Consistent Low Prevalence of Arthritis in Quebec: Findings from a Provincial Variation Study in Canada Based on Several Canadian Population Health Surveys

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ABSTRACT. ***Objective.*** To examine interprovincial variations of arthritis prevalence focusing on comparisons between Quebec and the rest of Canada.

Methods. Data were derived from the 1991 General Social Survey (GSS), the 1991 Health and Activity Limitation Survey (HALS), and the 1994 and 1996 National Population Health Surveys (NPHS). Arthritis was variously ascertained through self-report of people aged 15 years or older. Prevalence in Quebec was compared with other provinces using extremal quotients (EQ) and correlation analysis. Multiple logistic regression analysis (1996 NPHS) was used to determine whether the low prevalence in Quebec persisted after controlling for confounding factors including age, sex, education, marital status, occupation, body mass index (BMI), comorbidity, and smoking.

Results. Quebec consistently had the lowest provincial prevalence of arthritis, with age-sex adjusted prevalences of 18.4% (GSS), 1.9% (HALS), 8.8%, and 10.1% (1994 and 1996 NPHS), which were significantly lower than the corresponding national estimates: 21.2%, 3.1%, 12.9%, and 13.3%. EQ from different surveys varied from 1.5 to 3.0 (significantly > 1). Correlation analyses reveal that relative rankings for provinces were consistent in all surveys. Logistic regression analyses showed a low risk of arthritis for Quebecois: odds ratio 0.75 (95% confidence interval 0.65, 0.87) after controlling for potential confounding factors.

Conclusion. The low prevalence of arthritis observed in Quebec cannot be explained by potential confounding factors included in the NPHS and warrants further epidemiological studies. (J Rheumatol 2003;30:126–31)

Key Indexing Terms:
ARTHRITIS PREVALENCE VARIATION SURVEY QUEBEC

Arthritis is one of the most common chronic health conditions and the leading cause of disability in Canada[1-3]. It poses a major economic and health threat to our society, yet little is known about the factors associated with arthritis. Examining regional differences in arthritis may provide useful information for the provision of medical service and shed light on identifying preventable risk factors. There have been several national health surveys in Canada from 1990 to 2000. Most surveys included arthritis as a chronic disease. However, to our knowledge there is no reported work examining provincial variations of arthritis prevalence in Canada.

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As the sampling schemes and questions identifying persons with arthritis differ from one survey to another, it is not surprising that overall national and provincial estimates of arthritis prevalence vary[2]. However, it is not known whether significant provincial variations existed within each survey. If so, it would further beg the questions whether these variations remained consistent across surveys, and whether they could be accounted for by the difference in factors (e.g., age and sex) associated with arthritis.

To address these issues surrounding provincial variations of arthritis prevalence, we gathered the available data from 4 national health surveys conducted in the 1990s, the 1991 General Social Survey (GSS)[4], the 1991 Health and Activity Limitation Survey (HALS)[5], and the National Population Health Survey (NPHS) 1994 and 1996[6].

MATERIALS AND METHODS

Data collection. Arthritis prevalence estimates from 1991 General Social Survey. The 1991 GSS is one of a series of household surveys conducted by Statistics Canada annually since 1985. The 1991 GSS (Cycle 6) collected information regarding health status, health indicators, and activity limitations (disability). The target population for the GSS was all persons 15 years of age and older in Canada, excluding residents of the Yukon and Northwest Territories and fulltime residents of institutions.

Data for the 1991 GSS were collected monthly from January to December. To carry out sampling, each of the 10 provinces was divided into

strata or geographic areas. Generally, for each province one stratum represented the Census Metropolitan Areas (CMA) of the province and another represented the non-CMA areas. The sample was evenly distributed over the 12 months to counterbalance seasonal variations in the information gathered. Most subjects of the sample were selected using the technique of random digit dialing with elimination of non-working banks[7,8]. The sample consisted of 14,875 households. A person 15 years of age or older was randomly selected from each household to provide the health information. A response was obtained from 11,924 of the selected households, yielding a response rate of 80.2%. People with arthritis were identified through their answers to a list of health problems, where the question used to elicit arthritis was "Do you have arthritis, rheumatism or bursitis?".

Arthritis disability prevalence estimates from the 1991 Health and Activity Limitation Survey. The 1991 HALS was conducted by Statistics Canada in the fall of 1991. The target population was all persons with physical, sensory, or psychological disabilities who were living in Canada at the time of the survey, including residents of the Yukon and Northwest Territories, and permanent residents of most collective dwellings and healthcare institutions. Indian reserves and settlements were excluded in the 1991 HALS. Persons excluded for operational reasons were residents of penal institutions, correctional facilities, military camps, campgrounds and parks, soup kitchens, merchant and coast guard ships, and children's group homes.

The Household Survey was carried out in 2 stages. The first stage involved 2 activity limitation screening questions in the 1991 Census long questionnaire, and the second stage comprised interviews with a sample person answering affirmatively to these questions. A sample of individuals who had responded negatively to the census questions was also interviewed by telephone, of whom 5% changed their answer to indicate activity limitation. The basic census characteristics of all these individuals were included in the data set, with full data on those indicating that they had activity limitation. The survey comprised 91,355 adults residing in households throughout Canada, of whom 25,942 had activity restriction. The overall response rate for the household survey was 87.0%. People with arthritis related disability were those who reported arthritis and rheumatism as a cause of disability for any of 12 activity-specific questions (related to mobility and agility) or for a general disability question referring to restriction in the kind or amount of activity lasting, or expected to last, 6 months or more[9].

Arthritis prevalence estimates from National Population Health Survey 1994 and 1996. The target population of the NPHS included household residents in all provinces, with the principal exclusion of populations on Indian reserves, Canadian Forces bases, and some remote areas in Quebec and Ontario. The sample design for the NPHS household survey was a stratified 2 stage design. In the first stage homogeneous strata were formed within each province and independent samples of clusters were drawn from each stratum. In the second stage, dwelling lists were prepared for each cluster and dwellings, or households, were selected from the lists. In total 59,439 (26,429 households) and 210,377 (81,804 households) individuals were surveyed across Canada for the years 1994 and 1996, respectively. For each household, some limited information was collected for all household members, referred to as the general file, and one person in each house aged 12 years and over was randomly selected for a more in-depth interview. These data were combined with data from the household interview related to that person to give a combined data set referred to as the health file. In this study, the 2 general files were used for descriptive analyses and the 1996 health file was used for multiple logistic regression. The response rates at the personal level for the general files were 96.1% (1994) and 95.6% (1996), and 92.8% for the 1996 health file.

Chronic health problems were ascertained in connection with a question, "Do you have any of the following longterm conditions that have been diagnosed by a health professional." The longterm health problems included arthritis or rheumatism, food and other allergies, back problems (excluding arthritis), high blood pressure, migraine headaches, asthma, heart disease, diabetes, stomach or intestine ulcers, and bronchitis or emphysema. The arthritis or rheumatism status was only asked for those 12 years or older.

To make data from these surveys more comparable, only information for those aged 15 and over was used for this report. After application of this age criterion, the final analytical sample sizes were: 43,979 (1994 NPHS general file), 163,391 (1996 NPHS general file), 70,578 (1996 NPHS health file), 11,801 (GSS), and 91,355 (HALS), respectively.

Statistical analyses. Prevalence of arthritis by age and sex for each province was generated. All prevalence estimates presented here were weighted by the sample probability weight. Therefore, the prevalence estimates reported are representative of the general household population. The standard error for each estimate was calculated after taking probability sampling weight and design effect into account. Specifically, we first divided each population probability weight by its correspondent mean weight, so the number of observations would concur with the actual sample size (adjusted sample size). The adjusted sample size was further divided by the corresponding design effect factor to correct the undue small variation caused by cluster sampling[7]. To adjust for the difference in the distribution of age and sex across province within survey and over time between surveys, the direct standardization method was employed using the 1991 Canadian population as the standard population. To test the null hypothesis that the ranking of arthritis/arthritis related disability prevalence was random, we used correlation analyses examining whether correlation coefficients between surveys were significantly different from 0. The extremal quotient (EQ) was used to quantify regional variation[10]. The EQ is the ratio of the arthritis prevalence from the province with the highest level relative to the province with the lowest prevalence level. Age-sex-specific prevalence of arthritis in Quebec (defined by resident status) was derived and compared with the corresponding national mean and median using the 1996 NPHS data. In addition to assessing arthritis prevalence difference between Quebec and national levels, we also juxtaposed arthritis with other chronic health conditions, such as back pain and diabetes, in terms of their prevalence deviation from the national mean and median.

Multiple logistic regression analysis (1996 NPHS) was used to determine whether the low prevalence in Quebec persisted after controlling for confounding factors including age, sex, education, body mass index (BMI) expressed as weight (kg) divided by height $(m)^2$, comorbidity, and smoking. This particular data file was chosen for its better representation of the current Canadian population. In this model, an indicator variable for Quebec (1 = Quebec, 0 = all others) was created. As age is a crucial determinant for arthritis, to best capture the association between age and arthritis, we explored different ways to categorize in our regression models. In our final model, we used age 15–29 years as a baseline and every 5 year interval afterward. We treated ages 15–29 years as one group (baseline) to get a stable estimate because arthritis prevalence is generally very low before age 30 years.

Education, marital status, and comorbidity were treated as binary variables. Low education was defined as having some secondary or lower; married and common-law were combined and compared with all others; comorbidity was reporting at least one non-arthritis chronic condition. Smoking status was grouped into 4 nominal categories: non-smoker, ex-smoker, occasional smoker (< 1 cigarette per day), and current smoker (≥ 1 cigarette per day). Occupation was measured using the Pineo[11] (Pineo-Porter-McRoberts) socioeconomic classification of occupation scale, which groups occupations into 16 categories that have common attributes across the entire labor force. We trichotomized the 16 level Pineo scale into professional (Pineo scores 1–6), skilled (scores 7–11), and semiskilled or lower (scores 12–16). This grouping is consistent with our previous study[12].

BMI was introduced as 3 dummy variables reporting 4 levels: < 25, 25–26.9, 27–29.9, and ≥ 30. Participants were asked for their ethnic/cultural background: "To which ethnic or cultural groups did your ancestors belong?". A binary variable for French or other was derived based on the answers to this question. Participants with missing values for the outcome variable (1.3%) were excluded from the logistic regression. As this study was based on a very large sample, a stringent cutoff point of $p < 0.01$ for statistical significance was used to reduce type I errors. To compare the effects of ethnic/cultural origin along with residence status, we further derived age-sex adjusted prevalence by residence and ethnic/cultural status using logistic regression. All statistical analyses were performed using SAS 8.0[13] on a Unix mainframe computer.

RESULTS

The national prevalence levels of arthritis according to the NPHS (1994 and 1996) and 1991 GSS were 13.0%, 13.2%, and 20.8%, respectively (Table 1). The national prevalence level of arthritis associated disability based on 1991 HALS was 3.1%. The prevalence of arthritis or rheumatism diagnosed by a health professional (1994 NPHS) varied from 8.8% (Quebec) to 20.0% (Nova Scotia). The prevalence of arthritis, rheumatism, or bursitis (GSS) varied from 18.0% (Quebec) to 27.1% (New Brunswick). A similar 3-fold gradient of 1.8% (Quebec) to 5.7% (Nova Scotia) was also found for the prevalence of arthritis associated disability (HALS). As shown in Table 1, Quebec had the lowest prevalence in all surveys, while Nova Scotia and Saskatchewan had consistently higher prevalences. Variations, as well as the relative ranking, remained after age and sex adjustment. The EQ presents the variation in a quantified way: the variation among the 10 provinces was most noticeable for the 1991 HALS (EQ = 2.97).

Correlation analyses between prevalence estimates derived from different surveys were used to measure the consistency of arthritis prevalence across surveys. As shown in Table 2, the correlation coefficients between provincial prevalence estimates for any 2 surveys were all statistically significant, excluding r = 0.6, indicating that the relative magnitudes of the prevalence estimates from different surveys are consistent.

Using data from the 1996 NPHS, Figure 1 shows the extent to which arthritis prevalence in Quebec deviated from the corresponding national average by age and sex, and shows that the absolute difference in arthritis prevalence between Quebec and the national level increased with age. The low prevalence of arthritis in Quebec was reflected in almost every age-sex subgroup.

Table 3 displays results from the multiple logistic regression analysis using the 1996 NPHS data, in which Quebec was compared with all other provinces (combined as baseline). Living in Quebec was significantly associated with a decreased likelihood of reporting arthritis, with an odds ratio of 0.75 (95% CI 0.65, 0.87), after controlling for other covariates in the model. Older age, female sex, comorbidity, and overweight (BMI > 25) were all significantly associated with arthritis. In further logistic regression analyses (data not shown), we modeled each province separately using Ontario as baseline while holding all other covariates unchanged. The results consistently suggest Quebec had the lowest arthritis prevalence. Similar results were also found when the analyses were repeated using the other surveys (data not shown).

To assess the possible effects from cultural/ethnic related factors on arthritis, we compared arthritis prevalence in Quebec by French versus other ethnic/cultural origin. We further examined arthritis prevalence in people outside of Quebec with French ethnic origin. Figure 2 shows the age, sex, and ethnicity adjusted prevalence of arthritis between Quebecois and other Canadians. When the analyses were repeated using French versus other languages spoken at home the results were unchanged. The findings indicate that "where people live" rather than "where people are from" mattered more. The similarity between francophones and non-francophones in Quebec, and noticeable differences between francophones living in Quebec and other provinces suggest that social or environmental factors may play an important role.

To explore the possibility of systematic differences in reporting, we compared the prevalence of arthritis with other chronic conditions in Quebec (Figure 3). In general, Quebec had a lower prevalence of most chronic health conditions, which was particularly marked for arthritis and back problems.

DISCUSSION

Based on multiple Canadian surveys, we have shown that there are significant provincial variations in the prevalence of arthritis and arthritis related disability, as reflected in EQ

Table 1. Raw and age/sex adjusted prevalence of arthritis and ranking orders by prevalence based on the National Population Health Survey (NPHS, 1994, 1996), the 1991 General Social Survey (GSS), and the 1991 Canadian Health and Activity Limitation Survey (HALS).

	1996 NPHS			1994 NPHS			1991 GSS			1991 HALS		
	Raw % (SE)	Adjusted %	Rank*	Raw % (SE)	Adjusted %	Rank	Raw % (SE)	Adjusted %	Rank	Raw % (SE)	Adjusted %	Rank
NS	19.4 (0.59)	18.9	1	20.0 (0.83)	20.1	1	25.2 (1.62)	25.7	3	5.6 (0.51)	5.7	1
SK	17.6 (0.57)	16.5	2	18.3 (0.82)	17.5	2	26.0 (1.49)	25.3	2	4.3 (0.23)	3.9	2
PEI	16.8 (0.23)	16.7	3	16.1 (0.84)	15.6	3	23.8 (2.51)	22.2	5	2.2 (0.14)	2.5	8.5
MB	16.1 (0.08)	15.4	4	15.3 (0.77)	15.1	5	24.6 (3.3)	24.2	4	4.2 (0.24)	4.0	3
NB	15.6 (0.44)	15.6	5	14.6 (0.69)	14.9	6	27.1 (1.69)	27.8	1	3.5 (0.28)	3.6	4
ON	14.1 (0.04)	14.3	6	14.3 (0.36)	14.7	7	21.2 (0.81)	21.5	7	3.3 (0.13)	3.4	7
AB	13.2 (0.06)	14.7	8	13.4 (0.61)	15.4	4	18.8 (2.4)	21.2	9	3.3 (0.17)	4.0	6
NF	13.4 (0.26)	14.5	7	12.9 (0.74)	14.6	8	20.1 (1.62)	22.9	8	2.2 (0.14)	2.5	8.5
BC	13.0 (0.64)	13.0	9	12.6 (0.52)	12.8	9	21.9 (1.06)	21.4	6	3.4 (0.22)	3.3	5
QE	10.1 (0.50)	10.2	10	8.8 (0.39)	9.1	10	18.03 (0.81)	18.4	10	1.8 (0.15)	1.9	10
Canada	13.2 (0.10)	13.4		13.0 (0.23)	12.9		20.82 (0.36)	20.8		3.1 (0.06)	3.1	
EQ	1.92	1.85		2.27	2.21		1.40	1.40		3.10	2.9	

* Ranking was based on standardized prevalence. SE: standard error. EQ: extremal quotient.

Table 2. Correlation coefficients between surveys (based on age-sex adjusted prevalence, n = 10). Numbers in each cell are correlation coefficients and p values.

	1994 NPHS	1996 NPHS	1991 GSS	1991 HALS
1996 NPHS	0.97			
	0.001			
1991 GSS	0.70	0.75		
	0.023	0.012		
1991 HALS	0.81	0.73	0.61	
	0.004	0.017	0.060	

varying from 1.4 (1991 GSS) to 3.1 (1991 HALS). These variations could not be explained by difference between provinces in age, sex, or other factors. Correlation analyses showed that the variations were similar for all the national surveys considered. Nova Scotia and Saskatchewan had consistently higher prevalences of arthritis. The most striking finding was that Quebec consistently had the lowest prevalence of arthritis. Results from multiple logistic regression analyses using the 1996 NPHS suggest that low prevalence in Quebec persists even after controlling for potential confounding factors of age, sex, BMI, level of education, and smoking status. Therefore, none of these factors are likely to explain the observed variations in the NPHS and other surveys across Canada especially the low prevalence in Quebec.

The association between arthritis and older age, female sex, low education, and high BMI is well established[14,15]. In this study, smoking was identified as a risk factor for arthritis. The literature on smoking and arthritis is relatively scant, and is mainly centered on rheumatoid arthritis (RA)[16-19]. Cigarette smoking is likely to increase one's susceptibility to RA[20]. It is suggested exposure to tobacco smoke may trigger the production of rheumatoid factors and subsequently contribute to the development of clinically manifest RA[19]. In people with arthritis, heavy smoking is also associated with the severity of RA[21,22]. Published data that directly address the association between osteoarthritis and smoking are less consistent[23-26]. As the smoking prevalence in Quebec was highest in Canada, difference in smoking prevalence is unlikely to be a possible explanation for the observed low arthritis prevalence in Quebec.

The racial difference in prevalence of arthritis has been reported in the literature; Asian people have lower risk of arthritis[27]. Proportionally, Ontario and British Columbia have more Asian people, but their prevalence of arthritis was not significantly different from the national level.

We are not aware of any significant differences in environmental factors that might likely be responsible for the wide provincial variation in Canada. The low prevalence of arthritis appears to be related to residence in the province of Quebec rather than a francophone cultural background. The generally lower prevalences of all chronic conditions in Quebec do not support an explanation that the low prevalence of arthritis is due to misreporting of arthritis.

Our study has several limitations. First, the outcome variable was based on self-report. Even though the NPHS probing question contained the phrase "diagnosed by a health professional," little is known about the validity and reliability of self-reported prevalence of arthritis and rheumatism as a chronic health problem. The term "health professional" is subject to self-interpretation, which could be influenced by cultural belief. However, possible self-reporting bias, if any, is unlikely to account for all observed difference between Quebec and other parts of Canada. Quebec not only had the lowest prevalence of self-reported arthritis, but also had the lowest prevalence of arthritis associated disability (1991 HALS), which is less influenced by self-perception.

Second, we were unable to differentiate subtypes of arthritis as well as joint sites. It was possible that the observed low

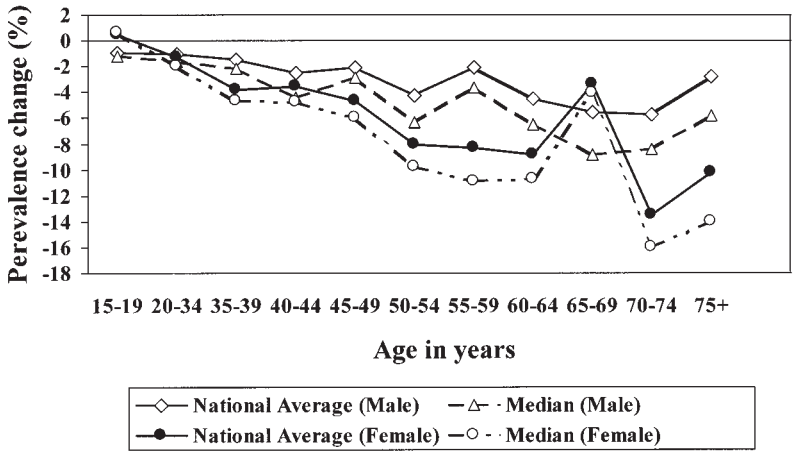

Figure 1. Arthritis prevalence in Quebec: deviation from median and national average by age and sex based on the 1996 NPHS.

Table 3. Logistic regression analysis for self-reported arthritis in people aged 15 years and over: based on the 1996 Canadian National Population Health Survey.

Variable	OR	99% CI	
		Low	High
Resident			
Non-Quebec	1		
Quebec	0.75	0.65	0.87
Age			
15–29 yrs	1		
Every 10 yrs	1.80	1.72	1.88
Sex			
Male	1		
Female	1.82	1.60	2.07
Marriage			
Others	1		
Married/common law	1.12	0.99	1.28
Level of education			
Not low	1		
Low	1.15	1.01	1.42
Occupation			
Professional	1		
Skilled	0.99	0.81	1.22
Semiskilled or lower	1.02	0.86	1.20
Smoking			
No	1		
Ex-smoker	1.17	1.02	1.35
Occasional smoker	1.16	0.81	1.66
Current smoker	1.45	1.23	1.70
Other chronic condition			
No	1		
Yes	9.49	8.31	10.83
BMI (weight in kg/height in m^2)			
< 25	1		
25–26.9	1.20	1.01	1.42
27–29.9	1.27	1.10	1.50
30 and over	1.67	1.40	1.99

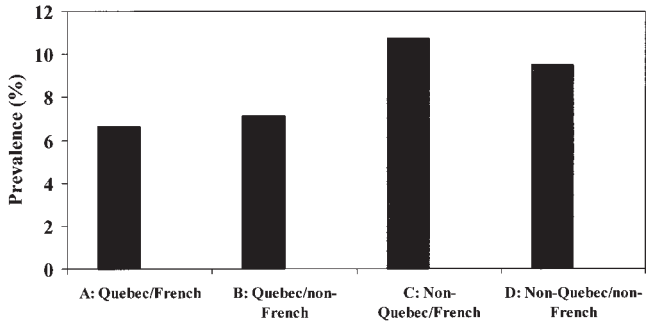

Figure 2. Arthritis prevalence by ethnic and residence status: derived from logistic regression model after controlling for age and sex based on the 1996 NPHS. Not statistically significant for comparisons A:B, C:D; $p < 0.01$ for paired comparisons A:C, A:D, B:C, B:D.

prevalence of arthritis was only for some selected types. Examining provincial arthritis prevalence variation by subtypes may help unveil the underlying causes for the observed findings. Lastly, information related to joint trauma and overuse, which are a major risk for osteoarthritis, was not available to us.

The consistency in our findings among all the surveys makes it highly unlikely that they were due to chance. Indeed, their validity is further enhanced by the great representiveness of each of the surveys. The inexplicable findings beg scientific explanation and we must examine any possible systematic factors or biases that may have contributed to the consistent difference in arthritis prevalence across surveys and over time between Quebec and other parts of Canada. These biases may include differences in terms of cultural belief, medical consultation pattern, etc., that may influence reporting. However, to examine all these factors is beyond the scope of the available data.

In conclusion, provincial variations in arthritis prevalence

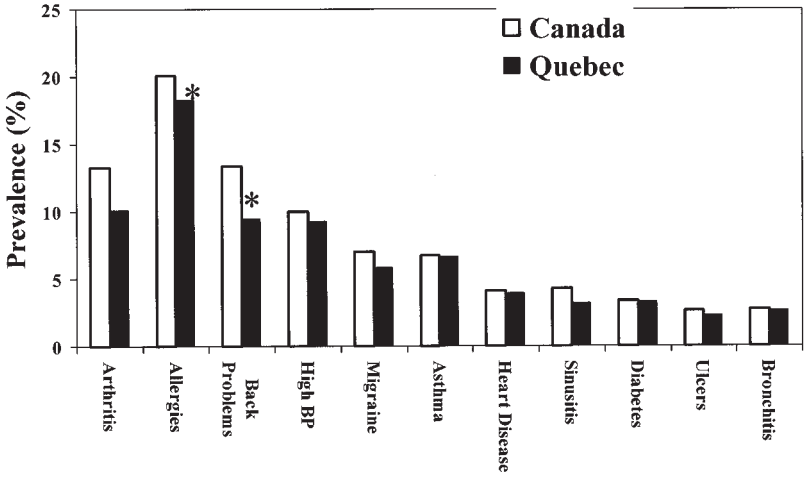

Figure 3. Prevalence of selected chronic health conditions: comparisons between Quebec and the corresponding national average based on the 1996 NPHS. *Statistically significant, $p < 0.01$.

persisted despite controlling for the demographic composition of the population and factors known to be associated with arthritis. Although this study cannot offer satisfactory explanations for the observed wide variation of arthritis prevalence, it has important implications for future studies.

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