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QUANTITATIVE RESEARCH

Disability trends in Canada: 2001–2014 population estimates and correlates

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Abstract

Objectives Disability is a major concern for the health of midlife and older Canadians. Understanding disability trends is critical for detecting socio-economic and health precursors that could be amenable to policy interventions. The purpose of this study is to assess trends in rates of disability among Canadian adults age 40–64 and 65+. We also examine the impact of changing socio-demographic and health factors over time on the trends.

Methods Data from the 2001–2014 Canadian Community Health Survey (CCHS), a repeated cross-sectional nationally representative study, are used to estimate age- and gender-stratified logistic regression models of disability as a function of the year of interview to assess trends. Disability is defined as experiencing difficulties with a variety of individual functions, such as seeing, walking, climbing stairs, and bending.

Results Among men and women 65 and older, disability has declined since 2001 in most subgroups and regardless of changing socio-economic and health characteristics. Adults 40–64 years of age, in contrast, have experienced stagnating disability over the observation period. If it were not for changes in the distribution of education and household income, the disability rate would be increasing significantly.

Conclusion Older Canadian adults are experiencing mild but systemic improvements in disability. More worrisome is the stagnating trend among midlife cohorts, which could portend greater disability burden in the future as Canada's population ages. Preventive efforts need to be targeted at vulnerable groups at earlier ages in order to prevent future increases in disability-related financial, caregiving, and medical burden.

Résumé

Objectifs L'incapacité importe beaucoup pour la santé des Canadiens à partir de la quarantaine. Il est essentiel de connaître les tendances en la matière pour détecter les précurseurs socioéconomiques et de santé qui peuvent se prêter à des interventions stratégiques. Notre étude vise à évaluer les tendances dans les taux d'incapacité des Canadiens adultes de 40 à 64 ans et de 65 ans et plus. Nous examinons aussi l'incidence sur ces tendances de l'évolution des facteurs sociodémographiques et de santé au fil du temps.

Méthode Nous avons utilisé les données de l'Enquête sur la santé dans les collectivités canadiennes (ESCC) de 2001-2014, une étude transversale répétée, représentative à l'échelle nationale, pour évaluer des modèles de régression logistique de l'incapacité, stratifiés par âge et par sexe en fonction de l'année d'entrevue, afin d'en dégager des tendances. L'incapacité est définie comme étant le fait d'éprouver des difficultés avec diverses fonctions individuelles comme voir, marcher, monter ou descendre les escaliers et se pencher.

Résultats Chez les hommes et les femmes de 65 ans et plus, l'incapacité a baissé dans la plupart des sous-groupes depuis 2001, indépendamment de l'évolution des caractéristiques socioéconomiques et de santé. L'incapacité chez les adultes de 40 à 64 ans,

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par contre, est restée stable sur la période de l'étude. Si ce n'était des changements dans la distribution du niveau d'instruction et du revenu des ménages, le taux d'incapacité aurait sensiblement augmenté.

Conclusion Il y a eu des améliorations légères mais généralisées dans les taux d'incapacité des Canadiens âgés. La stagnation des taux dans les cohortes de 40 à 64 ans est plus inquiétante, car elle laisse présager un plus grand fardeau d'incapacité à mesure que la population du Canada vieillit. Les efforts de prévention doivent cibler les groupes vulnérables à un âge moins avancé pour prévenir les hausses futures des coûts financiers, de la prestation de soins et du fardeau médical liés à l'incapacité.

Keywords Disability evaluation · Canada · Adult · Demography · Population

Mots-clés Évaluation de l'incapacité · Canada · Adulte · Démographie · Population

Introduction

Disability is not an inevitable aspect of aging; however, a significant proportion of midlife and older adults experience functional limitations resulting in disability (Freedman et al. 2002; Manton and Gu 2001). An increase in the proportion of adults experiencing disability becomes problematic as it may place significant strain on the health care system (Lefrançois et al. 2013). Disabled individuals are the greatest beneficiaries of health care expenditures (Carrière 2006; Rotermann 2006), in part because medical costs among disabled adults are significantly higher than among those without disability (Freedman et al. 2002). Canadian disability-related expenditures were approximately $30 billion in 2010. This includes disability insurance, social assistance programs, and tax measures (Stapleton 2012). Moreover, additional costs per family with at least one person with a disability can exceed $7000 annually, which includes over-the-counter medications and the use of essential paramedical care and services (Dumais et al. 2015). In addition to its financial impact, disability is also associated with a loss of independence and long-term care needs (Geerts and Willemé 2012; Verropoulou and Tsimbos 2016). This may lead to higher instances of caregiver burden which includes the physical and psychological hardships experienced when caring for a loved one (Garlo et al. 2010; Zarit et al. 1980). Caregivers and their families report needing to make major life changes and personal sacrifices (Garlo et al. 2010; Emanuel et al. 2000). The negative health outcomes and psychological strain of caregiving have been well documented among multiple nationalities and cultures (Uwakwe and Modebe 2007; Andrieu et al. 2003; Ho et al. 2009).

The high burden and cost of disability makes it imperative to understand disability prevalence and trends. A recent report by Statistics Canada (2017) provided a detailed profile of disability prevalence rates and disparities in the Canadian population, using the 2012 Canadian Survey on Disability. They found that 16% of adults 45 to 64 years of age and 33% of older adults experienced a disability (Statistics Canada 2017). However, the report provided only a static picture at one time point. The question of whether the prevalence rates have increased, decreased, or remained stable has not been addressed.

For chronic conditions and functional limitations, some evidence suggests that trends during the late twentieth century were decreasing among Canadians age 40 and over. These declines seemed to be driven by increases in educational attainment and income; once changes in education and income were taken into account, the declines were substantially attenuated (Millar and Chen 2000). Additional research suggested stable trends in disability rates among Canadians age 65 and over between 1996 and 2003 (Lafortune and Balestat 2007). However, although substantial research has been done in other countries, there is a critical lack of recent research concerning disability trends in the Canadian population (Lefrançois et al. 2013).

In countries outside Canada, extensive work described disability trends since the latter part of the twentieth century. The central finding was that in the 1980s and 1990s, the prevalence rate of disability among midlife and older adults decreased in the United States and Europe (Manton and Gu 2001; Martin and Schoeni 2014). More recent US and European studies also suggest that the prevalence rate has continued to decline among older adults (Crimmins 2004; Cutler 2001; Freedman et al. 2007; Tsai 2016; Moe and Hagen 2011; Sulander et al. 2006). The declining rate of disability among older adults represents one of the most important advances in overall health and well-being (Schoeni et al. 2008). If rates continue to decline, a greater proportion of the older population could remain economically active and require fewer medical interventions (Cutler 2001).

However, recent US studies have also found that individuals between 40 and 64 years of age are increasingly reporting functional limitations, while evidence from Europe has found either flat or increasing disability trends across nations (Verropoulou and Tsimbos 2016; Martin and Schoeni 2014; Cambois et al. 2012). A continued increase in functional limitations becomes a concern as those individuals represent the future older population (Robine et al. 2013). Examining disability trends among midlife adults has important implications for their overall health, ability to remain in the workforce, and

health care expenditures (Martin et al. 2010). Given these worrisome patterns, it is critical to determine disability trends among Canada's working-age population because the similarities to the US and European populations presage disability increases among Canadians as well.

Findings on current disability rates may improve predictions of future changes in disability by allowing policymakers to gain a better understanding of disability precursors, and thus where interventions may be most effective (Tsai 2016; Schoeni et al. 2008). To address this important gap in knowledge, we assess disability trends among Canadian adults and identify critical socio-demographic and medical correlates. Because the literature suggests fundamentally different trends among non-elderly and older adults, we correspondingly analyze adults 40–64 and 65+ separately. The analyses are also estimated separately for men and women because of the large gender differences in disability rates: usually, women's rates of functional limitations and disability are higher than men's across the adult life course (Verropoulou and Tsimbos 2016; Wahrendorf et al. 2013), even though the changes in disability have tended to occur in concert for both genders (Verropoulou and Tsimbos 2016; Millar and Chen 2000; Crimmins 2004). The analyses use the Canadian Community Health Survey (CCHS) 2001–2014, which is the best available data source because of the large sample size and identical disability measures over nine waves, which meets requirements for determining population trends (Verropoulou and Tsimbos 2016; Martin et al. 2011).

Methods

Data

All analyses are estimated on pooled data from the 2001–2014 CCHS (Statistics Canada. Canadian Community Health Survey 2014). The CCHS is a cross-sectional survey that collects information on health and health determinants from nationally representative samples of the non-institutionalized Canadian population age 12 and older from all provinces and territories (Rodd and Sharma 2016). The survey began collecting data in 2001 biannually with a sample size of approximately 130,000 respondents. Since 2009, the data have been collected annually. In even years, the sample is approximately 65,000 respondents and in odd years, the sample is approximately 130,000. Due to an error in the interview process, the 2011 wave did not ask the disability questions and is thus omitted from analysis. The survey is conducted by either computer-assisted interviewing (CAI), computer-assisted personal interviewing (CAPI), or computer-assisted telephone interviewing (CATI). The response rates exceed 75% of the targeted sample.

The analytic sample is restricted to adults 40 years of age and older. After excluding 1115 respondents who did not provide valid answers to the disability measure, the sample includes 601,663 respondents.

Measures

Outcome variable

Disability is defined as experiencing difficulties with a range of activities. Individuals were asked "Do you have any difficulty hearing, seeing, communicating, walking, climbing stairs, bending, learning or doing any similar activities?" The answer is dichotomized as (0) never experiencing limitations versus (1) sometimes/always.

Explanatory variables

The focal explanatory variable includes the year of interview, which is used to assess disability trends over time. Preliminary checks indicated that a linear function of time is an adequate and parsimonious specification. For all logistic models, we rescaled year into a continuous variable ranging from 0 to 1 using the formula *year01 = (year-2001)/13*, so that the coefficient associated with a one-unit change in time reflects the change in the log-odds of disability from the start to the end of the observation period, or 2014 relative to 2001.

We included covariates which prior studies of disability identified as particularly important (Martin and Schoeni 2014; Martin et al. 2010; Zajacova and Montez 2018). Most analyses are stratified by age and gender. Age is coded such that each category represents a 5-year interval. Gender is also a critical socio-demographic characteristic with large disparities in many health outcomes, including disability (Read and Gorman 2010; Rieker and Bird 2005); consequently, analyses are estimated separately for men and women. Additional covariates include education, household income, marital status, region, minority status, immigrant status, and various chronic health conditions. Level of education consists of four categories: (1) less than high school; (2) high school graduate; (3) some postsecondary; and (4) postsecondary graduate. Household income is coded in five intervals based on the 2014 survey ranging from (1) no income or < $20,000 to (5) $80,000 or more. The earning thresholds for these categories increased over time, likely as a result of inflation since the survey's inception. Marital status includes three categories: (1) married; (2) previously married; and (3) never married. The region variable groups the Canadian provinces and territories into the following categories: (1) Atlantic Region; (2) Quebec; (3) Ontario; (4) Prairie Region; (5) British Columbia; and (6) Territories. Minority status and immigrant status are dichotomized into the following two categories: (0) no and (1) yes. Finally, health conditions, including asthma, arthritis, bowel disorder, cancer, diabetes, heart disease, and hypertension, are also dichotomized into two categories:

(0) no and (1) yes. The covariates have all been identified as key additional factors in studies related to disability trends (Zajacova and Montez 2018).

Statistical analysis

All analyses are estimated separately for midlife adults (40–64 years) and older adults (65 and older), also separately for men and women. In order to examine baseline disability trends for each category of the covariates in this study, we estimate age- and gender-stratified logistic regression models of disability as a function of linearly specified year, controlling only for age. We then estimate additional logistic regression models for each subgroup: The second model controls for socio-demographic characteristics, the third model adds measures of socio-economic status, and the final models also include medical correlates.

Missing data range from < 0.2% for marital status, and chronic conditions, to about 3% for education, minority, and immigrant status, and 10.9% for income. We imputed the missing values using multiple imputation by chained equations with ten replicates (Royston and White 2011). The analyses use sampling weights in order to obtain unbiased population estimates.

Sensitivity analysis

We estimated descriptives stratified by age and gender; women had slightly higher level of disability than men (28% among women vs. 26% among men in adults 40–64; 50% and 47% in older adults, respectively). We graphed the adjusted predicted disability trend by gender; the lines were close enough for men and women of both age groups that they were difficult to distinguish. We also estimated all models using an alternative definition of disability where the threshold for disability is recoded into the following two categories: (0) never or sometimes and (1) always. This is done in order to assess rates of severe disability. For adults 40–64 years of age, trends remain flat or decrease over time, whereas for adults 65 and over, trends continue to decrease albeit more substantially.

Results

Table 1 shows weighted sample characteristics stratified by age. Among adults age 40–64, approximately 27% had a disability. About half were women and nearly two thirds had postsecondary diplomas. Among the older adults, approximately 48% had a disability. In this group, 55% were female and about half did not have any postsecondary schooling. In both age groups, the health conditions with highest prevalence were hypertension (20% at ages 40–64 and 46% at ages 65+) and arthritis (19% and 43%, respectively).

Table 1 Weighted study sample characteristics

	Age 40–64 $N = 371,125$	Age 65+ $N = 230,538$
Restricted activities (%)		
Never	72.9	51.6
Sometimes/always	27.1	48.4
Age (mean)	51.2	73.1
Gender (%)		
Female	50.2	55.0
Education (%)		
< HS	12.8	35.6
HS graduate	18.1	16.4
Some postsecondary	5.4	4.7
Postsecondary graduate	63.7	43.3
Household income (%)		
No or < $20,000	6.8	15.0
$20,000–$39,999	13.4	33.8
$40,000–$59,999	18.1	23.2
$60,000–$79,999	19.7	13.4
$80,000 or more	42.0	14.6
Marital status (%)		
Married	75.8	62.9
Previously married	14.1	32.4
Never married	10.1	4.7
Region (%)		
Atlantic	7.5	7.8
Quebec	24.0	24.8
Ontario	38.8	38.5
Prairies	16.1	14.8
BC	13.5	14.0
Territories	0.3	0.1
Minority (%)	17.6	10.2
Immigrant (%)	24.4	27.0
Diagnosed conditions (%)		
Asthma	7.3	7.5
Arthritis	18.7	42.8
Bowel disorder	4.6	5.6
Cancer	1.9	6.1
Diabetes	6.8	16.6
Heart disease	4.3	18.2
Hypertension	19.5	46.0

Table 2 presents age-adjusted linear trends in disability within gender- and age-stratified subgroups for each category of the covariates. Due to the way we rescaled the time predictor, the results show the odds ratio of disability in 2014 relative to 2001. The first row shows the age-adjusted trend for each subgroup. Among the younger men and women age 40–64, disability trends remained flat, with no significant

Table 2 Trend in disability for Canadian population subgroups

	Men 40–64	Women 40–64	Men 65+	Women 65+
All	0.99	1.03	0.80***	0.90***
Education				
< HS	1.17*	1.10	1.08	0.95
HS graduate	1.20*	1.34***	1.14	0.97
Some postsecondary	0.88*	0.71***	0.89	0.84***
Postsecondary graduate	0.93	0.95	1.04	0.88**
Household income				
No or < $20,000	1.06	1.15	0.70***	0.79*
$20,000–$39,999	1.14	0.77***	0.97	1.03
$40,000–$59,999	0.97	0.84***	0.87*	1.08
$60,000–$79,999	0.94	1.05	1.04	0.99
$80,000 or more	1.05	0.95	0.85	0.85
Marital status				
Married	0.95	0.90*	0.80**	1.13
Previously married	1.01	1.02	0.93	0.96
Never married	0.79***	1.01	1.15*	0.78*
Region				
Atlantic	0.91	0.89	1.02	0.79**
Quebec	1.15*	0.98	1.02	0.80**
Ontario	0.84*	0.95	0.83**	0.99
Prairies	1.09	0.91	0.88*	1.47*
BC	1.09	0.75***	0.94	1.14
Territories	1.15*	0.86**	1.11	1.90**
Minority status				
Non-minority	1.04	0.80***	0.99	0.94
Visible minority	1.09**	0.90***	0.86	0.90
Immigrant status				
Non-immigrant	1.06	0.81***	0.88	0.78**
Immigrant	1.15***	0.93*	0.76**	0.85*
Arthritis				
Not diagnosed	0.99	0.79***	1.31***	0.87*
Diagnosed	1.07	0.88**	1.42***	1.02
Diabetes				
Not diagnosed	0.99	0.80***	0.90	0.69***
Diagnosed	1.03	0.86***	0.88	0.96
Heart disease				
Not diagnosed	1.00	0.85	0.99	0.70***
Diagnosed	1.04	0.92*	1.04	0.98
Hypertension				
Not diagnosed	0.95	0.79***	1.00	0.76***
Diagnosed	1.02	0.84***	1.11	0.93

All models control for age. Models include sampling weights to account for unequal probability of selection into the sample. Disability is defined as experiencing restricted daily activities never versus sometimes to always. The table shows odds ratios from logistic regression models of disability as a function of time (year of interview). Time is a continuous covariate rescaled so that the odds ratio represents the change in the likelihood of disability in 2014 relative to 2001

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

change over time. This overall flat trend varied across population segments, but with little systematic tendencies. For instance, university graduates experienced no significant change in disability, those with some postsecondary education experienced a decline, while those with high school or less experienced an increase or stagnation (for women with less than high school) of disability. This could suggest increasing inequalities in disability by education, but a similar pattern is not observed by income. There are additional differences in disability trends across other factors, but the patterns are not systematic or similar for both genders. For instance, disability has increased in Quebec but only among men, and it has declined in Ontario but also only among men; in British Columbia and the Territories, disability declined but only among women. Interestingly, contrasting results are found for both the minority and immigrant status, whereby men are experiencing stagnating or increasing disability trends while the opposite is observed for women.

Among the older group, disability trends are decreasing significantly for both genders ($p < 0.001$): men 65+ have 20% lower odds of disability in 2014 compared to 2001; women have 10% lower odds. Among older women (but not men), the decreasing disability only occurs for those with postsecondary schooling. Interestingly, for both genders, those with the lowest household income level experienced the most pronounced decreases in disability. There are additional differences in the trends for various subgroups, but again without systematic tendencies. For instance, married men (but not married women) experienced a significant decline in disability trends while significant increases were found among never-married men and significant declines among never-married women. Both minority and immigrant status reveal comparable results for both gender subgroups among the older population.

Tables 3 and 4 present estimates of disability trends from weighted gender-stratified nested logistic regression

Table 3 Logistic regression predicting disability trends—men and women age 40–64

	Men 40–64				Women 40–64			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Year	0.99	0.99	1.09*	1.08*	1.03	1.02	1.13***	1.20***
Age	1.04***	1.04***	1.04***	1.02***	1.05***	1.05***	1.04***	1.01***
Marital status								
Married		(1)	(1)	(1)		(1)	(1)	(1)
Previously married		1.34***	1.02	1.02		1.44***	1.11***	1.09**
Never married		1.39***	0.98	1.02		1.45***	1.12***	1.13***
Region								
Atlantic		1.12***	0.98	0.94		1.07*	0.94*	0.88***
Quebec		0.64***	0.58***	0.68***		0.59***	0.54***	0.65***
Ontario		(1)	(1)	(1)		(1)	(1)	(1)
Prairies		1.01	1.04	1.07		1.01	1.02	1.05
BC		0.97	0.97	1.04		1.02	1.01	1.13***
Territories		1.12*	1.16**	1.25***		1.03	1.08	1.13*
Minority		0.90*	0.77***	0.76***		1.03	0.91*	0.92
Immigrant		0.63***	0.62***	0.69***		0.71***	0.71***	0.78***
Education								
< HS			(1)	(1)			(1)	(1)
HS graduate			0.76***	0.83***			0.75***	0.84***
Some PS			0.94	0.98			0.92	1.01
PS graduate			0.76***	0.82***			0.76***	0.86***
Income			0.78***	0.82***			0.80***	0.85***
Diagnosed								
Asthma				1.65***				1.76***
Arthritis				3.87***				4.14***
Bowel disease				2.24***				2.01***
Cancer				1.83***				1.78***
Diabetes				1.36***				1.61***
Heart disease				1.86***				2.31***
Hypertension				1.31***				1.40***
Observations	172,047	172,047	172,047	172,047	199,078	199,078	199,078	199,078

HS high school, *PS* postsecondary

Exponentiated coefficients

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 4 Logistic regression predicting disability trends—men and women age 65+

	Men 65+				Women 65+			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Year	0.80***	0.81***	0.86***	0.83***	0.90***	0.91***	0.93*	0.92**
Age	1.08***	1.08***	1.07***	1.06***	1.08***	1.07***	1.07***	1.06***
Marital status								
Married		(1)	(1)	(1)		(1)	(1)	(1)
Previously married		1.09**	1.01	1.04		1.23***	1.18***	1.19***
Never married		0.96	0.87**	0.90*		1.19***	1.17***	1.29***
Region								
Atlantic		1.18***	1.10**	1.09*		1.02	0.99	0.96
Quebec		0.67***	0.64***	0.72***		0.64***	0.62***	0.72***
Ontario		(1)	(1)	(1)		(1)	(1)	(1)
Prairies		1.11***	1.10**	1.15***		1.06*	1.05	1.11***
BC		1.06	1.07	1.14***		0.92**	0.93**	1.06
Territories		1.53***	1.46***	1.49***		1.68***	1.66***	1.62***
Minority		0.86**	0.84***	0.89*		1.03	1.01	1.09
Immigrant		0.84***	0.84***	0.89***		0.96	0.96	0.98
Education								
< HS			(1)	(1)			(1)	(1)
HS graduate			0.75***	0.78***			0.86***	0.92**
Some PS			0.96	0.98			1.00	1.05
PS graduate			0.85***	0.88***			0.88***	0.93**
Income			0.91***	0.94***			0.96***	1.00
Diagnosed								
Asthma				1.57***				1.71***
Arthritis				2.52***				2.88***
Bowel disease				1.90***				1.82***
Cancer				1.40***				1.36***
Diabetes				1.34***				1.53***
Heart disease				1.81***				2.06***
Hypertension				1.15***				1.27***
Observations	94,145	94,145	94,145	94,145	136,393	136,393	136,393	136,393

Exponentiated coefficients

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

models. The first model adjusts for year and age, the second model includes the socio-demographic controls, the third model adjusts for education and income, and the final model includes health indicators. Table 3 represents adults 40–64 years of age. In this group, disability trend remains flat net of changes in marital status, region of residence, racial, and immigrant composition of the population over time. However, when controlling for socio-economic characteristics (education and income), the disability trend becomes significant and increasing. This increasing trend is also observed in the last model that controls for changes in the distribution of chronic illness in the population. The main effects of all predictors on disability are in the expected direction: for instance, all health conditions are linked to a significantly higher odds of disability, with arthritis an especially salient correlate (odds ratio (OR) = 3.9 for men and 4.1 for women, $p < 0.001$).

Table 4 shows findings for adults age 65+. For both genders in this group, the trends remain significantly declining regardless of the variables we included in the models. With all covariates added in Model 4, the odds ratios for trend are only slightly attenuated (OR = 0.83 in Model 4 versus 0.80 in Model 1 for men; OR = 0.92 versus 0.90 for women). The main effects of the predictors on the odds of disability, again, are in the expected direction: older age, not being married, and having any health conditions are all significant predictors of disability.

Figures 1 and 2 display the probability of experiencing disability for adults 40–64 and 65+, respectively, calculated from fully adjusted logistic regression models. For the younger group, there is stagnation until 2009, with steep increase afterwards. For the older group, declines in disability are evident but only until 2009. For both groups, there is a pronounced spike in disability in 2012, which declines by 2014 but not to pre-2012 levels. The cause of the high 2012 prevalence is unclear but appears to be well within bounds of sampling variability, according to the authors' exchange with Statistics Canada.

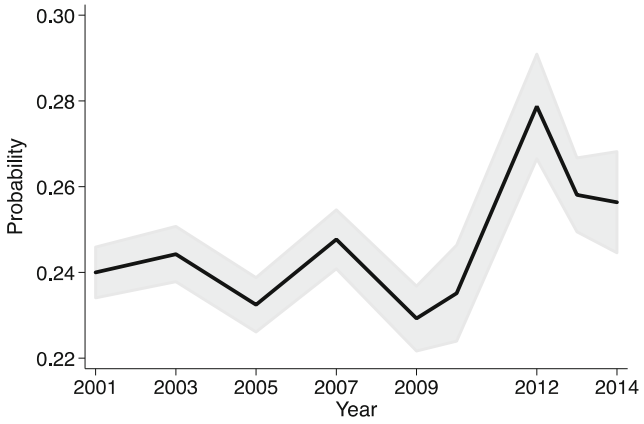

Fig. 1 Canadian disability trends 2001–2014; adults 40–64

Discussion

Understanding recent trends in disability is vital for adequate planning for future needs of disabled adults and for effective prevention efforts. Given its importance, it is surprising that no prior research has addressed this important question in Canada (Lefrançois et al. 2013). This study filled the critical gap by estimating disability trends among Canadian adults age 40 and older between 2001 and 2014, using the CCHS. Our key finding is that disability is remaining stable or increasing for both genders among adults age 40–64 while decreasing significantly for those 65 and older.

The continued decrease in disability among older Canadians in the first part of the twenty-first century is an encouraging pattern. It fits with a large body of research outside Canada, which continues to indicate decreasing trends among older adults (Martin and Schoeni 2014; Crimmins 2004; Cutler 2001; Freedman et al. 2007; Tsai 2016). Our analysis suggests that changing socio-economic conditions and the prevalence of important health conditions are not the reason for the declines. However, other factors, including more effective treatment and management of health conditions

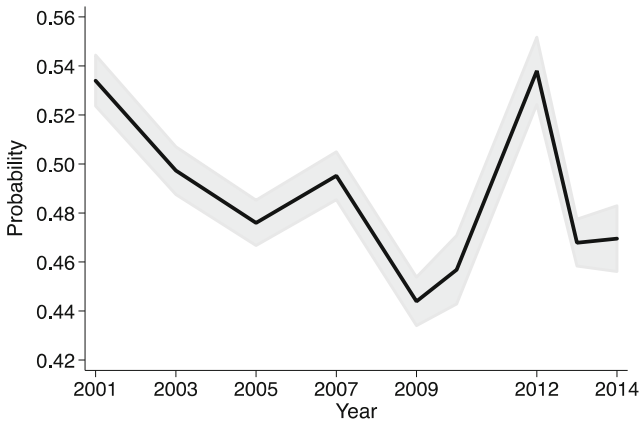

Fig. 2 Canadian disability trends 2001–2014; adults 65+. Figures 1 and 2 show predicted probability of disability net of all covariates comparable to Model 4 in Tables 3 and 4 at mean values of all predictors

(such as arthritis) as well as changing social conditions or family arrangements, may have contributed to the declines (Crimmins 2004; Freedman et al. 2007). In any case, the declining disability is an encouraging pattern of health improvements among older adults.

The stagnating or increasing disability in midlife Canadians observed alongside the decreasing disability among their older counterparts may be paradoxical; however, it is similar to findings reported from US and European countries (Verropoulou and Tsimbos 2016; Martin and Schoeni 2014; Cambois et al. 2012). Over the past two decades, midlife adults in the US and several European countries have had increasingly worse health, including disability and higher mortality. This worrisome trend, moreover, reverses the prior improvements in health, functioning, and longevity these populations experienced in the late twentieth century (Manton and Gu 2001; Martin and Schoeni 2014). The systemic patterns observed across many populations at mid-adulthood hint at underlying similar causes of these age-specific health changes across populations.

Our results suggest that if the level of education and household income did not change between 2001 and 2014 among midlife Canadians, there would have been a significant increase in disability among adults 40–64 years of age. This finding highlights the importance of socio-economic conditions for health trends. Policies that foster greater educational attainment and higher family income among Canadians may have many indirect beneficial consequences, including reducing disability prevalence rates. Other factors, which are not included in our study, may also play a role in disability trends in midlife. For example, work conditions, including stressful precarious employment and work-family conflicts, are linked to health deterioration over time (Lantz et al. 2005; Halpern 2005). Health behaviours are also linked to disability trends: lower smoking rates are beneficial but higher rates of obesity clearly increase disability rates (Freedman et al. 2007; Zajacova and Montez 2018). Interestingly, changes in the prevalence of relevant health conditions such as arthritis and heart disease did not play a major role in the disability trends of either age group we examined. This may indicate that changes in treatment and management, which we did not have information about, are more important than the presence of the diagnoses.

Unlike the clear differences by age, the observed trends were relatively similar for men and women. For instance, among the younger group, both genders had flat trends, which became significantly increasing once education and income were controlled for. At the same time, it is important to note that the disability increases were steeper among women than among men once we account for the changing social and medical landscape. The pattern of broad gender similarities, but also steeper increases among women than men in midlife, corroborates findings from outside Canada (Verropoulou and Tsimbos 2016; Martin and Schoeni 2014). However, we did

find some additional differences between men and women, when we estimated trends separately by gender, which is a strong justification for assessing these population subgroups individually (Verropoulou and Tsimbos 2016). The trends at older ages and across other characteristics varied but not in clear and systematic ways. Importantly, for adults 65+, nearly all population subgroups experience significantly lower disability in 2014 compared to 2001.

In addition to the key focus of our analysis on disability trends and how the changing composition of the population influenced the trends, the findings also show the associations between disability and each predictor regardless of the time of interview. This provides a useful check of validity of our approach because we found expected associations between socio-demographic and medical factors with disability. For instance, arthritis has a very strong effect: it is associated with approximately four times the odds of being disabled, compared to not having arthritis. These effects are important to keep in mind in order to better understand how to target preventive and intervention efforts.

We note several limitations of our study, with the first pertaining to our dependent variable. Unfortunately, the CCHS does not ask questions about disability that would be comparable to those collected in other population health surveys, such as the ADL/IADL items. The basic activities of daily living (ADL) involve personal care, including eating, bathing, and dressing, whereas instrumental activities of daily living (IADL) include preparing meals, housework, managing finances, and going shopping (Lefrançois et al. 2013; Martin and Schoeni 2014; Schoeni et al. 2008; Jette 2007). The information available in the CCHS pertains to restricted activities, which confounds functional limitations and disability, making it difficult to compare the estimates of average disability levels to those from other surveys. It also groups physical, emotional, cognitive, and sensory limitations, which prevents us from gaining a better understanding of the underlying causes of disability. Other limitations include changes over time in the household income category thresholds, which could have some impact on its estimates. Moreover, it would be advantageous if we had information about social ties, employment quality, disability benefits, and other variables that potentially influence disability trends.

Despite these limitations, our study provides the first estimates of disability trends among midlife and older Canadians in the twenty-first century. An understanding of recent changes in disability rates is necessary for predicting future health care costs as well as where interventions may be best utilized (Martin et al. 2010). Our finding that midlife Canadians have been experiencing stagnating or even increasing disability trends is particularly problematic, and we suggest that additional research should expand on the issue. For instance, researchers could use data with a shorter duration but more detail on disability. As moderate to severe disability, rather than mild disability, is associated with particularly high health care expenditures (Carrière 2006; Rotermann 2006), further work on the types and severity of disability problems is needed (Lefrançois et al. 2013). If additional studies corroborate our worrisome finding of non-decreasing disability trends among midlife Canadians, policymakers should seek to implement more robust health care interventions earlier in the life course, as these individuals represent our future older population (Martin and Schoeni 2014).

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