

The excess burden of rheumatoid arthritis in Ontario, Canada

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Abstract

Objectives

The purpose of this study was to estimate the excess burden of RA in Ontario, the largest province in Canada.

Methods

The records of all adult Ontarians who participated in the Canadian Community Health Survey (CCHS) cycle 1.1 (2000/2001) and provided consent to data linkage were linked to the Ontario Health Insurance Program (OHIP) physician claims database and the Discharge Abstract Database (DAD) In-Patient (i.e. hospitalisation) and Day-Procedure databases. RA individuals (n=233) were identified using CCHS 1.1 and the physician claims database. A control group matched by age, gender and rural/urban status was created with three controls for one case (n=699). Socio-demographic variables, medical characteristics, health-related quality of life (HRQoL) and one-year physician services, hospitalisations and day procedures costs were determined for the RA and non-RA groups. Regression techniques were used to identify predictors of medical characteristics, utility and cost data.

Results

The mean age of the population was 59 years and 76% were female. Compared to the matched control group, individuals with RA were statistically more likely to be obese, less educated, physically inactive and have a lower income. RA individuals also reported a statistically higher number of comorbidities and a lower HRQoL. Although no statistical differences were observed between the RA and non-RA groups for the costs associated with hospitalisations, the physician (\$1,015 vs. \$624, respectively) and day procedure (\$102 vs. \$51, respectively) costs were statistically higher among RA individuals.

Conclusion

These results indicate that the human and economic burden of RA in Ontario is considerable.

Key words

rheumatoid arthritis, burden of illness, Ontario Canada

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Introduction

The prevalence of rheumatoid arthritis (RA) worldwide varies between 0.3% and 1% and RA is most common in women and in developed countries (1, 2). In Canada, the prevalence of RA has been documented at 1% of the adult population (3). RA is a major source of pain and deformity that severely impacts the health-related quality of life (HRQoL) of sufferers (4, 5). When HRQoL is measured using preference-based instruments, RA has been shown to be one of the diseases with the worst quality of life scores among chronic diseases (6). On a 0–1 scale where 0 represents death and 1 represents a perfect health state, health utilities (*i.e.* HRQoL) associated with RA have been reported ranging from 0.41 to 0.66 (7–9). Since the onset of RA typically happens between the ages of 20 to 40, RA severely impacts the productivity of affected individuals. Within 10 years on onset, more than 50% of individuals with RA are unable to hold down a full-time job (1).

In addition of being a major source of disability, the economic burden of RA is considerable from both a payer and a societal perspective. However, large variations in cost estimates were noted in systematic reviews of cost-of illness studies of RA (10, 11). A more recent study published in 2008 estimated the direct and indirect costs of RA in several regions/countries based on a cost model populated with published literature and epidemiological data. The total annual costs per RA patient were calculated at \$13,133 in Canada, \$19,465 in UK, \$21,538 in Western Europe and \$26,455 in the US (2006 US dollars; 1 Euro = 1.26 US dollars) (6). Between 9% (Canada) and 39% (Western Europe) of the RA costs were attributed to indirect costs, while drug costs represented 3% (UK) to 43% (US) of the direct costs. A 2009 study using large administrative databases estimated that the excess direct costs of RA in the US were \$8.4 billion. Societal costs were calculated in this study at \$19.3 billion and at \$39.2 billion, depending on the assumptions used for the calculations of indirect costs (2005 US dollars) (12). In Canada, two cost of illness studies

using a prevalence-based approach have estimated the total costs (*i.e.* direct and indirect) of arthritis at \$5.9 billion in 1994 (13) and \$4.4 billion in 1998 (14). However, these studies did not differentiate between osteo-arthritis (OA) and RA, which limit our understanding of the burden of RA and the generalisability of these studies to either disease. This distinction is important from a health policy point of view as RA and OA differ in terms of age of onset, treatments, impact on HRQoL and costs. Although OA is 10 times more prevalent in Canada than RA (*i.e.* 10% vs. 1% prevalence rate, respectively) (3), the annual per-patient direct and indirect costs of RA in Canada were twice and five times higher than the OA costs, respectively (15). While the two other Canadian prospective studies published in 2004 and 2007 provided information on the costs associated with RA, large cost differences were observed. The 2007 study, based on 121 RA patients, estimated the annual direct costs per RA patient at \$10,287 (2002 Canadian dollars) (16), which was twice as high as the estimate from the 2004 study (\$2,575 per 6-month based on 253 RA patients; 1998 Canadian dollars) (15). In addition, these studies did not provide any information on the excess burden of RA (*e.g.* comparing costs of patients with RA with costs of a matched control patients without RA), which may limit the generalisability of the results.

There is also a lack of Canadian data on the impact of RA on HRQoL, which means that in many cases, physicians and health care policy makers are unaware of the true burden of RA. The purpose of this study was to use the richness of administrative data linked to population health survey data to estimate the humanistic and economic burden of RA in the province of Ontario, Canada, and to compare it with a matched control group composed of non-RA individuals.

Material and methods

Study setting and population

The study population consisted of 29,797 adult Ontarians who participated in the Canadian Community Health Survey (CCHS) (17) cycle 1.1 and provided consent to data linkage with administra-

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tive databases. CCHS is a national cross-sectional health survey collecting information on the health status, health care use and health determinants of a representative sample of Canadians 12 years of age and older living in private households ($n=32,848$). Detailed information regarding survey sampling methods can be found in the CCHS user guide (17). CCHS 1.1 was conducted by Statistics Canada from September 2000 to October 2001. To meet the study objectives, CCHS 1.1 was linked to two administrative databases to document the costs associated with physician services (Ontario Health Insurance Plan or OHIP), hospitalisations (Discharge Abstract Database Inpatient or DAD IP) and day procedures (DAD-Day Procedure or DAD-DP). The OHIP claims database contains the records of all fee-for-service billings for physician services in Ontario. The data include claims made by physicians paid through fee-for-service mechanisms (*i.e.* approximately 95% of all Ontario physicians) as well as laboratory or diagnostic tests conducted outside of hospitals by commercial laboratories. The OHIP database includes up to 20 fields per claim (*e.g.* physician specialty, diagnosis code, amount of the physician fees). DAD contains patient-level demographic (*e.g.* gender), administrative (*e.g.* length of stay) and clinical (*e.g.* diagnosis) data for hospital discharges (inpatient acute, chronic, rehabilitation) (DAD – Inpatient or DAD-IP) and day procedures/surgeries (DAD-Day Procedure or DAD-DP). A maximum of 400 variables are recorded for each admission. Three fiscal years of data were provided by the Ontario Ministry of Health and Long-Term Care for DAD and OHIP (*i.e.* fiscal years: 1999/2000, 2000/2001 and 2001/2002). Using information from CCHS and OHIP databases, individuals had to meet two conditions to be classified as having RA: 1) declared in CCHS survey to have been diagnosed with RA by a physician; 2) had at least one ICD9 code of RA (ICD-9 code: 714) recorded in the physician claims database (*i.e.* OHIP) over the three fiscal years available. As such, the final sample of RA individuals used for the analyses was a subset of the CCHS sample of individuals declaring

having RA. Requiring in addition that individuals declaring having RA had at least one physician visit in the claims database was meant to minimise misclassification of RA by individuals (*i.e.* having other forms of arthritis). A control group (*i.e.* individuals without RA) matched by age and gender was created using three controls for one case. As the CCHS over-sampled residents in rural areas to ensure sufficient coverage of the vast geography of Canada, cases and controls were also matched for rural/urban status.

Using CCHS data, the two populations were described in terms of socio-demographic characteristics (*e.g.* income), body mass index (BMI) categories (*e.g.* obese), medical characteristics (*e.g.* comorbid conditions), physical activity, self-reported health status (*e.g.* excellent) and Health Utility Index-3 (HUI-3) utility scores. The HUI-3 is a validated instrument which has been widely used to measure health status, HRQoL, and to produce utility scores (18). A utility of 1 corresponds to the perfect health state, while 0 corresponds to death. Negative utility scores represent health states worse than death. The HUI-3 utility scores (18) calculated by Statistics Canada were used in the analyses.

The costs of the RA and non-RA groups were derived from the administrative data over a one-year period covering the period of 6 months prior and 6 months after the CCHS interview date. OHIP data was used to identify the total amount paid to physicians (*i.e.* general practitioners and specialists) and non-hospital laboratories, while one-year hospitalisation costs were derived from DAD-IP. Inpatient hospital stays were assigned costs using the resource intensity weight (RIW) recorded in DAD-IP, which was multiplied by the average cost per RIW in 2001/2002 (\$2,995 CAN). Same day procedures were identified using DAD-DP and costs were calculated using a similar approach as for hospitalisations. The record linkage was conducted by Statistics Canada.

Statistical analyses

Means (standard deviations) and frequencies were used for continuous variables and dichotomous variables,

respectively. *t*-tests and chi-square tests were used to compare differences between means and proportions, respectively, when comparing the RA and control groups. The odds ratios (ORs) of having a specific comorbid condition (*e.g.* back pain), being hospitalised or having a day surgery were calculated using multivariate logistic regressions. The utility scores were analysed with a multivariate Tobit model (19). A multivariate generalised linear model (GLM) with a logarithmic link function with a gamma distribution was used to model physician costs (20, 21). The hospitalisation and day procedure cost data were modeled using a two-part model (22, 23) to reflect the fact that many individuals are not hospitalised or undergo a day procedure. The probability of observing a cost (*i.e.* being hospitalised) was first calculated using a logistic regression, while positive costs were modeled in a second step using a generalised linear model. The probability of having any use was then multiplied by the expected cost conditional on use. Age, gender, RA status, BMI category, personal income, rural/urban, smoking and physical activity status were used in all regressions (*e.g.* logistic, Tobit) to adjust for differences between the RA and non-RA groups. These variables were previously used when analysing other burdens of disease in Canada using patient-level data (24, 25).

The main analyses were conducted for the total combined costs (physician costs + hospital costs + day procedure costs) and for each cost component (*e.g.* physician services, hospitalisation and day procedures). To get a better understanding of the structure of the costs, the analyses for the combined costs were conducted by gender and age groups. Bootstrap techniques were used to generate confidence intervals associated with the expected costs and the excess costs (*i.e.* cost of RA group – cost of control group).

Results

Socio-demographic and medical characteristics

We identified 233 individuals who reported a physician diagnosis of RA in CCHS 1.1 and who also had an ICD-9

code of RA in the physician database, yielding a RA prevalence of 0.78% (*i.e.* 233/29,797). The mean age of these individuals was 59 years and 76% were female. Compared with 699 controls matched by age, gender and rural status, RA individuals were statistically more likely to be obese (22.8% *vs.* 16.5%, respectively), less educated (*e.g.* 27% of RA individuals have a university diploma *versus* 45.7% for the control group), physically inactive (65.5% *vs.* 57.1%) and to have a lower income (*e.g.* \$23,717 of personal income *vs.* \$32,434 for the control group) (Table I). In addition to suffering from RA, RA individuals declared having on average 2.8 other medical conditions that were diagnosed by a physician, for a total of 3.8 (SD: 2.4) medical conditions. The non-RA group reported on average 2.5 (SD: 2.1) medical conditions (Table II). The most common medical conditions assessed in CCHS and reported by RA individuals are given in Table II as well as the adjusted ORs. RA individuals were statistically more likely to suffer from migraine, cataracts, high blood pressure and non-food related allergies (Table II).

Self-reported health status and HRQoL

RA individuals reported a worse health status than non-RA individuals and statistically more RA individuals had perceived a deterioration of their health state over the year preceding the interview (Table III). The mean HUI-3 utility score was 0.66 (SD: 0.30) for the RA group compared to 0.84 (SD: 0.21) for the non-RA group (*p*-value <0.0001) and these differences were also observed for all age and gender comparisons (Table III). Other predictors of utility were the number of comorbidities, which was associated with a decrease in utility scores, while being physically active or a smoker significantly increased utility values.

Costs associated with hospitalisations, same day surgery and physician services

As shown in Table IV, the annual combined costs (*i.e.* costs of physician services + hospitalisations + day pro-

Table I. Socio-demographic characteristics.

	RA n=233	Control n=699	<i>p</i> -value
Mean age (Standard deviation)	58.9 (15.9)	58.9 (15.9)	1.000
<50	30.5%	30.5%	
50–65	29.6%	29.6%	
66–75	24.0%	24.0%	
>75	15.9%	15.9%	
Gender			1.000
Male	24.5%	24.5%	
Female	75.5%	75.5%	
Marital status			0.5328
Married and common law (living with partner)	56.5%	59.0%	
Single, never married, other (widowed, separated, divorced)	43.5%	41.0%	
Place of birth			0.529
Born in Canada	78.5%	76.5%	
Born elsewhere	21.5%	23.5%	
Body Mass Index category			0.0439
Under weight			
Normal weight	36.7%	44.9%	
Overweight	40.5%	38.6%	
Obese	22.8%	16.5%	
Education*			<0.0001
Non-university certificate	12.9%	12.8%	
University certificate/bachelors degree	27.0%	45.7%	
Smoking status			0.6789
Current smoker	19.9%	21.1%	
Former smoker	50.4%	47.6%	
Non-smoker	29.7%	31.3%	
Rural/urban			1.000
Urban	82.4%	82.4%	
Rural	17.6%	17.6%	
Physical activity			0.0291
Active/moderately active	34.5%	42.9%	
Inactive	65.5%	57.1%	
Working status			0.5175
Retired	39.7%	36.8%	
Employed	60.3%	63.2%	
Mean income (Standard deviation)			
Personal	\$23,717 (\$422,152)	\$32,434 (\$26,308)	<0.0001
Household	\$41,313 (\$32,689)	\$55,149 (\$41,061)	<0.0001

*Based on available information (n=93 for RA and n=408 for control); differences between means and proportions when comparing the RA and control groups were tested using *t*-tests and chi-square tests, respectively.

cedures) were statistically higher in the RA group than in the control group (\$1,391 *vs.* \$899, respectively). The excess costs associated with RA were also greater in men (\$1,135) than in women (\$394) and increased with age (Table IV). RA individuals also incurred statistically higher physician and day procedure costs than non-RA individuals. No statistical differences between the two groups were observed for the hospitalisation costs. In addition to age and RA status, an increased number of medical conditions was statistically associated with higher costs in all regression

models. Table V presents as an example the GLM regressions for the combined costs.

Discussion

This study confirms that RA is associated with a negative impact on HRQoL and a significant financial burden. Data from the CCHS survey highlighted many differences between RA individuals and a matched control group. For example, 23% of RA individuals were obese compared to 17% of controls and RA individuals were more likely to report comorbid conditions. With almost

Table II. Medical characteristics and adjusted odds ratios (OR)*.

	RA n=233	Control n=699	p-value
Mean number of comorbidities (Standard deviation)	3.8 (2.4)	2.5 (2.1)	<0.0001
Percentage of patients with:			<0.0001
0 comorbidity	0.0%	18.3%	
1 comorbidity	14.6%	21.3%	
2 comorbidities	18.9%	19.2%	
3 comorbidities	21.5%	14.0%	
4 or more comorbidities	45.1%	27.2%	
Percentage of specific comorbidities	RA n=233	Control n=699	Adjusted OR* (CI)
Allergies other than food	35.6%	27.6%	1.5 (1.1–2.1)
Back problems	29.6%	26.5%	1.2 (0.8–1.6)
High blood pressure	33.1%	25.4%	1.4 (1.0–2.0)
Other chronic condition	17.6%	14.7%	1.4 (0.9–2.1)
Migraine	14.2%	7.2%	2.3 (1.4–3.7)
Heart disease	14.2%	12.2%	1.2 (0.8–2.0)
Cataracts	15.5%	11.7%	1.7 (1.0–2.8)

* Adjusted for age, gender, BMI categories, rural/urban, personal income, smoking and physical activity status. CI: confidence interval.

Table III. Health-related quality of life.

	RA (n=233)	Control (n=699)	p-value
Self-reported health:			0.0001
Excellent / very good / good	52.4%	82.1%	
fair / poor	47.6%	17.9%	
Compared to one year ago:			<0.0001
Much better now than 1 year ago / somewhat better / about the same	71.7%	84.0%	
Somewhat worse now than 1 year ago / much worse	28.3%	16.0%	
Mean (Standard deviations) Health Utility Index (all)	0.66 (0.30)	0.84 (0.21)	<0.0001
<50 years of age	0.68 (0.31)	0.88 (0.19)	<0.0001
50–65 years of age	0.68 (0.28)	0.86 (0.18)	0.0002
66–75 years of age	0.67 (0.28)	0.80 (0.24)	0.0003
>75 years of age	0.58 (0.34)	0.80 (0.25)	0.0023
Male	0.70 (0.30)	0.81 (0.25)	0.0063
Female	0.65 (0.30)	0.85 (0.20)	<0.0001

Differences between means and proportions when comparing the RA and control groups were tested using *t*-tests and chi-square tests, respectively.

50% of RA patients rating their health as “fair or poor” and 30% reporting a deterioration of their health over the last year, the results showed that RA has a profound impact on HRQoL. When comparing HUI scores, the RA group had a significantly lower utility (0.66) than the non-RA group (0.84), where a difference in score of 0.03 is considered minimally important (26, 27). RA individuals also incurred higher costs due to physician services, day procedures and hospitalisations than non-RA individuals (\$1,391 vs. \$899 in controls).

When compared to previous Canadian studies, our cost figures were slightly different from the costs reported by Maetzel *et al.* (15), in which 253 RA patients were prospectively surveyed in 1999/2000. In this study, the 6-month costs for physician services and hospitalisation were estimated at \$272 (family doctor + non-surgeon specialists + surgeon specialists) and \$153 (inpatient hospitalisation costs), respectively (2000 US dollars). In contrast, we estimated a 6-month cost of approximately \$500 for physician services and \$90 for hospitalisations. Our estimates

are somewhat different from Fautrel *et al.* (16) (n=121 RA patients) in terms of annual physician costs (\$930 vs. \$1,015 in our study in 2001/2002 Canadian dollars), hospitalisation costs (\$420 vs. \$195 per year in our study) and day procedures (\$252 vs. \$101 in our study). Differences in methods (*e.g.* administrative data vs. survey based on patient recall) may explain these differences. In addition, these studies did not provide any information on the excess burden of RA. This is important as we found that the differences in hospitalisation costs between RA and non-RA individuals were not statistically significant. Two other Canadian studies (13, 14) have used a prevalence based approach to estimate the direct and indirect costs of arthritis, but they did not differentiate between RA and OA. As such, these studies cannot be used for comparison.

To the best of our knowledge, our study is one of the few existing studies that linked administrative data to survey data to estimate the human (*e.g.* HRQoL from the health survey) and economic (*e.g.* healthcare costs from administrative data) burden of RA in Ontario. This data linkage enabled the analyses to be performed at the individual level and to better control for individual differences (*e.g.* BMI levels), because the survey data provide unique information regarding the determinants of costs and HRQoL. This method also overcomes the limitations associated with studies relying only on aggregated measures or patient recall survey data to calculate the economic cost of a disease as they may be prone to measurement errors. Since CCHS is representative of provincial data and Ontario has a publicly funded healthcare system, the results generated by our study should be relevant for other Canadian provinces or countries with public-funded systems. Despite the strengths associated with linking administrative data to survey data that are representative of Ontario, several limitations were associated with the study. First, the true costs associated with RA are underestimated as drug costs, costs associated with other non-physician healthcare providers or indirect costs were not included

Table IV. One-year adjusted* costs (confidence intervals) by age and gender (2001/2002 Canadian Dollars).

	RA	Control	Incremental costs (CI)
Total cost (CI)	\$1391 (\$1202–\$1580)	\$899 (\$807–\$991)	\$492 (\$281–\$704)
Male (CI)	\$2036 (\$1172–\$2901)	\$901 (\$709–\$1093)	\$1135 (\$251–\$2020)
Female (CI)	\$1278 (\$1100–\$1456)	\$884 (\$782–\$985)	\$394 (\$186–\$603)
Age <65 (CI)	\$1146 (\$952–\$1339)	\$667 (\$569–\$764)	\$479 (\$255–\$703)
Age ≥65 (CI)	\$1980 (\$1506–\$2455)	\$1189 (\$1061–\$1316)	\$791 (\$309–\$1274)
OHIP (CI)	\$1015 (\$886–\$1144)	\$624 (\$570–\$678)	\$391 (\$250–\$531)
IP (CI)	\$195 (\$164–\$226)	\$220 (\$192–\$249)	-\$25 (-\$68–\$17)
DP (CI)	\$102 (\$82–\$122)	\$51 (\$45–\$57)	\$51 (\$30–\$72)

* Adjusted for age, gender, BMI categories, personal income, rural/urban, smoking and physical activity status and number of medical conditions.

CI: confidence interval; OHIP: Ontario Health Insurance Program; IP: inpatient stay/procedures; DP: day (outpatient) procedure.

Table V. Generalised linear model estimates for total cost.

Parameter	Coefficient	Standard error	p-value	Confidence intervals
Intercept	5.09	0.27	<0.0001	(4.56–5.61)
Age	0.01	0.003	<0.0001	(0.005–0.02)
Gender (female)	0.17	0.12	0.14	(-0.06–0.41)
Rheumatoid arthritis status	0.36	0.11	0.001	(0.15–0.56)
Underweight	0.26	0.17	0.13	(-0.08–0.61)
Overweight	0.23	0.11	0.04	(0.01–0.45)
Obese	0.17	0.12	0.18	(-0.08–0.41)
Personal income	0.001	0.001	0.43	(-0.002–0.004)
Former smoker	0.52	0.11	<0.0001	(0.31–0.74)
Current smoker	-0.18	0.12	0.13	(-0.42–0.06)
Physical activity	-0.14	0.10	0.15	(-0.33–0.05)
Rural/urban	0.16	0.12	0.21	(-0.09–0.4)
Number of medical conditions	0.12	0.03	<0.0001	(0.07–0.18)

in this analysis. These costs have been shown to be substantial. For example, the Canadian studies of Maetzel *et al.* (15) and Fautrel *et al.* (16) reported that drug costs accounted for between 50% to 60% of the direct costs. Similar or higher shares of medications have also been reported in the international literature (6, 10, 28). In terms of indirect costs, other Canadian studies have reported that indirect costs could account for 40%–60% of the total burden of RA. As such and despite the fact that the cost of a disease is composed of direct medical costs, direct non-medical costs and indirect costs, the available data restricted our analyses to direct medical costs only, which represents an underestimation of the true economic burden of RA to the Canadian society. Second, our sample of respondents excluded respondents living in long-term care facilities, nursing homes or the armed forces. Third, although misclassification of RA should have been

minimised by our inclusion criteria (*i.e.* self-reported RA and one claim for RA in administrative database), there is still a risk that some individuals were not accounted for if they did not have a claim for RA this particular year. For example, 3,301 individuals declared having RA diagnosed by a physician in the CCHS survey (approximately 11% of all adult population), which greatly exceeds any estimates of RA prevalence (1). In contrast, our sample size of 233 RA individuals was more aligned with the prevalence of RA. For this reason, we restricted our analyses to those 233 who also had a diagnosis of RA in the physician database. However, there is a chance that we may have included the most serious cases of RA. Although aligned with previous prospective Canadian studies, our sample size of 233 RA individuals was relatively small. As such, results from the sub-group analyses should be interpreted with caution. Finally, we evalu-

ated an adult population with RA and did not determine the burden of RA in a paediatric population. Similarly, we did not evaluate the burden of ankylosing spondylitis, another chronic inflammatory rheumatic disease, which has been compared to RA (29, 30). This is left for future research.

Conclusion

In conclusion, this work provides a better understanding on the humanistic and economic burden of RA in Ontario. In particular, it provides new and previously unavailable information on the excess costs associated with physician services, hospitalisations, day procedures and health status of RA patients. By exploiting the richness of survey data linked to administrative databases (*i.e.* using BMI from CCHS to control for obesity status when estimating costs using administrative database), the results emphasise the tremendous humanistic and economic burden of RA in Ontario. The data generated in this study can also be used to inform decision models and policies or programs to reduce or contain the burden of RA in Canada.

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