ORIGINAL ARTICLE

Prevalence of and risk factors for self-reported chronic bronchitis in a Canadian population: The Canadian Community Health Survey, 2007 to 2008

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C Karunanayake, B Hagen, J Dosman, P Pahwa. Prevalence of and risk factors for self-reported chronic bronchitis in a Canadian population: The Canadian Community Health Survey, 2007 to 2008. Can Respir J 2013;20(4):231-236.

BACKGROUND: Chronic bronchitis (CB) represents one of the respiratory disease phenotypes that affect the Canadian health care system significantly. Presently, almost 6.5% of total health care costs are related to respiratory diseases.
OBJECTIVE: To determine the prevalence of self-reported CB and associated risk factors in the Canadian general population.
METHODS: Data regarding individuals ≥12 years of age from the Canadian Community Health Survey, 2007 to 2008, were analyzed. CB was determined through self-reported health professional diagnosis. Information regarding covariates of importance, such as demographics, lifestyle variables and socioeconomic status, was obtained. A weighted logistic regression analysis was performed with appropriate technique for clustering effects.
RESULTS: The prevalence of self-reported CB was 2.5%. A greater prevalence of self-reported CB associated with older age, female sex and white ethnic group was found. There were differences in the prevalence of self-reported CB among regions of Canada for household income, educational attainment and smoking status.
CONCLUSION: The results suggest an association between ethnicity and the prevalence of CB. The associations between self-reported CB prevalence and household income, educational attainment and smoking status varied according to region of Canada.

Key Words: *Canadian Community Health Survey; Chronic bronchitis; Visible minority; White*

La prévalence et les facteurs de risque de bronchite chronique autodéclarée au sein d'une population canadienne : l'Enquête sur la santé dans les collectivités canadiennes, 2007 à 2008

HISTORIQUE : La bronchite chronique (BC) est l'un des phénotypes de maladie respiratoire qui a une incidence significative sur le système de santé canadien. Près de 6,5 % de l'ensemble des coûts de santé sont liés à des maladies respiratoires.
OBJECTIF : Déterminer la prévalence de BC autodéclarée et des facteurs de risque connexes au sein de la population canadienne.
MÉTHODOLOGIE : Les chercheurs ont analysé les données portant sur les individus de 12 ans et plus tirées de l'Enquête sur la santé dans les collectivités canadiennes, 2007 à 2008. La BC était déterminée par le diagnostic autodéclaré par des professionnels de la santé. Ils ont obtenu l'information relative aux covariables d'importance, telle que la démographie, les variables liées au mode de vie et la situation socioéconomique. Ils ont effectué une analyse de régression logistique pondérée au moyen d'une technique permettant d'obtenir des effets de regroupement.
RÉSULTATS : La prévalence de BC autodéclarée s'élevait à 2,5 %. Les chercheurs ont observé une plus forte prévalence de BC autodéclarée associée à l'âge plus avancé, au sexe féminin et au groupe de race blanche. Ils ont constaté des différences de prévalence de BC autodéclarée entre les régions du Canada selon le revenu familial, l'instruction et le tabagisme.
CONCLUSION : Les résultats semblent indiquer une association entre l'ethnie et la prévalence de BC. Les associations entre la prévalence de BC autodéclarée et le revenu familial, l'instruction et le tabagisme variaient selon les régions du Canada.

Chronic bronchitis (CB) represents one of the serious respiratory disease phenotypes that affect the Canadian health care system significantly. Presently, almost 6.5% of total health care costs are related to respiratory diseases (not including lung cancer) (1). CB is a chronic inflammatory condition that causes swelling and irritation in the respiratory passages, increased mucus production and damage to the lungs (2). CB is defined by chronic cough or mucus production for at least three months in two successive years when other causes have been excluded (3).

Many previous definitions of chronic obstructive pulmonary disease have emphasized the terms 'emphysema' and 'chronic bronchitis', which are no longer included in the definition of chronic obstructive pulmonary disease. Chronic obstructive pulmonary disease is a common, preventable, treatable disease and is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and lungs to noxious particles or gas. However, it is important to recognize that CB (chronic cough and sputum production) is an independent disease entity that may precede or follow the development of airflow limitation and may be associated with development and/or acceleration of fixed airflow limitation. CB may also be present in patients who demonstrate normal spirometry (4).

According to the National Population Health Survey, 1998/1999 (5), the prevalence of self-reported health professional-diagnosed CB or emphysema was 3.2% among adult Canadians (2.8% for men and 3.6% for women) ≥35 years of age. There is no recent report of CB prevalence in the general Canadian population. The purpose of the present study was to determine the prevalence of self-reported CB and associated risk factors in the Canadian general population ≥12 years of age.

METHODS

Study population

The present study used data from public use microdata files of the Canadian Community Health Survey – Annual component, 2007 (CCHS-2007) (6) and the CCHS – Annual component, 2008 (CCHS-2008) (7), which were conducted by Statistics Canada in 2007 and 2008. The CCHS data were cross-sectional and accounted for approximately 98% of the Canadian population ≥12 years of age living in private dwellings in the 121 health regions covering all 10 provinces and three territories of Canada. Excluded from the sampling frame were individuals living on Indian Reserves and on Crown lands, institutional residents, full-time members of the Canadian Forces and residents of certain remote regions (6,7).

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TABLE 1
Percentages* of self-reported chronic bronchitis in Canada (≥12 years of age)

	Chronic bronchitis, %	
Demographic	Yes (n=2886)	No (n=89,741)
White	2.8	97.2
Visible minority	1.5	98.5
General Canadian population	2.5	97.5

**Percentages weighted to the Canadian population*

The CCHS was based on a complex design, with stratification and multiple stages of selection, and unequal probabilities of selection of respondents. Between January 2007 and December 2008, a total of 131,959 valid interviews were conducted using computer-assisted techniques (6,7). Approximately one-half of the interviews were conducted in person using computer-assisted personal interviewing and the other one-half were conducted over the telephone using computer-assisted telephone interviewing by employing trained interviewers. The overall national response rate was 76.4% (6,7).

Primary respiratory health outcome

CB was determined by self-reported health professional diagnosis. The following question was asked in the CCHS 2007/2008 survey: "Remember, we're interested in conditions diagnosed by a health professional. Do you have chronic bronchitis?". This question was not in the survey at the beginning of the data collection, but was added during the July to August 2007 collection period and, hence, approximately 29% of individuals ≥12 of age did not respond to this question. The sample size for this analysis was 92,627.

Covariates

Information regarding covariates of importance, such as demographic variables, environmental variables, health and lifestyle variables, and socioeconomic status, was obtained. Demographic variables consisted of age, sex, ethnicity and marital status. Age was divided into seven categories: <20 years, 20 to 29 years, 30 to 39 years, 40 to 49 years, 50 to 59 years, 60 to 69 years and ≥70 years. Ethnicity was self-selected by the individual and grouped into two categories according to cultural or racial background: white and visible minority. The visible minority group consisted of Chinese, South Asian (eg, East Indian, Pakistani, Sri Lanka), Black, Filipino, Latin American, Southeast Asian (eg, Cambodian, Indonesian, Laotian, Vietnamese), Arab, West Asian (eg, Afghan, Iranian), Japanese, Korean, Aboriginal identity or other. The other racial or cultural origin not described above and mixed races of combinations of more than one category listed above were grouped into the 'other' ethnic category. Therefore, statistical analysis of these data enabled the estimation of the prevalence of self-reported CB in the general Canadian population. Furthermore, it enabled comparison of the prevalence of self-reported CB between whites and visible minority populations (based on these data). Marital status included three categories: married or common-law or living together; single or never married; and widowed or divorced or separated. Environmental variables consisted of geographical areas and defined as location of residence. Location of residence was a nominal variable with six categories: Atlantic (Nova Scotia, Newfoundland. New Brunswick, and Prince Edward Island); British Columbia; Prairies (Alberta, Saskatchewan, Manitoba); Territories (Yukon, Northwest Territories, Nunavut); Quebec; and Ontario. Body mass index (BMI) represented the health-related variable. BMI was calculated based on self-reported weight and height and categorized into obese (BMI ≥30.0 kg/m^2), overweight (BMI 25.0 kg/m^2 to 29.9 kg/m^2) and normal-to-underweight (BMI <25.0 kg/m^2). The lifestyle variable consisted of participants' personal smoking history. Personal smoking history was divided into the three categories: never smokers; ex-smokers; and current smokers. Socioeconomic status variables consisted of respondents' education and household income level. Respondents' education had four categories: postsecondary degree/diploma; some postsecondary education; high school completed; and less than high school completed. Annual household income consisted of six groups, increasing in $20,000 increments beginning with zero.

Statistical analysis

The prevalence of self-reported CB and risk factors were calculated using weighted percentages. An appropriate weight variable computed by Statistics Canada was used in all analyses to ensure that final estimates were representative of the Canadian population. A weighted multiple logistic regression modelling technique, based on a maximum likelihood, was used to test the association of risk factors for CB. The Taylor linearization variance estimation (8) was used to estimate the robust standard errors of regression coefficients to account for clustering inherent in the study design of the cross-sectional multistage complex survey. A series of weighted logistic regression models were fitted to determine whether potential risk factors, confounders and interactive effects contributed significantly to the prevalence of CB. Scientifically important two-way interactions were examined. Based on bivariable analysis, statistically significant variables with P<0.20 become candidates for the multivariable model. All variables that were statistically significant (P<0.05) were retained in the final multivariable model.The results of the models were presented as ORs with associated 95% CIs. SPSS version 20 (IBM Corporation, USA) (9) and STATA version 11 (StataCorp, USA) (10) software were used to conduct all statistical analyses.

RESULTS

Among adult respondents, 80.2% were white and 19.8% were visible minorities. There were 49.3% males and 50.7% females. Approximately one-fifth (21.0%) of the sample was ≥60 years of age.

Crude prevalence of self-reported CB

The crude prevalence of self-reported CB was 2.8% for whites and 1.5% for visible minorities. In the overall general Canadian population, the prevalence of self-reported CB was 2.5% (Table 1). There were differences in prevalence of self-reported CB among educational attainment, household income and smoking status according to location of residence (Table 2). The regional variation in these factors may contribute to the differences in the prevalence of self-reported CB.

As shown in Table 3, self-reported CB was more prevalent among females than among males and increased with age from 1.0% in individuals <20 years of age to 5.2% for those ≥70 years of age. The prevalence was highest in the Atlantic region (3.2%). The prevalence was also highest among individuals with lower annual income and educational attainment. Current smokers had a CB prevalence of 4.4%, while nonsmokers had a prevalence of 1.4%. Table 3 summarizes both the prevalence and ORs for CB.

Adjusted prevalence of self-reported CB

In the multivariable model, the visible minority group had lower odds of having CB than whites who live in Canada (OR 0.77 [95% CI 0.60 to 0.99]). Table 3 summarizes all variables that were found to be significant predictors (P<0.05) of self-reported CB in the multivariable model. As expected, older study participants were more likely to self-report CB compared with participants in the <20 years age group: OR for individuals 50 to 59 years 3.07 (95% CI 2.04 to 4.61); OR for individuals 60 to 69 years 3.04 (95% CI 2.07 to 4.46); OR for individuals ≥70 years of age 4.19 (95% CI 2.88 to 6.07). Marital status was not a significant predictor in the multivariable analysis and, hence, not retained in the final model. BMI was also found to be a significant predictor of CB (obese group OR 1.64 [95% CI 1.39 to 1.94]).

There were three significant interactions between educational attainment, smoking status and household smoking and location of residence. The relationship between self-reported CB and the above-mentioned factors was varied according to the location of residence. The prevalence of self-reported CB was higher among study participants who had less than high school education and who resided in

TABLE 2
Distribution of household income, educational attainment and smoking status stratified according to location of residence

	Location of residence, %* (prevalence of self-reported chronic bronchitis)					
	Territories†	Quebec	Ontario	Prairies‡	British Columbia	Atlantic§
Household income/year, $						
<20,000	8.7 (3.8)	10.7 (6.1)	7.7 (5.8)	6.7 (6.4)	8.1 (4.8)	11.1 (7.3)
20,000–39,999	13.3 (1.3)	22.1 (3.7)	15.5 (3.4)	15.5 (3.5)	17.7 (3.4)	23.5 (4.8)
40,000–59,999	14.2 (1.3)	19.8 (2.5)	17.0 (3.3)	15.8 (2.4)	18.3 (2.8)	20.2 (2.6)
60,000–79,999	13.0 (0.1)	16.4 (2.2)	16.5 (1.6)	15.5 (1.2)	15.9 (1.5)	16.5 (2.6)
≥80,000	50.9 (0.9)	31.0 (1.5)	43.3 (1.9)	46.5 (1.7)	40.0 (1.2)	28.6 (1.2)
Education attainment						
Less than high school	33.0 (1.5)	25.5 (4.2)	21.1 (3.6)	23.2 (2.5)	18.8 (2.5)	27.7 (4.3)
High school completed	11.3 (0.0)	11.5 (3.2)	16.9 (2.5)	17.2 (2.6)	17.8 (1.5)	14.5 (1.9)
Some postsecondary education	6.2 (3.6)	8.1 (2.7)	7.8 (2.5)	8.4 (1.8)	10.5 (1.6)	8.3 (3.5)
Postsecondary degree/diploma	49.6 (0.6)	54.9 (2.7)	54.1 (2.2)	51.2 (2.0)	53.0 (2.4)	49.4 (2.9)
Smoking status						
Current smoker	37.1 (1.7)	23.7 (4.4)	20.2 (4.5)	23.1 (3.9)	18.5 (4.3)	23.6 (5.6)
Ex-smoker	31.5 (0.8)	40.0 (3.0)	35.1 (2.9)	35.6 (2.3)	37.6 (2.2)	41.0 (2.7)
Never smoker	31.4 (0.3)	36.3 (1.5)	44.8 (1.5)	41.4 (1.2)	43.8 (1.1)	35.4 (2.2)

**Percentages weighted to the Canadian population; †Northwest Territories, Yukon and Nunavut; ‡Alberta, Saskatchewan and Manitoba; §Newfoundland and Labrador, Nova Scotia, New Brunswick and Prince Edward Island*

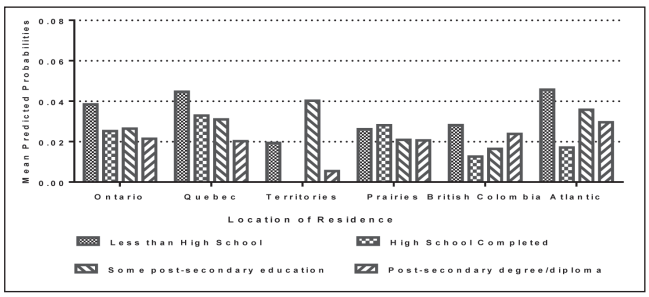

Figure 1) *Mean predicted probabilities of self-reported chronic bronchitis according to education attainment and location of residence*

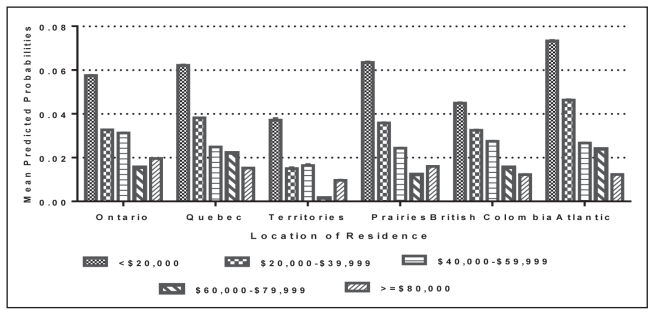

Figure 2) *Mean predicted probabilities of self-reported chronic bronchitis according to household income and location of residence*

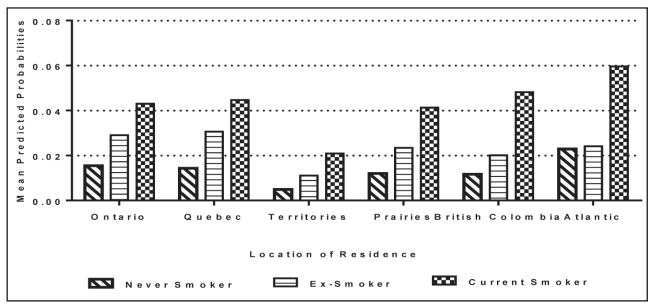

Figure 3) *Mean predicted probabilities of self-reported chronic bronchitis according to smoking status and location of residence*

the regions of Ontario, Quebec, British Columbia and Atlantic Canada compared with those who had a postsecondary degree/diploma (Figure 1). There was a significantly higher prevalence of self-reported CB among study participants with an annual household income <$20,000, irrespective of the location of residence, compared with the highest income level (Figure 2). The highest prevalence of self-reported CB was among current smokers in the Atlantic region, while the lowest prevalence of self-reported CB was observed among current smokers who resided in the Territories (Figure 3).

DISCUSSION

Using the CCHS 2007 to 2008 cross-sectional cohort, the present study determined the prevalence of self-reported CB and examined some of the associated risk factors among adults in the Canadian general population. We found the overall prevalence of self-reported CB to be 2.5%. The prevalence for whites and for visible minority groups was 2.8% and 1.5%, respectively. The multivariable analysis showed that older age, female sex, being obese and white ethnicity were significantly associated with self-reported CB. Two-way interactions between location of residence and educational attainment, household income and smoking status were observed. There was a difference in the prevalence of self-reported CB and socioeconomic status and smoking status according to location of residence. The observed regional differences of self-reported CB may be due to the differences in patterns of household income, education and smoking status in these jurisdictions. We have provided additional information to explain the differences in the prevalence of self-reported CB between educational attainment, household income and smoking status according to location of residence (Table 2). Previous studies have also reported such variations across Canada (11-16). The regional variation in these factors may contribute to the differences in the prevalence of self-reported CB.

According to our recent population-based survey conducted among residents of rural Saskatchewan (17), the prevalence of CB was 5.9%. The prevalence of CB in the general Canadian population ≥12 years of age is significantly lower (2.5%) than the prevalence of CB among the Saskatchewan rural population (5.9%) (11). One of the reasons for this may be that environmental exposures, socioeconomic status and educational attainment of the general Canadian population are different than in the rural Canadian population.

In Canada, similar to the rest of the world, the prevalence of CB increased with age for both males and females, with CB being more prevalent in females (1,18). Our study also reported similar results. Using data from the CCHS 2005 database, Evans and Chen (19)

TABLE 3
Bivariable and multivariable logistic regression analysis of the association of the prevalence of self-reported chronic bronchitis and risk factors

	Prevalence* of self-reported chronic bronchitis (n=2886)	OR (95% CI)†	
		Unadjusted	Adjusted
Ethnicity			
White	2.8	1.00	1.00
Visible minority	1.5	**0.52 (0.41–0.66)**	**0.77 (0.60–0.99)**
Sex			
Male	2.0	1.00	1.00
Female	3.1	**1.57 (1.36–1.81)**	**1.65 (1.39–1.95)**
Age group, years			
<20	1.0	1.00	1.00
20–29	1.4	1.38 (0.98–1.96)	1.30 (0.85–2.01)
30–39	1.9	**1.94 (1.39–2.71)**	**1.79 (1.19–2.70)**
40–49	2.1	**2.14 (1.55–2.97)**	**1.76 (1.18–2.63)**
50–59	3.4	**3.58 (2.63–4.89)**	**3.07 (2.04–4.61)**
60–69	3.9	**4.08 (3.04–5.47)**	**3.04 (2.07–4.46)**
≥70	5.2	**5.52 (4.14–7.37)**	**4.19 (2.88–6.07)**
Marital status			
Married/common-law/living together	2.5	1.00	N/A
Widow/separated/divorced	5.1	**2.10 (1.82–2.43)**	
Single/never married	1.6	**0.66 (0.56–0.77)**	
Location of residence			
Ontario	2.8	1.00	1.00
Quebec	2.6	1.07 (0.90–1.28)	0.67 (0.28–1.57)
Territories‡	1.0	**0.38 (0.23–0.63)**	0.25 (0.03–1.98)
Prairies§	2.2	0.84 (0.68–1.03)	0.80 (0.38–1.71)
British Columbia	2.1	**0.82 (0.67–1.00)**	0.76 (0.38–1.52)
Atlantic region¶	3.2	**1.24 (1.04–1.48)**	0.90 (0.43–1.85)
Educational attainment			
Postsecondary degree/diploma	2.2	1.00	1.00
Some postsecondary education	2.3	1.06 (0.80–1.41)	1.27 (0.67–2.41)
High school completed	2.5	1.11 (0.90–1.38)	0.99 (0.65–1.51)
Less than high school	3.5	**1.60 (1.38–1.85)**	**1.67 (1.24–2.25)**
Household income/year, $			
≥80,000	1.7	1.00	1.00
60–79,999	1.8	1.05 (0.80–1.38)	0.71 (0.46–1.11)
40–59,999	2.8	**1.71 (1.33–2.19)**	1.25 (0.82–1.90)
20–39,999	3.6	**2.22 (1.79–2.74)**	1.13 (0.81–1.60)
≤20,000	6.0	**3.76 (3.02–4.67)**	**1.93 (1.35–2.76)**
Body mass index, kg/m^2			
<25	2.0	1.00	1.00
25–29.9	2.6	**1.30 (1.10–1.54)**	**1.22 (1.00–1.48)**
>30	3.7	**1.88 (1.62–2.18)**	**1.64 (1.39–1.94)**
Smoking status			
Never smoked	1.4	1.00	1.00
Ex-smoker	2.7	**1.90 (1.59–2.28)**	**1.67 (1.14–2.44)**
Current smoker	4.4	**3.15 (2.62–3.78)**	**3.00 (2.06–4.35)**
Interactions (see Figures 1, 2 and 3 for different levels)			
Education attainment × Location of residence			**P<0.05**
Smoking status × location of residence			**P<0.05**
Household income × location of residence			**P<0.05**

*Bolded values indicate statistical significance. *Prevalences were weighted to the Canadian Population; †CI based on Taylor linearization method; ‡Northwest Territories, Yukon and Nunavut; §Alberta, Saskatchewan and Manitoba; ¶Newfoundland and Labrador, Nova Scotia, New Brunswick and Prince Edward Island. N/A Not applicable (variable not included in the model)*

demonstrated that nonwhite individuals had a lower prevalence of CB. Our findings confirmed this result and showed that visible minorities had a lower prevalence of CB compared with the white Canadian population (based on the present study). One plausible explanation for this is that the white population has a higher smoking prevalence than the visible minority population (20). Confirming this, our data reported 22.7% current smokers among whites compared with 17.3% current smokers among visible minorities.

Cigarette smoke exposure remains the most important risk factor for the development of CB. Cigarette smoke causes an inflammatory reaction in bronchial or alveolar mucosa, and increased sensitivity to irritants. Previous studies have reported a higher prevalence of CB in smokers

compared with nonsmokers (21-29). Our results also supported these findings and showed that in all regions, current smokers had a higher prevalence of self-reported CB compared with never smokers. Furthermore, these prevalences varied according to location of residence.

Numerous studies have demonstrated a relationship between socioeconomic status and CB (18,21,29-34). Educational attainment is among the key indicators of socioeconomic status and our results demonstrated that less than high school-educated participants were significantly more likely to self-report CB in the Ontario, Quebec, British Colombia and Atlantic regions. Household income level was inversely associated with self-reported CB and varied according to location of residence.

Globally, more than one billion people are overweight or obese (35). Obesity has emerged as an important risk factor for chronic respiratory diseases such as asthma, CB, emphysema and chronic obstructive pulmonary disease, although the nature of this relationship is not well understood (36-39). Individuals with obstructive airway disease who are overweight and obese are more often diagnosed with CB than emphysema (37,39).

The observation of variation of prevalence of CB according to ethnicity was not previously well studied. One of the reasons for this variation was the distribution of the immigrant population in Canada because Ontario consisted of 55% of the total immigrant population according to 2006 Canadian census data (40). Canada is one of the most ethnically diverse countries in the world. In our study, 65.1% of visible minorities were immigrants. New immigrants were younger and tended to be healthy, but their health status declines as their length of residence in Canada increases (41). There was no evidence of disparities in the rates of contact with physicians, both general practitioners and specialists, between members of visible minorities and white people (42).

Study strengths and limitations

The strengths of our study were the availability of information on a large number of people across Canada, including all 10 provinces and three territories. The overall response rate was high and there were a large number of determinants available for analysis. Several markers of socioeconomic status were assessed including education and household income level. There were also some limitations. The CCHS does not include occupational exposures information, which is an important determinant of CB. In addition, data in the present analysis relied on self-reported physician-diagnosed CB, which can lead to self-report bias.

CONCLUSION

Our results suggest an association between ethnicity (white versus visible minority) and the prevalence of CB. The associations between self-reported CB prevalence and household income, educational attainment and smoking status varied according to region of Canada. This may be due to the regional differences among these factors. Additional studies are needed to explore the factors underlying such differences across ethnicities and whether they are associated with CB.

ACKNOWLEDGEMENTS: This study was supported by the Canadian Institute for Health Research pilot project program and the Canadian Centre for Health and Safety in Agriculture.

DISCLOUSRES: The authors have no financial disclosures or conflicts of interest to declare.

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