

Revisiting Arthritis Prevalence Projections — It's More Than Just the Aging of the Population

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ABSTRACT. *Objective.* Data for successive population surveys show there is a sustained increase in the prevalence of arthritis, surpassing projected estimates. We examined whether the often-made assumption of stability in age/sex-specific arthritis point-prevalence estimates when estimating future burden is upheld; we used nearly a decade of survey data, and computed new projections for arthritis prevalence in Canada, taking into account past changes in age/sex-specific prevalence estimates and anticipated changes in the age/sex structure of the population. The prevalence from 1994 to 2003, overall and by age and sex, was documented.

Methods. Analyses were based on persons aged 15+ years from 3 cycles of the National Population Health Survey (1994-99; n > 14,000) and 2 cycles of the Canadian Community Health Survey (2000-03; n > 130,000). Two projection scenarios were adopted to estimate future burden.

Results. Stability in age/sex point-prevalence estimates was not observed. From 1994 to 2003, absolute and relative increases were greatest in the older age groups (55+ yrs) and younger age groups (25-54 yrs), respectively. By 2021, we anticipate the prevalence of arthritis in Canada will have increased to between 21% and 26%. Overall, the prevalence increased from 13.4% to 17.6% from 1994 to 2003, an increase of nearly 50% in the number of Canadians reporting arthritis.

Conclusion. The assumption of stable age/sex prevalence estimates over time does not hold in Canada. Past projections have underestimated future burden; past trends need to be considered. (J Rheumatol 2006;33:1856-62)

Key Indexing Terms:

ARTHRITIS

PREVALENCE

PROJECTIONS

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Arthritis and other rheumatic conditions, referred to here as arthritis/rheumatism, rank among the most prevalent diseases in North America and are leading causes of morbidity, including activity limitations and disability and health care utilization¹⁻⁶. As well, having these conditions has consistently been shown to be associated with the reporting of poor health status⁷⁻⁹, as have the functional limitations associated with musculoskeletal disorders^{7,8,10}. Arthritis/rheumatism includes a range of illnesses and conditions¹¹, among which osteoarthritis (OA), rheumatoid arthritis, and gout are most common¹². In 1998-99 in Canada, these conditions accounted for an esti-

mated 8.8 million ambulatory care visits¹³. In the same year, Stokes, *et al* documented substantial and increasing costs associated with arthritis, albeit for a very restricted definition (*International Classification of Diseases*, Ninth Revision 714-716, 721), with nearly 80% of costs attributed to longterm disability¹⁴.

Undeniably, arthritis/rheumatism is a considerable public health burden, with associated high costs to society. Reasonable estimates of the number of people affected by these conditions, including past trends and future expectations, are of tremendous importance to governments and decision makers if health and economic policies are to meet current and future needs. While it would appear appropriate to use health administrative data to identify the number of people with arthritis/rheumatism, studies indicate that not all persons with these conditions seek medical help^{15,16}. Population-based self-report surveys, however, can aid our understanding of the overall public health burden of these conditions, although disadvantages with these data sources exist as well¹⁷.

Several studies in Canada and the United States¹⁸⁻²² have predicted the future prevalence of arthritis for their respective nations. By assuming stability in age/sex point-prevalence estimates into the future, these studies have applied these estimates to projected age/sex population figures. In effect, future arthritis prevalence estimates from these studies considered only the anticipated changing age and sex structure of the pop-

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ulation. Prevalence projections have, however, been surpassed, beyond that expected as a result of the aging of the population. Five large, nationally representative, Canadian population health surveys, using substantially the same methods and arthritis/rheumatism question over the past decade, allowed us the opportunity to examine whether the stability in age/sex arthritis point-prevalence estimates assumed by these studies is justified. Utilizing linear regression analyses of these same data, we recalculated the anticipated future burden of arthritis, with projections that incorporate changes in specific age/sex prevalence estimates based on past trends as well as the anticipated changes in the age and sex structure of the population.

MATERIALS AND METHODS

Data sources. Analyses were based on the cross-sectional, self-reported, household data from the 1994-95 ($n = 16,989$), 1996-97 ($n = 70,884$), and 1998-99 ($n = 14,682$) cycles of the National Population Health Survey (NPHS) Health Files²³⁻²⁵, and the 2000-01 ($n = 130,880$) and 2002-03 ($n = 130,700$) cycles of the Canadian Community Health Survey (CCHS)^{26,27}. The target population of the NPHS included persons living in private occupied dwellings in each Canadian province, excluding populations on Native reserves, Canadian Forces Bases, and some remote areas. The CCHS further included persons from the 3 Canadian territories ($< 0.3\%$ of the Canadian population). Each of the survey sampling frames covered a minimum of 95% of the targeted population. The objective of these surveys was to measure the health of Canadians and its determinants. General health and sociodemographic information was collected from respondents. The NPHS was launched in 1994 with the intent of administering the survey every 2 years for 20 years. Following the third cycle (1998) it was determined that the NPHS did not sample enough individuals to signal differences in health status between smaller subprovincial areas. The CCHS was launched in 2000 to produce cross-sectional estimates to address priority health gaps at the national, provincial, and regional levels, and thus superseded the cross-sectional component of the NPHS. Details of survey methodology have been published²³⁻²⁷.

In all cycles of each survey respondents were asked, "Do you have any of the following longterm conditions diagnosed by a health professional?" Longterm was defined as having lasted or expected to last 6 months or longer and a list of conditions was presented. In the NPHS the arthritis/rheumatism question read, "Do you have arthritis or rheumatism?" The question in the CCHS read, "Do you have arthritis or rheumatism excluding fibromyalgia?"

Statistical analyses. For each survey year, the percentage prevalence of arthritis/rheumatism was calculated overall and by age group and sex. Ten-year age groups (15-24 to 75+) were employed.

Population projection estimates for 2006 to 2026 in 5-year intervals were obtained from Statistics Canada²⁸. Statistics Canada provided 3 population growth scenarios, "high," "medium," and "low" growth. Population figures used in this study represent the medium-growth projections, based on 2000 population estimates, which have constant medium fertility, medium life expectancies, and medium annual immigration levels. Medium growth projections were utilized for previous Canadian^{19,21} and US^{20,22} projections.

Two projection scenarios were adopted for estimating the future number of people with, and the prevalence of, arthritis/rheumatism. Scenario 1 assumed, as did previous studies, that the age/sex point-prevalence estimates of arthritis/rheumatism remained unchanged from those estimates obtained from the latest survey (CCHS 2002). Scenario 2 assumed that observed increases in the age/sex point-prevalence estimates were sustained until 2021. Projections were presented for 5-year intervals from 2006 and to 2021. For comparison, earlier projections by Badley and Wang¹⁹ and Lagacé, *et al*²¹ were presented.

Analyses and results were based on those aged 15+ years. Prevalence data for 1994 to 2002 were weighted, taking into account the sample design,

adjustments for nonresponse, and poststratification, and are representative of the household population aged 15+ years. Variances of estimates (point-prevalence and differences between proportions) were calculated using rescaled weights and incorporating the design factors provided with each survey dataset.

To predict the age/sex-specific point-prevalence estimates for 2006-21, weighted linear regression analyses of the 1994 to 2002 self-reported data were carried out. Analyses were stratified by age and sex with age/sex-specific prevalence estimates regressed on year. To adjust for variability in stability of age/sex prevalence estimates, the estimates were weighted by the inverse of the variance of prevalence, calculated as $P^*(1 - P)/N$, where P is the prevalence, and N is the size of the population. Predicted age/sex prevalence estimates for future years were calculated from model coefficients.

RESULTS

The prevalence of self-reported arthritis/rheumatism among the Canadian population aged 15+ years from 1994 to 2002 is presented in Table 1. Over these years, the prevalence increased by more than 4 percentage points (difference = 4.2; 95% CI 3.46-4.94; $p < 0.01$), from 13.4 to 17.6, represented by an increase of nearly 50% in the number of people reporting these conditions.

Prevalence estimates by 10-year age groups and by sex, over the same years, are presented in Table 1 as well. As expected, the prevalence increased with increasing age and was higher among women. A significant increase in prevalence from 1994 to 2002 was found among those aged 35+ years. The largest absolute increases were observed in the 65-74 and 75+ year age groups, with increases of 6.7 (95% CI 3.85-9.43, $p < 0.01$) and 6.1 (95% CI 2.63-9.41, $p < 0.01$) percentage points, respectively. In relative terms, over the same period, the greatest increase in proportion reporting arthritis/rheumatism was observed in the 45-54 year age group, with an increase of 40%. The 35-44 year age group followed at 33%, and the 25-34 year age group at 23%.

The prevalence increased significantly by 3.2 percentage points in men (95% CI 2.22-4.12, $p < 0.001$) and 5.2 in women (95% CI 4.11-6.25, $p < 0.001$). Significant increases in age/sex point-prevalence estimates were found, increasing with increasing age.

Results from linear regression analyses (data not shown) revealed a cubic relationship between prevalence and age. As well, a significant interaction between sex and age was found, with the increasing prevalence with increasing age being greater among women. Predictive models were subsequently stratified by age and sex. The relationship between prevalence and year was found to be linear. No statistically significant residuals were detected (all p values > 0.590). Figure 1 shows observed (2002) and predicted (2006-21) age/sex-specific estimates, showing continued growth in the middle years of life and in older women.

Arthritis/rheumatism prevalence projections, including the projected number of people with arthritis/rheumatism, are presented in Table 2. Assuming that age/sex-specific prevalence estimates remain unchanged from 2002 (scenario 1), the prevalence of arthritis/rheumatism is estimated to increase by

Table 1. Prevalence of arthritis/rheumatism, overall, by age and by sex and total number with arthritis/rheumatism (ages 15+ yrs); 1994-2002, Canada.

	Prevalence (%) (95% Confidence Interval)				
	1994*	1996**	1998***	2000†	2002††
Overall	13.42 (12.8, 14.1)	14.50 (14.0, 15.0)	15.98 (15.2, 16.7)	16.00 (15.7, 16.3)	17.63 (17.3, 18.0)
Ages					
15-24	1.8 (1.1, 2.5)	1.7 (1.1, 2.3)	1.3 (0.7, 2.0)	2.2 (1.9, 2.5)	1.9 (1.6, 2.2)
25-34	3.5 (2.7, 4.3)	4.0 (3.3, 4.6)	3.8 (2.9, 4.7)	4.7 (4.3, 5.2)	4.3 (3.8, 4.8)
35-44	6.8 (5.7, 7.9)	7.7 (6.8, 8.6)	8.5 (7.2, 9.8)	8.8 (8.3, 9.3)	9.1 (8.5, 9.7)
45-54	13.9 (12.3, 15.6)	15.3 (13.9, 16.6)	17.2 (15.2, 19.3)	17.1 (16.3, 17.9)	19.5 (18.6, 20.3)
55-64	27.2 (24.7, 29.6)	28.5 (26.5, 30.4)	32.6 (29.7, 35.6)	29.8 (28.7, 31.0)	31.8 (30.7, 32.8)
65-74	37.5 (35.1, 40.0)	39.7 (37.9, 41.4)	42.1 (38.9, 45.4)	39.9 (38.5, 41.3)	44.2 (42.9, 45.4)
75+	45.4 (42.3, 48.5)	46.8 (44.7, 48.9)	48.5 (45.0, 52.1)	47.5 (46.0, 49.1)	51.5 (50.1, 52.8)
Sex					
Men	10.1 (9.3, 11.0)	10.2 (9.6, 10.9)	11.8 (10.8, 12.8)	12.0 (11.6, 12.4)	13.3 (12.8, 13.7)
Women	16.6 (15.7, 17.5)	18.7 (17.9, 19.4)	20.0 (18.9, 21.2)	19.8 (19.4, 20.3)	21.8 (21.3, 22.3)
Total no.	3,033,000	3,399,000	3,797,000	3,921,000	4,452,000

* National Population Health Survey, Health File, Cycle 1 (1994-1995); ** National Population Health Survey, Health File, Cycle 2 (1996-1997); *** National Population Health Survey, Health File, Cycle 3 (1998-1999); † Canadian Community Health Survey, Cycle 1.1 (2000-2001); †† Canadian Community Health Survey, Cycle 2.1 (2002-2003).

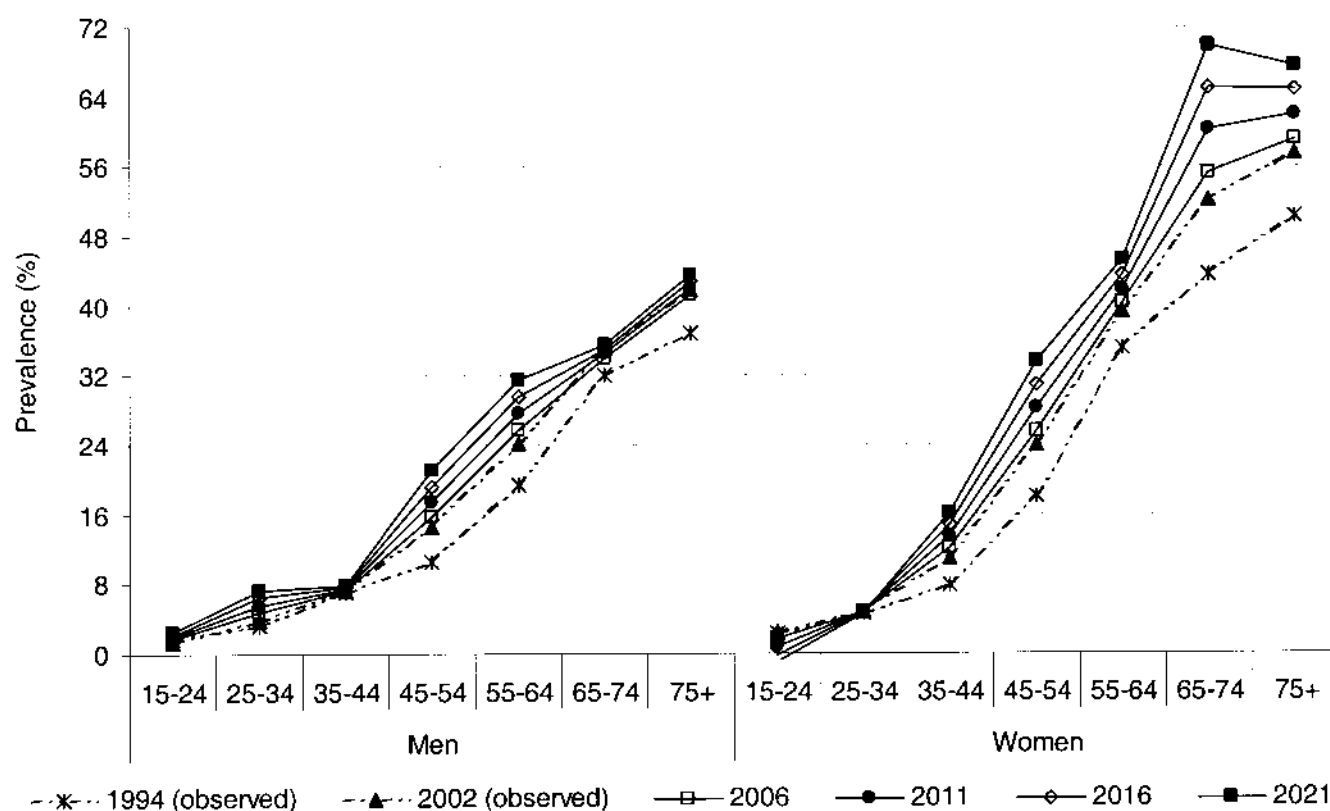


Figure 1. Observed (2002) and predicted (2006-21) age/sex-specific arthritis/rheumatism point-prevalence estimates, Canada.

26% by 2026, to an overall prevalence of 21%. However, with a sustained increase in age/sex point-prevalence until 2021 (scenario 2), the prevalence of arthritis/rheumatism is projected to increase by nearly 50% by 2021, to an estimated preva-

lence of 26%. The difference in the number of individuals with arthritis/rheumatism by 2021 between scenarios 1 and 2 is nearly a million and a half people. For comparability, Figure 2 presents an overlay of observed prevalence estimates along

Table 2. Projected number of people with, and overall prevalence (Prev) of, arthritis/rheumatism, 2006–2026, Canada.

	Age/sex Prevalence Rate	2006		2011		2016		2021	
		No. with Arthritis	Prev (%)	No. with Arthritis	Prev (%)	No. with Arthritis	Prev (%)	No. with Arthritis	Prev (%)
Total	Scenario 1*	4,911,000	18.39	5,410,000	19.24	5,911,000	20.26	6,395,000	21.28
	Scenario 2†	5,113,000	19.15	5,979,000	21.27	6,896,000	23.64	7,839,000	26.09
Men	Scenario 1*	1,797,000	13.71	1,990,000	14.40	2,189,000	15.25	2,385,000	16.12
	Scenario 2†	1,873,000	14.28	2,200,000	15.92	2,538,000	17.68	2,874,000	19.43
Women	Scenario 1*	3,114,000	22.91	3,420,000	23.92	3,722,000	25.11	4,010,000	26.28
	Scenario 2†	3,240,000	23.84	3,779,000	26.43	4,359,000	29.40	4,965,000	32.54

* Assuming stability in age/sex-specific point-prevalence estimates; similar to past studies. † Assuming sustained increases in age/sex-specific point-prevalence estimates up to 2021.

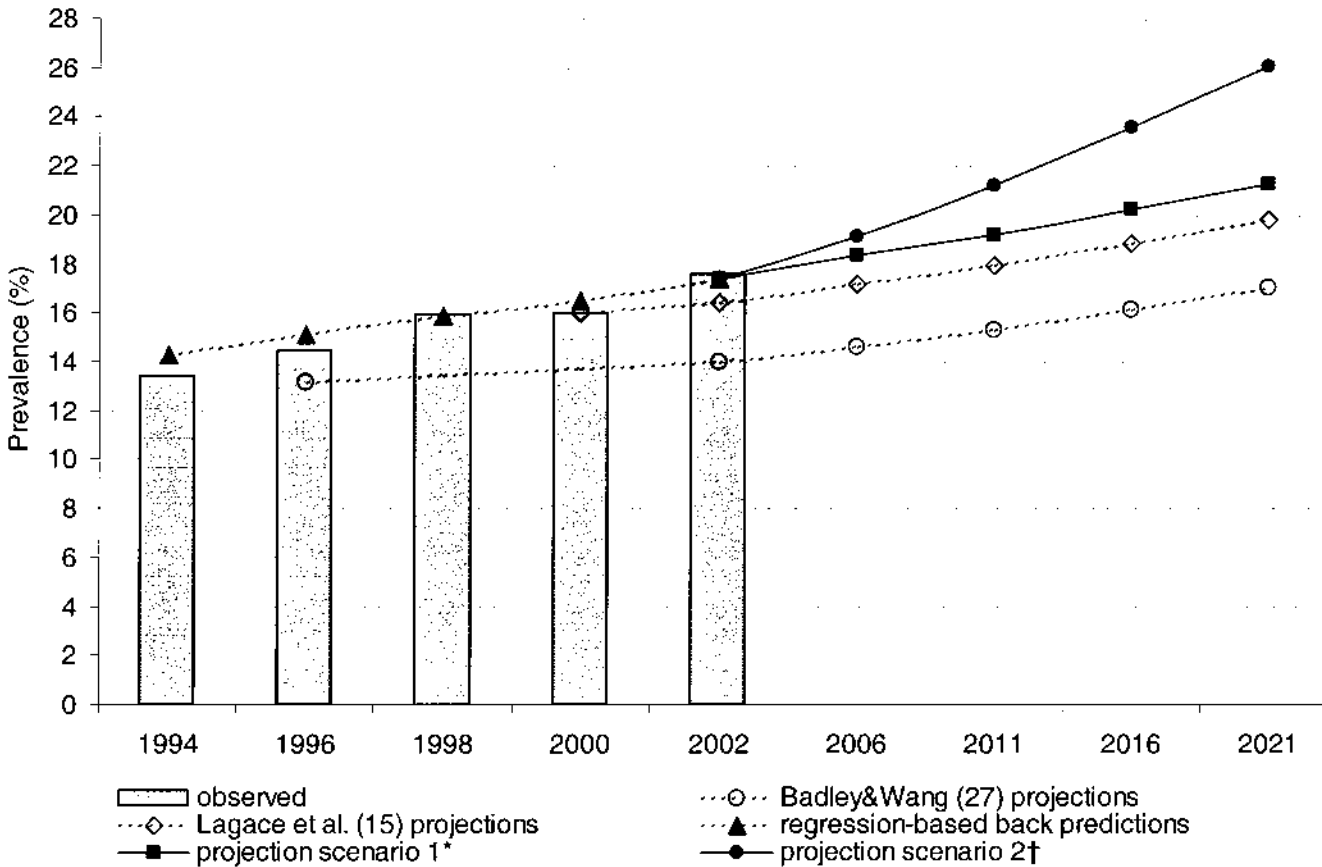


Figure 2. Overlay of observed arthritis/rheumatism prevalence estimates (1994–2002) along with projections by Badley and Wang¹⁹ and Lagacé, *et al*²¹ and projection estimates from the present study. *assuming stability in age/sex-specific point-prevalence estimates; similar to past studies. †assuming sustained increases in age/sex-specific point-prevalence estimates up to 2021.

with projections made by Badley and Wang¹⁹ and Lagacé, *et al*²¹ and projection estimates from the present study. Past projection estimates underestimated future observed estimates. Under either projection scenario, half of the people with arthritis/rheumatism in any year between 2006 and 2021 will be of working age (≤ 65 yrs).

DISCUSSION

Our study reveals that the prevalence of self-reported arthritis/rheumatism in Canada continued to increase beyond that expected with the aging of the population, and substantially surpassed projections. We have shown that the assumption of stable age/sex point-prevalence estimates over time used by

several studies¹⁸⁻²² to project future burden does not hold in Canada. Five national population health surveys over the past decade have revealed increasing age/sex arthritis/rheumatism point-prevalence estimates. These increases have been greatest for the 65+ year age groups, where the most prevalent of the rheumatic conditions is OA²⁹. This is the first study to estimate the future burden of arthritis/rheumatism in Canada taking into account not only the anticipated changes in the age and sex structure of the population, but also past observed changes in age and sex-specific prevalence estimates. To better plan and prepare for future health services needs and recognize the scope in size of programs needed to prevent arthritis-related disability, it is imperative to take into account past trends when predicting future burden.

In Canada, individuals aged 65+ years account for most of the direct costs associated with arthritis: 70% of hospital care expenditures and nearly one-half of total expenditures on prescription drugs¹⁴. They account for less than one-quarter of the arthritis morbidity costs due to longterm disability. Nearly 70% of this cost is incurred by the 35-64 age group. We showed that substantial growth in prevalence is anticipated among those of middle age. Even if age/sex point-prevalence estimates remain stable, it is estimated that nearly 3 million Canadians of this age will have arthritis/rheumatism within a decade, making up half of the arthritis/rheumatism population. As a result, longterm disability expenditures for arthritis/rheumatism are expected to increase substantially in the near future. The implications for labor force participation must be considered. The value of time lost from work and leisure activities by family members or friends who care for those with arthritis and related conditions must also be considered. Further, no economic analyses can calculate the intangible personal costs such as arthritis-related pain, suffering, and loss of opportunity.

A particular strength of this study is the large sample size available for analyses in each survey cycle. However, health surveys based on self-reports are dependent on respondents' recollection and willingness to report health conditions. In spite of these limitations, reviews have generally considered health surveys adequately reliable, economical, and practical for measuring morbidity^{16,30,31}. Beckett, *et al* report that while medical records may be more accurate than self-report data for conditions requiring a medical diagnosis and repeated attention (such as high blood pressure, asthma, and diabetes), they are probably less complete for conditions such as arthritis that are highly significant to the respondent but do not require continual medical supervision¹⁶. Examining self-reported data from the 1989 National Health Interview Survey in the United States, Rao, *et al* found that 16% of people reporting arthritis and other related conditions indicated not seeing a physician for their condition¹⁵. Therefore, as people with mild forms of conditions may not seek healthcare, they potentially would not be counted in the current prevalence estimates since the survey question specified that the condi-

tion had to be diagnosed by a health professional. With similar questions to those used in the current surveys, Bombard, *et al* found self-reported, physician-diagnosed arthritis or related conditions to have a sensitivity and specificity of 72.3% and 72.4%, respectively, compared to medical examination by a rheumatologist³².

The substantial and continued increase in self-reported arthritis/rheumatism observed over the past decade, even with the introduction of a more restrictive arthritis/rheumatism question beginning with the 2000-01 survey ("excluding fibromyalgia"), remains unexplained. Obesity has been shown to be positively associated with the reporting of arthritis/rheumatism overall and a risk factor for OA of the knee in several epidemiologic studies, and somewhat so with OA of the hip or hand³³⁻³⁶. The prevalence of obesity is increasing worldwide, and this is evident in Canada, where it has been estimated that the prevalence of overweight and obesity (combined) has increased and more than doubled over the past 15 to 20 years, in both children and adults³⁷⁻³⁹. Given that OA is a chronic condition and evolves over many years, it is possible that some of the age-specific increase might reflect previous changes in obesity, particularly in younger age groups. If there is a lag effect between obesity and OA, we might expect this momentum in increase to be sustained.

A further factor that might contribute to an increase in prevalence of arthritis could be an increase in injury. Injury has been associated with the development of OA⁴⁰⁻⁴⁶. Over the decade prior to 1996, Fast⁴⁷ reports an increasing incidence in repetitive strain injuries in Canada. Analysis of the same health surveys used in our study reveals an increasing proportion of the Canadian population reporting injuries (not including repetitive strain injuries) serious enough to limit normal activities, an increase in prevalence from 6.6% to 8.5% from 1996 to 2002 (unpublished data). These injuries included multiple injuries, broken or fractured bones, dislocation, and sprain or strain. Over this same period an increasing proportion of the Canadian population also reported having had a repetitive strain injury serious enough to limit their usual activities at some point in the previous 12 months, an increase in prevalence from 8.1% to 11.1% (unpublished data). This raises the question whether at least some of the increase in the reporting of arthritis/rheumatism reflects the chronic and late effects of musculoskeletal injury.

A further aspect that might affect reporting could be an increased awareness due to the considerable attention paid to new arthritis drugs and increased advertising of prescription drugs⁴⁸. This increase in awareness may have led to increases in reporting.

Whether the increasing reporting of arthritis/rheumatism represents new cases of the conditions or simply cases previously unreported, the message remains the same — there are more cases of these conditions than previously thought or anticipated. We documented that past projections have underestimated the current prevalence of arthritis/rheumatism.

While it is difficult to anticipate how long observed increases in age and sex-specific prevalence estimates will be sustained, we suggest that our 2 projection scenarios present reasonable bounds on the anticipated future burden of arthritis/rheumatism. Concern about arthritis as a public health problem is growing in North America⁴⁹, and our findings support this concern. If past trends are any indication, governments and policy planners need to consider the population implications of the increasing prevalence. Arthritis control approaches, for example, need to focus on prevention and improving health and reducing disability. Reducing arthritis-related disability has the potential to improve health status, reduce indirect costs, and increase health-adjusted life expectancy for the population as a whole^{9,14}. While the arthritis/rheumatism banner includes a varied number of conditions, only a few make up the majority, and proven public health interventions should be applied and new interventions developed to improve function, decrease pain, and delay disability among persons with arthritis/rheumatism, particularly those at highest risk for functional impairment and disability. In examining the “aging society” Cassel, *et al*⁵⁰ report that while advances in treatment have prolonged life, these achievements are making the task of providing healthcare services more difficult. While progress in postponing deaths from heart disease, cancer, and stroke has been realized, less progress has been made in preventing, postponing, and treating the non-fatal diseases of the aged. Cassel, *et al* argue for a greater emphasis on controlling disability and chronic disease and providing effective longterm care.

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