Osteoarthritis Incidence and Trends in Administrative Health Records from British Columbia, Canada

M. Mushfiqur Rahman, Jolanda Cibere, Charlie H. Goldsmith, Aslam H. Anis, and Jacek A. Kopec

ABSTRACT. ***Objective.*** To calculate the incidence rates of osteoarthritis (OA) and to describe the changes in incidence using 18 years of administrative health records.

Methods. We analyzed visits to health professionals and hospital admission records in a random sample (n = 640,000) from British Columbia, Canada, from 1991/1992 through 2008/2009. OA was defined in 2 ways: (1) at least 1 physician diagnosis or 1 hospital admission; and (2) at least 2 physician diagnoses in 2 years or 1 hospital admission. Crude and age-standardized rates were calculated, and the annual relative changes were estimated from the Poisson regression models.

Results. In 2008/2009, the overall crude incidence rate (95% CI) of OA using definition 1 was 14.6 (14.0–14.8); [12.5 (12.0–13.0) among men and 16.3 (15.8–16.8) among women] per 1000 person-years. The rates were lower by about 44% under definition 2. For the period 2000/2001–2008/2009, crude incidence rates based on definition 1 varied from 11.8 to 14.2 per 1000 person-years for men, and from 15.7 to 18.5 for women. Annually, on average, crude rates rose by about 2.5–3.3% for both men and women. The age-adjusted rates increased by 0.6–0.8% among men and showed no trend among women.

Conclusion. Our study generated updated incidence rates of administrative OA for the Province of British Columbia. Physician-diagnosed overall incidence rates of OA varied with the case definitions used; however, trends were similar in both case definitions. Age-adjusted rates among men increased slightly during the period 2000/2001–2008/2009. These findings have implications for projecting future prevalence and costs of OA. (First Release April 15 2014; J Rheumatol 2014;41:1147–54; doi:10.3899/jrheum.131011)

Key Indexing Terms:
OSTEOARTHRITIS INCIDENCE TREND
ADMINISTRATIVE DATABASES EPIDEMIOLOGY

Osteoarthritis (OA) is a major cause of pain and disability among older adults worldwide[1,2,3,4]. Globally, about 10% to 12% of the population have OA[5,6,7,8]. Estimates of OA incidence rates differ depending on the age and sex of the population under study, the method of case identification, and the joint sites included. Using an administrative database of British Columbia (BC), Canada, Kopec, *et al*[5] reported that the crude incidence of overall OA in any joint was 11.7 per 1000 person-years. The authors also showed that the incidence rates depend on the run-in period, that is, the number of years of health records used to delete the prevalent cases. The study drew on 10 years of administrative health records, and for this reason it might overestimate the rates. Based on a health survey conducted in Norway, Grotle, *et al*[9] estimated that 10-year cumulative incidence rates of self-reported hip, knee, and hand OA were 5.8%, 7.3%, and 5.6%, respectively. In the Framingham study of adults aged 63–91 years, the incidence rates of radiographic and symptomatic knee OA were 20 and 10 per 1000 person-years, respectively[3]. Using a population-based cohort in Bristol, UK, Cooper, *et al*[4] found that the incidence rate of radiographic knee OA was 25 per 1000 person-years among individuals aged 55 years or more. Reijman, *et al*[10] estimated that the 10-year cumulative incidence rate of radiographic hip OA was 9.3% among individuals 55 years of age or more, in Rotterdam, the Netherlands. Using data from the Fallon Community Health Plan, MA, USA, Oliveria, *et al*[11] obtained incidence rates of 10, 8.8, and 24 per 1000 person-years for hand, hip, and knee OA, respectively, among adults aged 20–89 years. These studies did not include long observation periods, and some were based on relatively small samples. In addition, most of these studies used different definitions of OA, were

From the School of Population and Public Health, and the Department of Medicine, University of British Columbia, Vancouver; Department of Health Sciences, Simon Fraser University, Burnaby; Arthritis Research Centre of Canada, Richmond; Centre for Health Evaluation and Outcome Sciences, Vancouver, British Columbia, Canada.

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M.M. Rahman, MSc, PhD candidate, School of Population and Public Health, University of British Columbia; J. Cibere, MD, PhD, Associate Professor, Department of Medicine, University of British Columbia; C.H. Goldsmith, PhD, Professor, Health Sciences, Simon Fraser University; A.H. Anis, PhD, Professor, School of Population and Public Health, University of British Columbia, and Director, Centre for Health Evaluation and Outcome Sciences; J.A. Kopec, MD, PhD, Professor, School of Population and Public Health, University of British Columbia.

Address correspondence to M.M. Rahman, Arthritis Research Centre of Canada, 5591 No. 3 Road, Richmond, British Columbia V6X 2C7, Canada. E-mail: mrahman@arthritisresearch.ca

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restricted to certain age groups and joint sites, and did not provide estimates for the overall OA incidence in any joint. Therefore, the rates may not be representative of the general population.

Despite the fact that OA is the most common form of rheumatic disease[1], data regarding the changes in OA incidence rates over time are very limited. Kopec, *et al*[12] observed that the age-standardized incidence rates of physician-diagnosed OA did not change among men and increased only slightly among women in BC between 1996/1997 and 2003/2004. This study used a relatively short observation time to estimate trends. Other studies showed that the prevalence of self-reported arthritis/rheumatism is increasing[13,14].

Established risk factors for OA include age, sex, obesity, family history, joint injuries, occupation, sports, joint alignment, muscle strength, and neuromuscular control[8,15]. Several studies have shown that Canadians are becoming increasingly overweight and obese[16,17]. Obesity and aging are associated with a higher risk of OA incidence[18,19,20]. Besides these factors, the prevalence of other risk factors might also influence the incidence of OA over time. Further, public awareness of OA may have increased because of new approaches to joint-specific exercise and education programs[21], new drugs such as cyclooxygenase-2 inhibitors[22], and the growing number of knee and hip replacement surgeries performed over the past decades[23]. Therefore, we hypothesized that there would be an increase in physician-diagnosed OA incidence over time, in the database collected from the BC universal healthcare system.

The aim of our study was to estimate the annual incidence rates of OA using a large random sample drawn from BC administrative health records compiled from 1991/1992 to 2008/2009. Using the same database, we studied changes in the incidence rates of OA over time. Our study also updated the results presented in earlier studies using the same database[5,12]. Incidence rates and trends are useful for assessing the effect of current control plans and for creating preventive OA strategies.

MATERIALS AND METHODS

Database. We analyzed the medical records of a random sample of 640,000 residents from BC for the fiscal years 1991/1992 through 2008/2009. All visits to health professionals and hospital admissions covered by the Medical Services Plan (MSP) of BC were included in the analyses. MSP is a universal plan with first-dollar coverage in which about 99% of BC residents are registered. Both the BC Ministry of Health, and Population Data BC, who facilitate administrative data acquisition, approved access to and use of the data for our study. The database includes *International Classification of Disease,* 9th and 10th revision (ICD-9 and ICD-10) diagnostic codes, date and type of service, hospital admission and separation dates, birth and death dates, sex, and MSP registration start and exit dates. On the physician billing statements, only 1 diagnostic code is included, whereas hospital discharge summaries include up to 25 diagnostic codes. To monitor deaths of individuals in the sample, the ministry linked vital statistics data to billing data using personal health numbers. In our random sample, 49.1% were male, and the mean age of the entire sample on April 1, 2009, was 48.6 years (SD 22.7).

OA case definitions. Two case definitions of OA, referred to as Def1 and Def2, were used in our study. Def1 required at least 1 visit to a health professional or 1 hospital separation with the ICD-9 code 715 or an ICD-10 code from M15 to M19. Def2 required at least 2 visits to a health professional within 2 years (at least 1 day apart) or 1 hospital separation with either of these ICD codes. These codes include OA in any joint except the spine, either generalized or localized. For Def2, the date of the second qualifying visit was used to assign the incidence date. These 2 definitions were implemented previously to estimate the incidence and prevalence of OA at the population level[5]. A visit was defined as any service by a health professional covered by MSP with the exclusion of diagnostic procedures and certain other procedures, such as dialysis/transfusion, anesthesia, obstetrics, or therapeutic radiation.

Incidence rate. The incidence rate was defined as the number of new cases of OA during a fiscal year (from April 1 to March 31) divided by the person-years at risk in the same fiscal year. To calculate the overall incidence rate for the year 2008/2009, new OA cases aged 20 years and older were identified after deleting the prevalent cases from April 1991 to March 2008 (a 17-year run-in). Age-specific and sex-specific incidence rates were calculated using the 2 case definitions discussed above and expressed per 1000 person-years.

Trend in incidence rates. In an administrative database, incidence rate of OA depends on the number of run-in years used to delete the prevalent cases[5], where a longer run-in period was recommended to control for overestimation. Because we have data for only 18 years, to control for overestimation in the trend analysis, we have selected a 9-year run-in and obtained incidence rates for the period 2000/2001–2008/2009. The number of new cases in a given age-sex category were identified according to 2 definitions during a given 1-year period, after deleting prevalent OA cases during the preceding 9-year run-in. For example, the incidence rate for the year 2003/2004 was calculated after deleting prevalent OA cases that were diagnosed between April 1994 and March 2003. For each age-sex category, person-years at risk for a given fiscal year were calculated from the MSP registration records. First, we deleted the prevalent cases. Next, within each age-sex category, we added up the number of days for which individuals were registered with the MSP. Individuals were censored if they developed OA, died, or left the province, whichever came first.

Statistical analysis. The 95% CI (rate ± 1.96 {rate/SQRT [new cases]}) were obtained for all incidence rates. Rates were age-standardized using the direct method, where the person-years for the fiscal year 2004/2005, calculated from the same BC administrative database, were considered as the standard population. Ten-year age categories (20–29, 30–39, … , 70–79, 80+) for each sex were used in the standardization process. Trends in incidence were shown graphically by plotting crude and age-standardized rates against the year. Statistically significant lack of fit (p value < 0.05) was observed when the linear models of rates on the year of diagnosis were fitted. Therefore, Poisson regression models were fitted to estimate trends separately for each sex. Age was included in the model to obtain trends for age-adjusted rates. Finally, we calculated the annual relative change (ARC) from the estimated coefficient as ARC = (EXP {estimated coefficient} – 1) × 100 for each case definition and sex. Along with 9 years of run-in, for the sensitivity analysis we obtained incidence rates and ARC for the period 2000/2001–2008/2009 using 5 years of run-in.

To account for the overestimation of incidence rates due to the length of the observation period in the administrative data, Sun, *et al*[24] proposed a regression approach to estimate OA incidence rates for Alberta, Canada, using the model $y = k + ax^b$, where x is the number of observation years, y is the estimated number of new cases, and k, a, and b are unknown variables. For the purpose of comparison and validation, we have applied this approach to estimate rates in 2008/2009 using both 17 and 9 years of run-in. All analyses were performed using SAS V.9.3 (SAS Institute). Our study was approved by the Behavioural Research Ethics Board of the University of British Columbia.

RESULTS

Overall incidence rates. After deleting prevalent cases in 17 years of health records, 6064 new OA cases were diagnosed in 2008/2009 using Def1. Among them, 3.5% were diagnosed in the hospital and the remaining 96.5% were diagnosed during the physician's visits. Among physicians, 84.4% were general practitioners, 10.2% were orthopedic surgeons, and the rest were other health professionals. The incidence rates of OA in the fiscal year 2008/2009, according to 2 case definitions and sex, for all ages and also for different age cutpoints, are shown in Table 1. The overall incidence rate (95% CI) of OA in Def1 for all ages combined was 14.6 (14.0–14.8) per 1000 person-years; 12.5 (12.0–13.0) in men and 16.3 (15.8–16.8) in women. The overall rate was 8.2 (7.9–8.4) per 1000 person-years when Def2 was used. Among persons aged 50 years or older, the rates were 31.6 (30.6–32.5) and 17.7 (17.1–18.3) per 1000 person-years for Def1 and Def2, respectively. The age-specific sex-specific incidence rates for 2008/09 are presented in Figure 1. Women had higher rates than men in all age groups and the highest rates were observed in the age group 80–89 for men and 70–79 for women. In Table 2, we present the age-specific sex-specific incidence rates based on Def1 and a 17-year run-in, and the rates obtained from the regression method proposed by Sun, *et al*[24]. The overall incidence rates were 12.4 (11.9–12.9) and 16.3 (15.6–16.6) per 1000 person-years, for men and women, respectively, using the regression approach. Rates obtained from a 9-year run-in were also compared with those obtained using the method proposed by Sun, *et al*[24] (data not shown). No significant differences were observed between rates obtained in 2 approaches.

Crude and age-standardized rates. Both crude and age-standardized incidence rates during 2000/2001–2008/2009 based on the 2 case definitions are shown in Table 3 and Figure 2. During the observation period, the crude rates (95% CI) based on Def1 increased from 11.6 (11.2–12.0) to 14.2 (13.7–14.6) per 1000 person-years in men and from 15.4 (15.0–15.9) to 18.5 (17.9–19.0) in women. The age-standardized rates in Def1 varied from 12.1 (11.7–12.6) to 13.2 (12.8–13.7) per 1000 person-years in men and from 16.0 (15.5–16.5) to 17.4 (16.9–17.9) in women. Incidence

Table 1. Crude incidence rates (95% CI) of osteoarthritis (OA) in the fiscal year 2008/2009 per 1000 person-years at different age cutpoints using a 17-year run-in to delete the prevalent cases.

Age, yrs	Def1			Def2		
	Men	Women	Total	Men	Women	Total
All*	12.5 (12.0–13.0)	16.3 (15.8–16.8)	14.6 (14.0–14.8)	7.1 (6.8–7.4)	9.2 (8.9 –9.6)	8.2 (7.9–8.4)
≥ 20	14.9 (14.3–15.5)	19.3 (18.7–20.0)	17.1 (16.7–17.5)	8.4 (7.9–8.8)	10.8 (10.3–11.2)	9.6 (9.3–9.9)
≥ 30	18.0 (17.3–18.7)	23.3 (22.6–24.1)	20.7 (20.1–21.2)	10.0 (9.5–10.5)	12.9 (12.4–13.5)	11.5 (11.1–11.8)
≥ 40	21.5 (20.7–22.4)	28.5 (27.5–29.5)	25.0 (24.3–25.6)	11.9 (11.3–12.5)	15.7 (15.1–16.4)	13.9 (13.4–14.3)
≥ 50	26.8 (25.6–28.0)	36.6 (35.2–38.0)	31.6 (30.6–32.5)	15.3 (14.4–16.1)	20.1 (19.2–21.1)	17.7 (17.1–18.3)

Def1: One visit to a health professional or 1 hospital diagnosis; Def2: Two visits to a health professional in 2 years or 1 hospital diagnosis. *OA cases below age 20 years were deleted, but the person-years for all individuals at risk were used in the denominator.

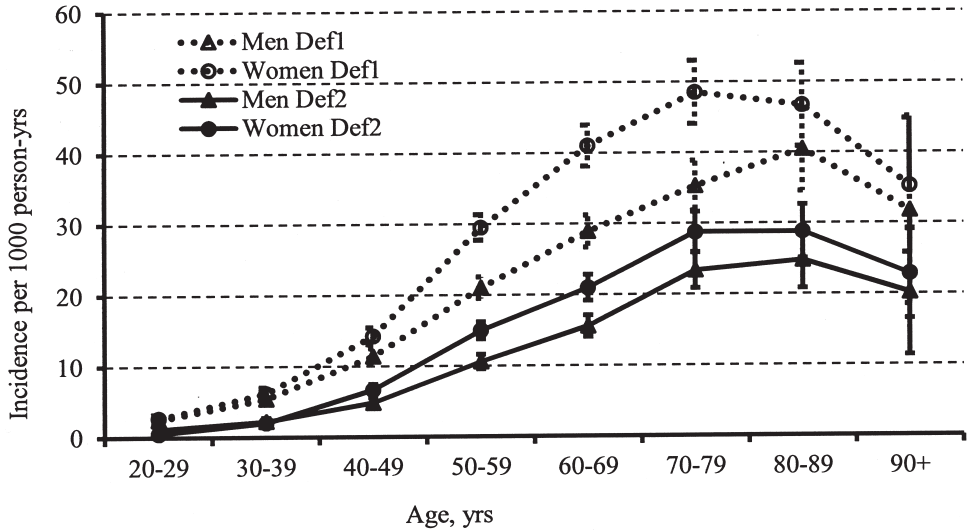

Figure 1. Age-specific and sex-specific crude incidence rates and the 95% CI of osteoarthritis in the fiscal year 2008/2009 per 1000 person-years using a 17-year run-in to delete the prevalent cases. Def1: one visit to a health professional or 1 hospital diagnosis; Def2: 2 visits to a health professional in 2 years or 1 hospital diagnosis.

Table 2. Osteoarthritis (OA) incidence rates for the fiscal year 2008/2009 based on a 17-year run-in and Def1, and the predicted rates obtained from the regression approach proposed by Sun, *et al*[24].

	Men					Women				
		New Cases		Rate per 1000 (95% CI)			New Cases		Rate per 1000 (95% CI)	
Age, yrs	Person-yrs	Run-in	Regression	Run-in	Regression	Person- yrs	Run-in	Regression	Run-in	Regression
00–19	34,225.2	—	—	—	—	32,676.3	—	—	—	—
20–29	35,350.7	87	86	2.5 (2.0–3.0)	2.4 (1.9–2.9)	34,515.2	93	93	2.7 (2.2–3.2)	2.7 (2.2–3.2)
30–39	31,398.8	170	171	5.4 (4.6–6.2)	5.4 (4.6–6.2)	32,656.1	201	200	6.2 (5.3–7.1)	6.1 (5.3–6.9)
40–49	38,006.7	434	433	11.4 (10.3–12.5)	11.4 (10.3–12.5)	39,855.3	568	566	14.3 (13.1–15.5)	14.2 (13.0–15.4)
50–59	35,369.6	741	743	21.0 (19.5–22.5)	21.0 (19.5–22.5)	34,753.6	1024	1014	29.5 (27.7–31.3)	29.2 (27.4–31.0)
60–69	21,878.9	633	627	28.9 (26.6–31.2)	28.7 (26.5–30.9)	18,669.0	766	754	41.0 (38.1–43.9)	40.4 (37.5–43.3)
70–79	10,874.0	384	382	35.3 (31.8–38.8)	35.1 (31.6–38.6)	9417.0	457	450	48.5 (44.1–52.9)	47.8 (43.4–52.2)
80–89	4372.2	177	172	40.5 (34.5–46.5)	39.3 (33.4–45.2)	5245.0	244	236	46.5 (40.7–52.3)	45.0 (39.3–50.7)
90+	692.5	22	22	31.8 (18.5–45.1)	31.8 (18.5–45.1)	1503.5	53	51	35.3 (25.8–44.8)	33.9 (24.6–43.2)
Total	212,168.6	2648	2636	12.5 (12.0–13.0)	12.4 (11.9–12.9)	209,291.0	3406	3364	16.3 (15.8–16.8)	16.1 (15.6–16.6)

Def1: one visit to a health professional or 1 hospital diagnosis.

Table 3. Crude and age-standardized incidence rates (95% CI) of osteoarthritis (OA) per 1000 person-years during the period 2000/2001–2008/2009 using a 9-year run-in to delete the prevalent cases.

	Men Def1		Men Def2		Women Def1		Women Def2	
Fiscal Year	Crude	Standardized	Crude	Standardized	Crude	Standardized	Crude	Standardized
00/01	11.8 (11.4–12.2)	12.7 (12.2–13.1)	6.3 (6.0–6.6)	6.8 (6.5–7.2)	15.7 (15.2–16.1)	17.0 (16.4–17.5)	8.5 (8.2–8.8)	9.2 (8.9–9.6)
01/02	11.6 (11.2–12.0)	12.3 (11.9–12.8)	6.1 (5.8–6.4)	6.5 (6.2–6.8)	15.7 (15.2–16.1)	16.7 (16.2–17.2)	8.8 (8.5–9.1)	9.4 (9.0–9.8)
02/03	11.7 (11.3–12.1)	12.1 (11.7–12.6)	6.2 (5.9–6.4)	6.4 (6.1–6.7)	15.4 (15.0–15.9)	16.0 (15.5–16.5)	8.5 (8.2–8.8)	8.9 (8.5–9.3)
03/04	12.5 (12.0–12.9)	12.7 (12.2–13.1)	6.6 (6.3–6.9)	6.8 (6.4–7.1)	16.9 (16.4–17.4)	17.2 (16.6–17.7)	9.3 (9.0–9.7)	9.5 (9.1–9.9)
04/05	12.6 (12.2–13.0)	12.6 (12.1–13.0)	6.7 (6.4–7.0)	6.7 (6.4–7.1)	17.3 (16.8–17.8)	17.3 (16.8–17.8)	9.7 (9.3–10.1)	9.7 (9.3–10.1)
05/06	13.6 (13.1–14.0)	13.2 (12.8–13.7)	7.1 (6.8–7.5)	6.9 (6.6–7.3)	17.8 (17.3–18.3)	17.4 (16.9–17.9)	9.7 (9.4–10.1)	9.5 (9.1–9.9)
06/07	13.5 (13.0–13.9)	12.8 (12.4–13.3)	7.5 (7.1–7.8)	7.1 (6.7–7.4)	18.1 (17.6–18.6)	17.3 (16.7–17.8)	9.8 (9.5–10.2)	9.3 (8.9–9.7)
07/08	13.9 (13.5–14.4)	12.9 (12.5–13.4)	7.4 (7.0–7.7)	6.8 (6.4–7.1)	18.1 (17.6–18.6)	16.9 (16.4–17.5)	10.2 (9.8–10.6)	9.4 (9.0–9.8)
08/09	14.2 (13.7–14.6)	12.9 (12.4–13.4)	7.9 (7.5–8.2)	7.1 (6.7–7.4)	18.5 (17.9–19.0)	16.8 (16.3–17.4)	10.2 (9.8–10.6)	9.2 (8.8–9.5)
Coefficient**	0.028	0.006	0.032	0.008	0.024	0.003	0.025	0.001
(95% CI)	(0.023–0.032)	(0.001–0.011)	(0.026–0.039)	(0.002–0.014)	(0.020–0.028)	(–0.002–0.007)	(0.020–0.030)	(–0.005–0.006)
ARC* (95% CI)	2.8 (2.3–3.3)	0.6 (0.1–1.1)	3.3 (2.6–3.9)	0.8 (0.2–1.4)	2.5 (2.1–2.9)	0.3 (–0.2–0.7)	2.5 (2.0–3.1)	0.1 (–0.5–0.6)

Def1: one visit to a health professional or 1 hospital diagnosis. Def2: two visits to a health professional in 2 years or 1 hospital diagnosis. Age-standardized rates were obtained by considering person-years of 2004/05 as standard population. *ARC stands for annual relative change = (EXP {coefficient} – 1) × 100, where coefficients were estimated from the Poisson regression models. **Coefficients for the standardized rates were obtained from the age-adjusted Poisson regression models.

rates were lower by about 45–47% under Def2 among men and women compared to the rates obtained under Def1, but the changes in rates over time were similar in both case definitions. Age-specific and sex-specific crude incidence trends from 2000/2001 through 2008/2009 using Def1 are plotted in Figure 3. Based on a 5-year run-in and Def1, crude rates rose from 13.4 (12.9–13.8) to 16.0 (15.5–16.4) per 1000 person-years among men and from 18.1 (17.6–18.6) to 21.5 (21.0–22.0) among women.

Annual relative change. We calculated the ARC for both crude and age-adjusted rates from the Poisson regression model (Table 3). Under Def1 and Def2, respectively, the ARC (95% CI) for crude rates were 2.8% (2.3–3.3) and 3.3% (2.6–3.9) for men, and 2.5% (2.1–2.9) and 2.5% (2.0–3.1) for women. The age-adjusted ARC (95% CI) were 0.6% (0.1–1.1) and 0.8% (0.2–1.4) under Def1 and Def2, respectively, among men, and were not statistically significant among women. We observed similar trends from 2000/2001 through 2008/2009 in the 5-year run-in approach (data not shown).

DISCUSSION

In this population-based study, we estimated incidence rates and trends in OA over time, using a large random sample drawn from administrative health records of BC, Canada. The overall incidence rate in the fiscal year 2008/2009 was 14.6 per 1000 person-years in the definition that used 1 visit to a physician or 1 hospital diagnosis. Incidence rates were lower by 44% when we used the definition of 2 visits to physicians within 2 years or 1 hospital diagnosis. In the trend analysis, crude rates showed a significant increase among men and women from 2000/2001 to 2008/2009.

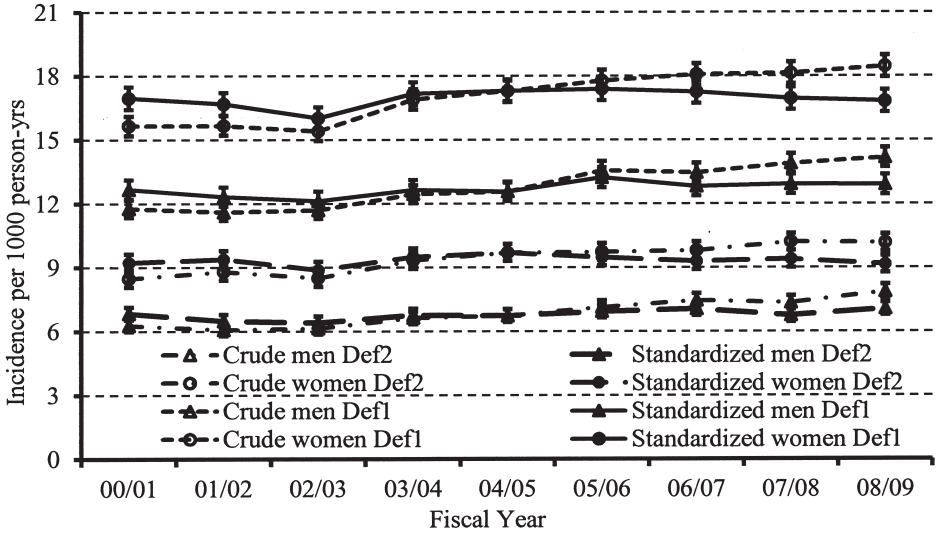

Figure 2. Crude and age-standardized incidence rates and the 95% CI of osteoarthritis per 1000 person-years during the period 2000/2001 to 2008/2009 using a 9-year run-in to delete the prevalent cases. Def1: one visit to a health professional or 1 hospital diagnosis, and Def2: 2 visits to a health professional in 2 years or 1 hospital diagnosis.

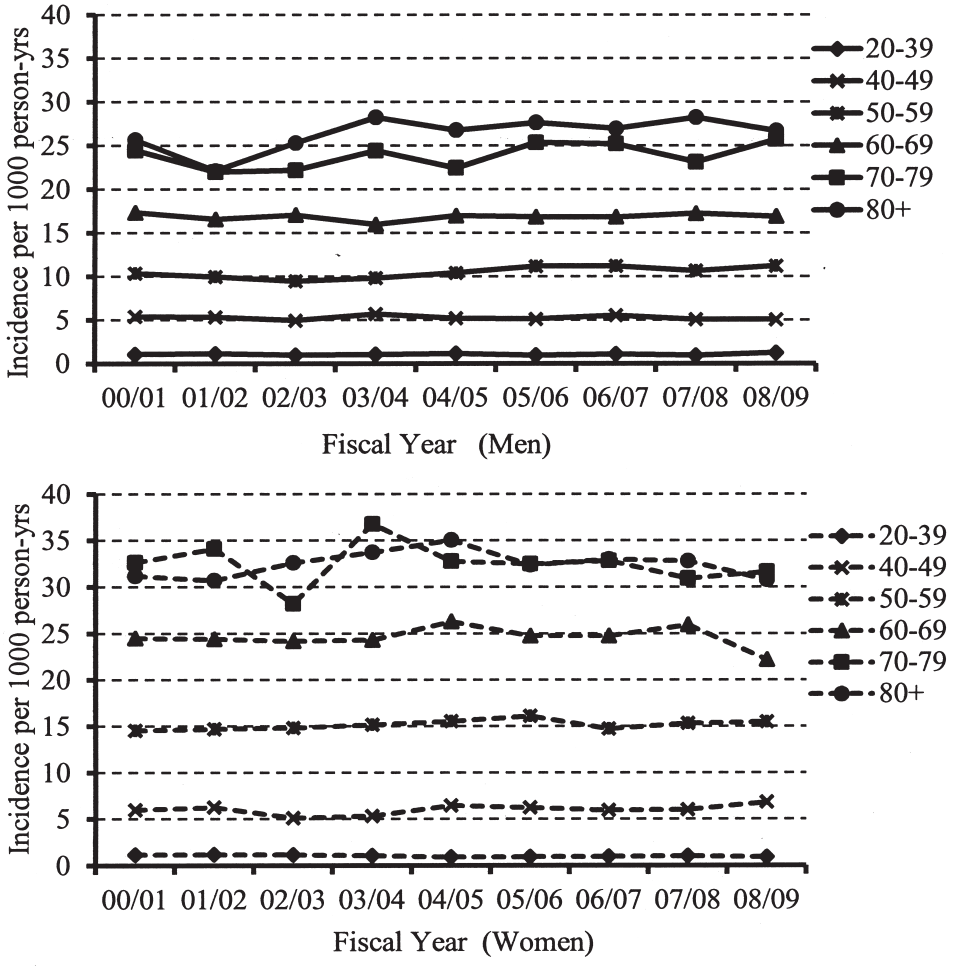

Figure 3. Age-specific and sex-specific crude incidence rates of osteoarthritis (OA) per 1000 person-years during the period 2000/2001 to 2008/2009 using a 9-year run-in to delete the prevalent cases. Rates were calculated based on Def1 (1 visit to a health professional or 1 hospital diagnosis); top panel is for men and bottom panel is for women. Because of a low number of new OA cases, to calculate incidence rates, the first 2 age categories (20–29 and 30–39) were combined to form 1 age category (20–39), and the last 2 age categories (80–89 and 90+) were formed into 1 age category (80+).

During this period, the age-standardized rates increased slightly for men but showed no change in the case of women.

Using the BC administrative database from April 1991 to March 2001, Kopec, *et al*[5] observed an overall incidence rate of 11.7 per 1000 person-years according to the definition that required 1 physician visit or 1 hospital admission for OA. Our overall incidence rates are higher than these earlier results, possibly because of the differences in the observation years and the denominator used. We used exact person-years from the registration records, whereas mid-year population estimates were used in the previous denominator. Thus, this study provides more precise and updated rates. Other studies have estimated incidence rates for knee, hip, and hand OA for different age cutpoints. Our overall annual incidence rates using Def1 are comparable to the self-reported estimates obtained in the Grotle *et al*[9] study, if the site-specific rates in the latter study were combined. Using survey data from Canada, Wilkins[25] calculated incidence rates of self-reported arthritis of 31 and 48 cases per 1000 person-years, for men and women aged 40 years or more, respectively. Our incidence rates differ slightly from those of radiographic and symptomatic knee OA estimated in the Framingham study[3], those of radiographic knee OA estimated in the Cooper, *et al*[4] study, those of self-reported arthritis obtained in the Wilkins[25] study, the rates of radiographic hip OA in the Reijman, *et al*[10] study, and those observed in the Oliveria, *et al*[11] study. These differences in rates are likely due to differences in the populations under study, the case identification used, and the joint sites considered in the definitions.

Incidence trends in our study differed from those obtained previously by Kopec, *et al*[12]. However, the earlier study used a 5-year run-in and found an increasing trend of OA among women during the period 1996/1997 to 2003/2004. One possible reason for this difference could be the inclusion of health records in our study extending forward for 5 additional years. The sensitivity analysis with 5 years of run-in (data not shown) showed an increasing trend among women during the period 1996/97–2003/04. The observed trends were consistent in both 5-year and 9-year run-in approaches for the period 2000/2001–2008/2009. Thus, our study gives updated and more accurate estimates. To our knowledge, there are no other published studies that describe trends in OA derived from administrative databases using a longer observation period. Hootman, *et al*[26] reported an overall 1.3% increase in the prevalence of OA for the US population. Using Canadian survey data, Perruccio, *et al*[13] reported that the overall prevalence of self-reported arthritis/rheumatism rose from 13.4% to 17.6% from 1994 to 2003. Our province-specific age-standardized incidence rates are not comparable with the national prevalence data. It is noteworthy that an increase in disease prevalence does not necessarily imply a simultaneous increase in incidence; nevertheless, in our study, changes in the crude incidence of OA due to population aging were in the same direction as changes in the crude prevalence of arthritis reported in earlier studies.

An important strength of our study is that it is based on a large random sample drawn from administrative health records that are representative of the entire province. All the OA cases in this study were physician-diagnosed or drawn from hospital-discharge records rather than self-reported illnesses. An additional strength is that we were able to access individual medical records over an 18-year period. However, certain limitations need to be acknowledged. Because we analyzed data from the province of BC only, the study results may not be generalizable to the entire Canadian population. Incidence rates depend on the case definition of OA[5,27], and the rates in our study were lower than those published earlier using self-reported and radiographic OA. Case definitions using ICD-9 and ICD-10 diagnostic codes represent another limitation, because both false negatives and false positives may occur owing to misdiagnosis or incorrect recording on administrative forms. However, these diagnostic criteria were previously validated[28,29]. Lix, *et al*[29] compared administrative OA diagnoses from the province of Manitoba, Canada, with the self-reported Canadian Community Health Survey data. We used data covering a period of 18 years and made every effort to minimize false positives by using Def2. Presumably, the degree of misclassification in the administrative case definitions was fairly constant during the study period and would not affect the observed trends. Incidence rates of administrative OA are also influenced by the run-in years used to delete the prevalent cases. Therefore, a longer run-in period is recommended to control for overestimation in OA incidence rates. Our overall incidence rates for 2008/2009 were based on a 17-year run-in time and were lower than those based on a 9-year run-in time by 12% and 10%, according to Def1 and Def2, respectively. The overall rates for 2008/2009 were also lower by 22–24% based on Def1 and a 5-year run-in time. Some authors have argued that run-in approaches may not eliminate all prevalent cases of a chronic disease[24,30]. To validate our results, we applied the method proposed by Sun, *et al*[24] in both the 17-year and 9-year of run-in for Def1. The incidence rates obtained from these 2 approaches were found to be similar.

Among the elderly with OA and other chronic diseases, the former often receives less priority when they present themselves to a physician. The real incidence is therefore likely to be higher than that of administrative OA, but the undiagnosed proportion might be very low in health records observed for 18 years. Obesity and aging have long been recognized as 2 of the most important risk factors for incident OA[18,19,20]. Although in Canada obesity is increasing, the obesity rate in the province of BC is significantly lower than the Canadian average[17,31]; indeed, BC has

experienced the smallest increase in the prevalence of obesity compared to other provinces for the period 2000–2011[32]. Therefore, in this province, the effect of obesity on the OA incidence rate is expected to be relatively low. Our age-standardized rates control for the effect of aging in the population. Besides age, sex, and obesity, changes in other factors such as diagnostic criteria, technology development, ICD coding, disease awareness, and access to the healthcare system could potentially influence the incidence as well as the trends. Future studies focusing on changes to these risk factors over time may explain the pattern of OA incidence. In epidemiologic research, there is no simple way to estimate trends in OA incidence. However, such estimates are essential for policy makers and healthcare professionals in their efforts to improve the health of patients with OA through detection, management, and public health programs[6,7,15,33,34]. At this point, more studies are necessary using other provincial or regional data to compare and generalize these results at the national level.

Our study has produced updated incidence rates and trends by examining administrative health records compiled over a longer period of time than heretofore, thus producing better estimates of OA incidence. Our data suggest that the incidence rate of physician-diagnosed OA in the administrative database differs as a result of different case definitions and the number of observation years included. These province-specific data indicate that during the period 2000/2001–2008/2009, the crude incidence of OA has increased among both men and women and that the age-standardized incidence has increased only among men. However, the trend may differ in other regions. More studies are needed to assess plausible projections for future OA incidence and prevalence based on demographic trends and changes to the major risk factors.

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