculation shows that the estimated benefit-to-cost ratio for a typical session ranges from 81.26 (for NNT = 5) to 58.04 (for NNT = 7). The half-group analysis results in a benefit-to-cost ratio ranging from 1.57 (for NNT = 5) to 1.12 (for NNT = 7).

Discussion

Interpretation

The 10-hour multi-component group memory intervention studied appears to be a cost-beneficial intervention. For every dollar spent on the program, a savings is accrued to one province's health care system – in terms of health care expenditures averted – ranging from $2.62 to $135.43. This range is within the parameters of a systematic review of cost-benefit ratios of 52 public health interventions in the United Kingdom (none of them relating to memory and aging), where the ratios ran from 0.66 to 167 (Masters, Anwar, Collins, Cookson, & Capewell, 2017). The cost benefits of the program are also evident when modelling higher NNTs with smaller groups and at potential sites with additional administrative expenses.

https://doi.org/10.1017/S0714980821000726 Published online by Cambridge University Press

Table 2. Estimated Costs for a Hypothetical Population of 100 Help-seeking Ontarians with Subjective Memory Complaints

Physician or laboratory service / Other direct diagnostic costs	Billing code	I-Fee	II-Fee	III-Fee	IV-Fee
		Family physician	Neurologist	Geriatrician	Geriatric psychiatrist
Consult – Family physician	A003	84.45	84.45	84.45	84.45
Age-based fee premium	A003/A007	12.67	12.67	12.67	12.67
Consult – Specialist	A003/A180/A770/A190	–	300.70	401.30	300.70
Extended consult – Specialist	K630	–	–	–	113.70
Follow-up appointment	A007/A186/A375/A196/ K630	36.85	84.95	105.25	105.25
Comorbid premiums (1/3 of patients)	E078	n/a	128.42	168.68	n/a
Specific neurocognitive assessment	K032	67.75	67.75	67.75	67.75
Sub-Total		201.72	678.94	840.10	684.52
Laboratory services	See Table 3	62.37	62.37	62.37	62.37
Structural imaging, CT, 50% of patients	See Table 4	66.65	–	–	–
Structural imaging, MRI, 50% of patients	See Table 4	–	137.92	137.92	137.92
Neuropsychology testing, 50% of patients	See Table 5	–	410.00	410.00	410.00
Total		330.74	1,289.23	1,450.39	1,294.81
Estimated patients		40	50	5	5
Total by service		13,229.60	64,461.50	7,251.95	6,474.05

Notes. Billing codes and fees are those assigned for each physician or laboratory service in schedules under Regulation 552 of the *Health Insurance Act* (Ministry of Health and Long-Term Care, 2020b; Ministry of Health and Long-Term Care, 2020a). Specific neurocognitive assessments (K032) may include the short form of the Behavioral Neurology Assessment or the Dementia Rating Scale.

Table 3. Estimated Laboratory Services for Ontarians With Subjective Memory Complaints

Laboratory service	Code	Fee
Documentation fee	L700	10.76
Complete Blood Count	L393	3.98
Fasting blood glucose	L112	1.55
Serum electrolytes – Sodium	L226	1.16
Serum electrolytes – Potassium	L204	1.16
Serum creatinine	L067	1.28
Serum calcium	L045	1.16
TSH (thyroid stimulating hormone)	L341	3.58
Serum vitamin B_{12}	L345	3.58
Alanine aminotransferase (ALT)[a]		2.59
Gamma-Glutamyl Transferase (GGT)	L107	1.28
RBC folate	L309	3.11
Fasting lipid panel	L151	8.27
Hemoglobin A_{1C} (HbA_{1C})	L093	7.25
25-OH-vitamin D	L606	11.66
Total – Laboratory services		62.37

Notes. Billing codes and fees are those assigned for each laboratory service in a schedule under Regulation 552 of the *Health Insurance Act* (Ministry of Health and Long-Term Care, 2020a).
[a]ALT testing cost taken from www.lifelabs.com/Documents/files/AssessmentPanels_Summary.pdf.

Table 4. Estimated Structural Imaging Costs

Laboratory service	Billing code	Cost/ Fee
Structural imaging, CT – hospital cost (estimate 2019/2020)[a]	–	68.35
Structural imaging, CT – diagnostic cost	X402	64.95
Structural imaging, CT – total		133.30
Structural imaging, MRI – hospital cost (estimate 2019/2020)[a]	–	136.70
Structural imaging, MRI – head, multislice sequence	X421	73.35
Structural imaging, MRI – head, with MR spectroscopy	E875	19.40
Structural imaging, MRI – head, repeat plane, different sequence	X425	36.70
Structural imaging, MRI – head, repeat with MR spectroscopy	E876	9.70
Structural imaging, MRI – total		275.85

Notes. Billing codes and fees are those assigned for each service in a schedule under Regulation 552 of the *Health Insurance Act* (Ministry of Health and Long-Term Care, 2020b).
[a]Estimated hospital costs are per unit averages for MRI ($128) and CT ($64) scanning services as described in the 2017/2018 annual report of the Auditor General of Ontario (Office of the Auditor General of Ontario, 2018). These estimated hospital costs were then inflated from 2017/2018 to 2019/2020 using the annual average increase in hospital funding for the two fiscal years, or 4.7% and 2.0%, respectively (Financial Accountability Office of Ontario, 2019; "Published Plans and Annual Reports 2019-2020: Ministry of Health and Long-Term Care," 2019).

One of our study's underlying assumptions is that memory intervention programs raise awareness in participants about what age-related cognitive changes are normal and which are not. Therefore, these interventions contribute to attendees' overall health literacy, or their ability to make informed, everyday decisions about health care needs (Kickbusch & Maag, 2008). Health

https://doi.org/10.1017/S0714980821000726 Published online by Cambridge University Press

Table 5. Estimated Neuropsychological Assessment Costs

Service	Cost
Neuropsychological interpretation, report writing, client feedback, psychologist, 7 hours x $100 per hour	700.00
Administrative support (approximately .8 hour x $25 per hour)	20.00
Neuropsychological testing, test fees	100.00
Neuropsychological assessment – subtotal	820.00

Table 6. Calculation of the Benefit-to-Cost Ratio of the Memory and Aging Program

	NNT = 3	
	Full group	Half group
Benefits	6,094.47	3,047.24
Cost of the program	45.00	1,165.00
Benefit-to-cost ratio	135.43	2.62

Note. Estimates for one session run at Baycrest Health Sciences with 20 participants (full group) or at an alternative site with 10 participants (half group). Half group sessions also include costs for a room rental.

literacy in older adults is positively correlated with cognitive health and healthier lifestyles, and a possible reduction in unnecessary physician visits and lower health care costs (Eichler, Wieser, & Bruegger, 2009; Geboers et al., 2018). The educational aspect of a memory intervention program, then, can play a crucial role in directing older adults who are at the highest risk of developing MCI or dementia to seek care. In normalizing age-related memory loss, memory programs and clinics can bring attention to cognitive changes that are not part of healthy aging.

Comparison with Other Studies

There are no similar published cost-benefit analyses of memory intervention clinics or programs. The present investigation is a proof of concept as to whether such an analysis is feasible and has merit. We have proven its feasibility. We believe the research approach also has merit. It is based upon the need to estimate the potential impacts individuals with subjective memory complaints (but no diagnosable disorders) can have on health care systems. The number of worried well clients in specialist clinics throughout England has been found to range from 24–50 per cent (Stone, Pal, Blackburn, Reuber, & Thekkumpurath, 2015). In Canada, help-seeking rates from older adults with subjective memory complaints can be inferred from studies not directly addressing this topic. For example, a survey of urban-based Canadian neurologists ($n = 26$) found that of 453 referrals for dementia-related symptoms (79% of which were from family practitioners), six per cent of the patients had no cognitive impairment (Chow et al., 2009). An evaluation of patients seen over three years in a memory clinic in Kitchener, Ontario, for memory complaints (e.g., word-finding problems) reported that of the 151 patients assessed by eleven family physicians and two geriatricians, about 20 per cent of the patients had normal cognitive function (Lee et al., 2010). These individuals' memory complaints were deemed attributable to factors other than cognitive impairment, such as depression or anxiety (Lee et al., 2010). Indeed, a recent study in Japan of 155 older adults (mean age = 69.56) found that subjective memory complaints were associated with negative mood (e.g., depressive symptoms) rather than objective measures of cognitive decline (Kawagoe, Onoda, & Yamaguchi, 2019). Furthermore, a 2017 study of a rural memory clinic in Saskatchewan found that 81 of 375 individuals (22%) who visited the clinic over 11 years had no identifiable neurological or neuropsychiatric disorders (Verity et al., 2018). These worried well older adults were younger, better educated, and more likely to have had previous psychiatric diagnoses or higher alcohol consumption than in a group later diagnosed with Alzheimer's disease (Verity et al., 2018).

Table 7. Sensitivity analysis of benefits of the Memory and Aging Program based upon NNT related to memory strategy use

	NNT = 5		NNT = 7	
	Full group	Half group	Full group	Half group
Benefits	3,656.68	1,828.34	2,611.92	1,305.96
Cost of the program	45.00	1,165.00	45.00	1,165.00
Benefit-to-cost ratio	81.26	1.57	58.04	1.12

Note. Estimates for one session run at Baycrest Health Sciences with 20 participants (full group) or at an alternative site with 10 participants (half group). Half group sessions also include costs for a room rental.

Extrapolating from these Canadian data, one can infer that a range of 6–20 per cent of potentially unnecessary consultations for subjective memory complaints impacts a health care system facing capacity pressures (*Hallway Health Care: A System Under Strain: 1st Interim Report from the Premier's Council on Improving Healthcare and Ending Hallway Medicine*, 2019) in non-trivial ways. Although wait times for secondary care physicians specializing in diagnosing memory disorders are not tracked in Ontario, a recent report of a 4.5-year wait time to see a neurologist in Kingston (Puzic, 2017) may be typical of similar-sized cities and attests to the need to triage out unnecessary visits to secondary care physicians. Fortunately, memory and aging programs present family physicians with options for appropriate, low-cost interventions for older adults with subjective cognitive decline before more costly medical treatments are explored.

Future Directions

The savings accrued by this and similar initiatives are expected to grow exponentially in the 2020–2030 period, as program delivery expands into underserved areas, such as remote and rural communities and smaller cities where healthy aging programs have yet to take root. Ongoing train-the-trainer workshops and program kits for licensed health care providers will promote this growth in smaller communities. Furthermore, expansion into underserved cultural and ethnic communities will help ensure that delivery of memory and aging programs is not restricted to English-speaking individuals. Online versions of memory and aging programs will provide more options for clients, particularly during and after coronavirus disease (COVID-19) (Owens et al., 2020), although the effectiveness of online versus in-person versions has yet to be determined. In some of the expansion areas described previously, the benefit-to-cost ratio will likely be at the lower end of the range, as host sites incur costs related to room rentals and translation of materials into different languages or formats. Yet, on economic grounds, a case will undoubtedly continue to exist for such expansion.

https://doi.org/10.1017/S0714980821000726 Published online by Cambridge University Press

Limitations

Cost-benefit analyses of health care outcomes offer a narrow window to evaluate the efficacy of a health/mental health program (Prigatano & Pliskin, 2003). They are best used in conjunction with broader outcome-based research, as cost-benefit approaches often rely on assumptions that are difficult to cost or conceptualize. Out-of-scope to the present analysis included indirect benefits, such as reduced personal and family stress, improved mental health, ability to work longer, and possible deferral of MCI/dementia to later onset, as even slowing the onset of neurodegenerative disorders can lead to substantial cost savings (Lenox-Smith, Reed, Lebrec, Belger, & Jones, 2018). Although these indirect benefits can be quantified or costed (Evers et al., 1997), such as through quality-adjusted life year analysis, such complex calculations are outside the present study's scope.

Conclusion

In light of demographic trends, a planning concern of provincial governments is how to contain care costs related to cognitive decline in older adults. Community-based memory intervention programs that educate cognitively normal older adults about memory and aging have the potential to save health care expenditures. They do so by reducing the intentionality of older adults who are worried about their age-normal memory changes (i.e., those with subjective memory complaints) to seek traditional outlets for medical help. Using publicly available data sources, we were able to determine that these memory intervention programs are cost-effective. We did so by calculating that their benefits (in medical assessment costs avoided) outweigh typically modest program costs. Our study is a proof-of-principle that objective markers of value can be used to measure community-based memory intervention programs' impacts. Thus, we provide a framework for future cost outcome or health literacy research, which may be informed by more robust data on the help-seeking behaviour of older adults with normal age-related memory changes.

Acknowledgements. We thank Susan Bronskill, Alita Fernandez, Dr. Jess Leah, Derrick Legere, Dr. Gary Naglie, and Dr. Gary Turner for their help and support in this project.

Conflicts of Interest. Drs. Vandermorris and Troyer have developed program materials and a train-the-trainer workshop for the Memory and Aging Program. Under Baycrest's Intellectual Property Policy, they are eligible to receive a percentage of the royalties collected from these products.

Supplementary Materials. To view supplementary material for this article, please visit http://doi.org/10.1017/S0714980821000726.

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