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Geographic variation of bone mineral density and selected risk factors for prediction of incident fracture among Canadians 50 and older

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Abstract

Background—Striking geographic variation in the incidence of osteoporotic fracture has been shown in national and international studies. The contributing risk factors for this variation are not fully understood.

Objective—To determine the geographic variation of bone mineral density (BMD) values, prevalent low-trauma fracture, prior falls, and vertebral deformity and to determine how this variation is related to the geographic variation of incident low-trauma fracture.

Methods—We studied incident fracture among 2484 men and 6093 women ages 50 and older from CaMos, a randomly-selected population-based longitudinal cohort recruited from within 50 kilometers of nine cities across Canada. Analyses included up to an eight-year follow-up.

Results—Estimates of fracture incidence are all age-standardized and given per 1000 person-years and CI denotes confidence interval. Among men, the lowest incidence of low-trauma fracture was 3.2 (95% CI: 1.1–7.5) in Quebec and the highest was 11.9 (95% CI: 7.1–18.6) in Calgary, compared with an overall incidence of 7.2 (95% CI: 5.8–8.7). Among women, the lowest incidence of low-trauma fracture was 11.5 (95% CI: 8.5–15.1) in Halifax and the highest was 18.5

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(95% CI: 14.6–23.3) in Calgary, compared with an overall incidence of 15.3 (95% CI: 14.1–16.7). The regional variation in low-trauma fractures was similar to variation in hip fracture incidence among women (Pearson correlation, $r=0.46$ to 0.76) but not men ($r=-0.06$ to 0.05). We noted significant geographic variation in the prevalence of low BMD, as defined by BMD T -score -2.5 , however this variation was not directly related to low-trauma fractures or other risk factors. Furthermore, a model including age, BMD, falls, vertebral deformity, and prior clinical fracture was a good predictor of geographic variation of low-trauma fracture incidence in both men ($r=0.66$) and women ($r=0.84$).

Conclusions—For both men and women, the burden of low-trauma fracture is not related to the prevalence of osteoporosis as defined by BMD, but is related to a more comprehensive assessment of fracture risk including the following: age, BMD, falls, prior fracture, and vertebral deformity.

Keywords

Osteoporosis; Low-trauma fracture; Epidemiology; Canada; Age; Men; Women; Hip fracture; Vertebral fracture; Falls; Bone mineral density; Risk factors; Geographic variation

Introduction

Vertebral and non-vertebral fracture rates are known to vary between populations world wide [1–3] with countries of northern Europe having the highest fracture rate [4,5]. For example, the age-adjusted rate of hip fracture in women is reported to be 10 times greater in Sweden than in Poland or Malta [6], and the incidence of vertebral compression fracture in men and women is greater in Sweden than in the rest of Europe [7].

Within North America, Canada is categorized as having “high” fracture risk, similar to Great Britain, whereas the United States is categorized as having “very high” risk, similar to the Scandinavian countries and Iceland [5]. The difference in fracture risk between the United States and Canada is based on the observation that bone mineral density (BMD) declines with age are greater in American women compared to Canadian women [8]. It is not known whether similar associations may be found when comparing different regions within Canada. This information is critical to guide appropriate screening and public health interventions.

Substantial cultural and demographic variation exists across Canada. Estimates of incident hip fracture rates in Canada are based on surveillance data [9] and there is some indication of variation in the age-adjusted rates both within and between provinces. However, there are no published data on the geographic variation of BMD across Canada, nor are there data on the association between geographic variation in hip fractures and BMD values. BMD is known to predict hip fracture. A meta-analysis using 12 cohort studies [10] showed that the gradient of risk for hip fracture is 2.07 (95% CI 1.91–2.24); hence variation in BMD might contribute to the geographic variation in hip and other fractures. Alternatively, there may be other, more important risk factors that contribute to the geographic variation in fracture rate. For example, geographic variation in fracture incidence found in the European Prospective Osteoporosis Study (EPOS) was more attributable to variation in falls than to variation in BMD [11].

The objective of our study was to determine the geographic variation of known risk factors for fracture, specifically, BMD, previous low-trauma fracture, fall history, and prevalent vertebral deformity and the relationship of this geographic variation to the variation of incident low-trauma fracture.

Materials and methods

Subjects

The study sample consists of participants in an on-going cohort study, the Canadian Multicentre Osteoporosis Study (CaMos), who were at least 50 years old at baseline interview or before the eighth annual follow-up. CaMos is a large population-based cross-sectional and longitudinal study of community-dwelling Canadian men and women. There were a total of 9423 (2884 men, 6539 women) participants at baseline, of which 8577 (2484 men, 6093 women) were eligible for the present study.

The methodological details of the study have been described elsewhere [12]. Briefly, eligible participants were at least 25 years at the beginning of the study, lived within a 50-kilometer radius of one of nine Canadian cities (St John's, Halifax, Quebec City, Toronto, Hamilton, Kingston, Saskatoon, Calgary, and Vancouver) and were able to converse in English, French, or Chinese. Households were randomly selected from a list of residential phone numbers and participants were selected from eligible household members using standard protocol. Of those selected, 42% agreed to participate and had baseline interview. Ethics approval was granted through McGill University and the appropriate ethics review boards for each participating center.

Data collection

All participants completed a standardized interviewer-administered questionnaire (CaMos questionnaire ©1995) at baseline. The questionnaire covered demographics, health, nutrition, lifestyle, as well as a history that included a detailed history of fracture and major risk factors for fracture. Participants underwent a baseline clinical assessment that included measurement of height, weight, bone mineral density (BMD), and for those older than 50, a lateral lumbar and thoracic spine X-rays. Vertebral deformities were assessed from X-rays by a trained technologist using vertebral morphometry [13]. Follow-up of participants was done irrespective of any information gathered at baseline. Participants were informed of their baseline BMD status but were not excluded on this basis of the results. Subjects also remained in the study irrespective of whether or not therapy was initiated. Follow-up visits were scheduled the third year (1998–99) for participants between 40 and 60 years old and the fifth year (2000–01) for all participants regardless of age. These visits also included an interviewer-administered questionnaire, height and weight measurements, and BMD testing. In addition, a self-administered fracture questionnaire was sent to all participants in all other years on the anniversary of enrollment. The analyses in this paper include fracture outcomes occurring before the eighth annual follow-up (2003–04).

Bone mineral density

Bone mineral density was measured at the lumbar spine (L1–L4), femoral neck, trochanter, Ward's triangle, and total hip. Seven centers used Hologic densitometers and two centers used Lunar densitometers. All Lunar measurements were converted to equivalent Hologic values using standard reference formulas: lumbar spine and femoral neck [14], total hip, trochanter, Ward's triangle [15]. Scans were reanalyzed to insure proper positioning of the regions of interest. A single European spine phantom was circulated across study sites and the measurements were used to calibrate machines. A threshold of 1.5% was used for between-center corrections. The resulting corrections reduced measurements in Halifax (2.18%) and St. John's (2.49%) and increased measurements in Vancouver (2.33%), Saskatoon (2.44%) and Toronto (2.96%). A machine-specific phantom local to each site was measured at the beginning of each day. The threshold for longitudinal change was defined as 1% difference from calibration point and seven of the nine machines remained within the limits. Hamilton and Toronto both needed a one-time correction. Hamilton measurements were reduced by 1.5% starting in January 1998 and Toronto measurements were increased by 0.85% starting in September 1997.

Fracture assessment

Self-reported incident fractures were identified by yearly postal questionnaire or scheduled interview at Year 3 and Year 5. Further information concerning the fracture was gathered using a structured interview which included items on date, fracture site, circumstances leading to fracture, X-ray, and medical treatment. We classified fractures by skeletal site and considered low-trauma fractures as those that occurred without trauma, or as a result of a fall from standing height or less. Summary estimates of low-trauma fracture did not include fractures of the skull, hands or feet.

Statistical methods

We performed separate analyses for men and women. We classified age as a categorical variable with age divided into categories by five-year age bands. We calculated the incidence for each stratum separately based on the total number of first events within the eight-year study period and the person-time at risk. We calculated summary incidence rates and prevalence using age-standardization based on the sex-specific Canadian 2001 census population. We computed confidence intervals for incidence rates based on the inverse gamma distribution rather than using the normal approximation, to account for the low number of events in the defined strata [16]. We used Pearson correlation coefficients (denoted by r) to compare geographic variation of incidence and prevalence after age-standardization. Pearson correlation coefficients were also used to compare geographic variation of incidence to surveillance data. We used a Cox model to study relationship between variation in the distribution of risk factors for fracture and low-trauma fracture incidence. Person-time for this analysis included the period from entry time (latest date: study enrollment or 50th birthday) to exit time (earliest date: low-trauma fracture event, death, loss to follow-up, or 95th birthday). We included the following covariates in our model: BMD, falls in the month prior to baseline, prevalent low-trauma fracture at baseline, and vertebral deformity; and adjustment for age was made by choosing age (with delayed

entry) as the variable for the time axis [17]. Geographic variation was assessed further using a Cox model with random effects (shared frailty) for center. Models with random effects permit the underlying risk to differ by subgroup and are used when certain subgroups might share common unmeasured risk factors [11]. All analyses were performed with Stata (version 9.2).

Results

The baseline characteristics of the 2484 men and 6093 women in the study population are shown in Table 1. There were 54 men and 88 women who had no follow-up fracture questionnaire. Men with no follow-up fracture questionnaire were on average 8.2 (95% CI: 4.8–11.5) years older, 2.6 (95% CI: 0.6–4.6) cm shorter, and weighed 6.7 (95% CI: 2.9–10.5) kg less, but had similar mean BMD compared with those included in the study. Women with no follow-up fracture were on average 8.9 years older (95% CI: 6.6–11.2), 2.3 cm shorter (95% CI: 0.9–3.7), weighed 5.3 kg less (95% CI: 2.0–8.6), and had on average 0.08 (95% CI: 0.05–0.11) g/cm² lower total hip BMD compared with those included in the study. The incident fracture analysis was based on the remaining 2430 men and 6005 women with eligible person-time at risk. There were also 297 men and 527 women who had eligible person-time but who were under 50 years at baseline and so were not included in the baseline risk factor analysis, but were included in the incident fracture analysis.

The difference of the center-specific age-standardized mean BMD from the overall age-standardized mean BMD is shown in Table 2 (total hip) and Table 3 (lumbar spine). For the total hip, the significantly positive differences and hence highest age-standardized means were in Saskatoon, Toronto, and Kingston for both men and women, and the significantly negative differences and hence the lowest age-standardized means were in Quebec (men) and Halifax (women). For the lumbar spine, the significantly positive differences and hence the highest age-standardized means were in Toronto and Kingston (men and women) and Hamilton (women only), and the significantly negative differences and hence the lowest age-standardized means were in Calgary and Quebec (men and women) and St. John's (women only).

The center-specific age-standardized prevalence of low BMD (as defined by lumbar spine or femoral neck BMD *T*-score ≤ -2.5), fall history (in month prior to baseline), prior low-trauma fracture (after age 40), and vertebral deformity (of grade 2 or more) is shown in Figs. 1 and 2. The center variation in the prevalence of low BMD mirrors the pattern of mean BMD with the highest prevalence in the centers with low mean BMD and vice versa. For men, the regional variation in the prevalence of low BMD was concordant with the regional variation in vertebral deformity ($r=0.34$), but not with the regional variation in prior low-trauma fracture ($r=0.02$) or fall history ($r=-0.13$). For women, the regional variation in the prevalence of low BMD was not concordant with the regional variation in prevalence of fall history ($r=-0.31$), prior low-trauma fracture ($r=-0.34$), or vertebral deformity ($r=-0.07$).

There were 119 men and 611 women with incident low-trauma fracture during the eight-year study period. Among men, the most common fracture sites were ribs ($n=42$), wrist/forearm ($n=20$), hip ($n=20$), and upper arm/shoulder ($n=15$). Among women, the most

common fracture sites were wrist/forearm ($n=173$), ribs ($n=94$), back ($n=85$), and hip ($n=79$).

Fracture incidence stated below is given per 1000 person-years of follow-up. The overall age-standardized incidence of low-trauma fractures was 7.2 (95% CI: 5.8–8.7) among men and 15.3 (95% CI: 14.1–16.7) among women. Incidence of low-trauma fracture by sex and age group is shown in Fig. 3. For men, there was a moderate exponential trend of increasing incidence with age from 3.3 (95% CI: 1.5–7.4) in the 50–55 age group to 24.1 (95% CI: 14.6–41.6) in the 85+age group. For women, there was a marked exponential trend of increasing incidence with age from 2.8 (95% CI: 1.5–5.3) in the 50–55 age group to 50.3 (95% CI: 40.1–63.0) in the 85+age group.

Age-standardized incidence of low-trauma fracture by sex and center is shown in Fig. 4. Among men, the lowest age-standardized incidence was 3.2 (95% CI: 1.1–7.5) in Quebec and the highest was 11.9 (95% CI: 7.1–18.6) in Calgary. Among women, the lowest age-standardized incidence was 11.5 (95% CI: 8.5–15.1) in Halifax and the highest was 18.5 (95% CI: 14.6–23.3) in Calgary. To assess whether geographic variation in incident fracture noted in our study reflects underlying variation in the Canadian population we compared our results to surveillance data. Observed variation in low-trauma fracture incidence from CaMos is similar to the geographic variation in hip fracture incidence available from the Canadian Institute for Health Information (CIHI) surveillance data for the years 2001–2003 [9] for women, but not for men. The Pearson correlation of between CaMos and CIHI point estimates for region specific incidence among women ranged from $r=0.46$ to $r=0.76$. In contrast, the correlation between CaMos and CIHI point estimates among men ranged from $r=-0.06$ to $r=0.05$.

For both men and women, the regional variation in the incidence of low-trauma fracture was not concordant with the regional variation in the prevalence of osteoporosis defined by BMD T -score ($r=-0.19$ for men, $r=0.00$ for women), but was concordant with the regional variation in the prevalence of fall history ($r=0.78$ for men, $r=0.58$ for women), prior low-trauma fracture ($r=0.60$ for men, $r=0.58$ for women), or vertebral deformity ($r=0.71$ for men, $r=0.50$ for women).

The joint contribution of risk factors to the geographic incidence of fracture for men and women was assessed using Cox proportion hazards models. The first set of models included variables for age, BMD, previous low-trauma fracture, fall history, and vertebral deformity, but no variables for possible center effect. There was a positive association between the observed number of fractures within each center and the number of fractures predicted by the model for both men ($r=0.65$) and women ($r=0.83$). Models with random effects were used to further assess the contribution of the risk factors. For a model including only age, the estimated random effects parameter was 0.094 ($p=0.026$) in men and 0.008 ($p=0.171$) in women, where the p -value indicated is for likelihood ratio test. For a model including age and BMD, the estimated random effects parameter was 0.124 ($p=0.013$) in men and 0.024 ($p=0.017$) in women. Including additional risk factors (previous fracture, fall history, and vertebral deformity) reduced the estimated random effects parameter to 0.063 ($p=0.161$) in men and to 0.009 ($p=0.209$) in women. Use of antiresorptive therapy was also assessed in

post hoc analyses, and estimates random effects parameters were similar after inclusion of this variable.

Discussion

There was modest variation of BMD by center or geographic location. The variation was larger than regional variation found in the U.S. [18], but smaller than geographic variation found within Norway, Mexico, Japan [19–21] or across Europe [22]. As expected, regional variation in the prevalence of osteoporosis (as defined by BMD *T*-scores ≤ -2.5) was related to underlying differences in the distribution of BMD. Possible explanations for the geographic variation include genetic determinants, differences in sun exposure and water fluoridation, differences in demographic and lifestyle variables, and measurement bias. We undertook several quality control measures to limit measurement bias including cross-calibration with a European Spine Phantom, but this may not accurately reflect in-vivo measurement bias [23].

It might be expected that the geographic variation of other risk factors associated with low-trauma fracture would be similar to the variation in osteoporosis defined by low BMD, but in many cases, they were not. Results from the European Prospective Osteoporosis Study (EPOS) have reported that BMD is related to vertebral deformity and that population geographic variation in vertebral deformity is partially explained by variation in BMD measurements [24,25]. While BMD was a predictor of vertebral deformity in this study, the geographic variation of BMD was not concordant with the geographic variation of vertebral deformity in women and only weakly concordant in men. The poor concordance between BMD and vertebral deformity may be due to the relatively low percentage of radiographs from which to assess vertebral deformity and resulting limited power to assess geographic variation of vertebral deformity. Another likely alternative is that other parameters of bone strength not captured by BMD, such as bone geometry and bone microarchitecture, influence risk of deformity.

Not surprisingly, we found that the geographic variation in BMD was unrelated to falls; consistent with EPOS results [11,26]. We did however find that falls were an independent risk factor for fracture and that there was a strong association between the geographic variation in falls and geographic variation of both prevalent and incident low-trauma fracture, which supports the concept that falls are an important determinant of geographic variation of fracture and may be an underappreciated risk factor in regions with very high rates of fracture. Possible sources of geographic variation in falls include genetic variation leading to variation in upper body sway, fall height, and vitamin D status, variation of nutrition and lifestyle variables, and finally variation of snow and ice conditions. As the fall frequency appears to be a contributing factor to geographic variation of fracture, further enquiry into the contributing factors for falls is necessary.

Our study demonstrated that the association between fracture rate and age was stronger in women than men. This result is consistent with prior studies that have reported that fracture rates are similar for 50-year old men and women but diverge with increasing age with a much higher fracture rate in older women [27,28]. Many factors may contribute to the

increased differences between sexes in fracture rates with ageing, including differences in bone strength [29,30], propensity to fall [26], and the load placed on the bone [31]. The gradient of fracture risk by age varies not only by sex, but also by skeletal site [28,32]. Of note, we used a composite outcome combining fractures occurring at different skeletal sites, and as such, we cannot comment on the relationships between age, sex and skeletal site.

The magnitude of the geographic variation of fractures within CaMos was smaller than noted in previous international studies [2,5,11,25], but comparable to the magnitude of variation found in other North American studies [33,34]. The pattern of geographic variation in incident low-trauma fracture was similar to the pattern of prevalent low-trauma fracture for both men and women. The variation in low-trauma fracture is also consistent with hip fracture surveillance data among women, but not men. The concordance between incident low-trauma fracture results and surveillance data suggest that even though the test of heterogeneity was above the traditional threshold ($p=0.05$), we cannot conclude there is no heterogeneity. Moreover, it is plausible that the observed differences reflect differences in the Canadian population. The discordance between incident low-trauma fractures and hip fracture surveillance data in men may be due to the smaller sample size in our study and event rate in men or possibly bias, notably selection, or retention bias. It is also possible that different fracture types (i.e. hip fracture vs. non-hip fracture) do not have the same underlying pattern of geographic variation. Of note, we were unable to assess geographic variation of hip fracture rates within the CaMos sample due to small numbers.

The geographic variation we observed in BMD leads to geographic variation in the prevalence of osteoporosis as determined by the BMD T -score. This is of great concern, as regions with high prevalence of men and women with BMD T -score -2.5 do not have a corresponding high rate of fracture. One approach to the discrepancy between BMD T -scores and fracture incidence is to consider the BMD T -score used in conjunction other risk factors for fracture, such as age and prior fracture. We found that consideration of other risk factors, in addition to BMD, increases the concordance between regions of high estimated risk with regions with high rates of fracture. This observation is further supported by the random effects analysis assessing the center-specific underlying fracture risk. The addition of falls, prior fracture, and vertebral deformity reduces the random effect parameter by nearly 50% in men and over 60% in women. Our population level findings reinforce what has been noted at the patient level; the addition of clinical risk factors other than BMD improves the prediction of fractures [35]. Furthermore, nomograms have been developed that incorporate age, BMD, and prior fracture, and falls in assessing fracture risk [36]. Calculating fracture risk using a set of clinical risk factors has the advantage of targeting treatment for those at highest risk of fracture. Such strategies must be assessed in view of the possible changes in the population considered at high risk of fracture [37].

Our study has several strengths. It is based on a large randomly-selected population-based prospective cohort of men and women sampled from a wide geographic area encompassing 40% of the Canadian population. In addition, the predictors used in this analysis were systematically assessed at baseline and Year 5, and supplemented by annual fracture questionnaires. Further, it was possible to compare our estimates of incident low-trauma fracture with surveillance hip fractures estimates over the same time period.

Our study had some limitations. We did not exclude participants who may have had low BMD or who were on antiresorptive therapy. However excluding participants on the basis of risk factors or use of therapy would have created a population not representative of the underlying population, and would likely have altered the pattern of geographic variation. Although large biases resulting from these inclusions could have changed the underlying pattern of geographic variation observed in our sample, the regional variation noted in our sample for women was similar to the hip fracture variation in the Canadian population as a whole, suggesting that large biases did not occur. For men the variation was in fact different than surveillance data, and this may have been the result of bias.

Recruitment rates varied by center and this may introduce selection bias; however, previous analysis suggests little bias for most of the age range [38]. Fractures outcomes were based on self-reported fractures, and this implies potential mechanisms of additional ascertainment bias provided there were between-center differences in fracture questionnaire response rates. The limited number of fractures in men results both in large uncertainty in the underlying center-specific fracture rates, and limited power to ascertain the source of the differences. Finally, the cohort only included those who were community-dwelling residents at the time of recruitment, and cannot be generalized the entire population.

In summary, we found modest regional variation in fracture incidence across Canada, which was notably not related to BMD, but was related to other risk factors for fracture. Our findings highlight the importance of developing a more comprehensive assessment of risk factors when making treatment and policy decisions and indicate that the set of risk factors should include, at the least, BMD, falls, prior fracture, and vertebral deformity.

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Fig. 1.
Age-standardized center-specific prevalence of selected risk factors at baseline interview (1995–96) among CaMos men.

Fig. 2.
Age-standardized center-specific prevalence of selected risk factors at baseline interview (1995–96) among CaMos women.

Fig. 3.

Incidence of low-trauma fracture per 1000 person-years by age group among CaMos men and women during eight years of follow-up (1995–2004). The upper limits of the 95% confidence intervals are indicated by error bars.

Fig. 4.

Age-standardized incidence of low-trauma fracture per 1000 person-years by center among CaMos men and women during 8 years of follow-up (1995–2004). The upper limits of the 95% confidence intervals are indicated by error bars. The results of model-based likelihood ratio tests of heterogeneity were $p=0.026$ for men and $p=0.171$ for women.

Table 1

Baseline characteristics of CaMos participants who were at least 50 years old and had follow-up data during study period ending at eighth annual follow-up (2003–04)

	<u>Men (N=2484)</u>		<u>Women (N=6093)</u>	
	Mean	(SD)	Mean	(SD)
Age (years)	64.0	10.9	65.1	10.5
Height (cm)	173.0	7.1	159.4	6.5
Weight (kg)	81.4	14.0	68.6	13.8
Total hip BMD (g/cm ²)	1.00	0.15	0.85	0.14
Lumbar spine BMD (g/cm ²)	1.05	0.17	0.93	0.17
	<i>n</i>	(%)	<i>N</i>	(%)
Prevalent fracture	127	5.1	637	10.5
Previous falls	162	6.5	401	6.6
Corticosteroid use	273	11.0	894	14.7
Antiresorptive use	8	0.3	1744	28.6
Tobacco use	421	16.9	835	13.7
Alcohol use	1773	71.4	3291	54.0
Vertebral deformity				
Normal	1098	44.2	2847	46.7
Grade 1	249	10.0	626	10.3
Grade 2	132	5.3	422	6.9
Missing data	1005	40.5	2198	36.1

Difference between center specific and overall age-standardized mean total hip BMD (g/cm^2) among CaMos participants ages 50 and over at baseline (1995–96)

Table 2

Center	Men		Women	
	Difference	95% CI	Difference	95% CI
Vancouver	-0.017	-0.036	0.002	-0.014
Calgary	-0.001	-0.019	0.018	-0.015
Saskatoon	0.029	0.008	0.049	0.004
Hamilton	-0.014	-0.034	0.007	-0.009
Toronto	0.062	0.042	0.083	0.011
Kingston	0.024	0.003	0.045	0.002
Quebec	-0.043	-0.063	-0.023	-0.024
Halifax	0.003	-0.017	0.022	-0.035
St. John's	-0.020	-0.042	0.001	-0.026

Difference between center specific and overall age-standardized mean lumbar spine BMD (g/cm^2) among CaMos participants ages 50 and over at baseline (1995–96)

Table 3

Center	Men		Women	
	Difference	95% CI	Difference	95% CI
Vancouver	-0.020	-0.043	0.002	-0.012
Calgary	-0.046	-0.067	-0.022	-0.035
Saskatoon	0.019	-0.004	0.006	-0.009
Hamilton	0.016	-0.004	0.022	0.006
Toronto	0.051	0.025	0.027	0.007
Kingston	0.041	0.014	0.038	0.020
Quebec	-0.038	-0.061	-0.028	-0.043
Halifax	0.005	-0.016	-0.002	-0.016
St. John's	-0.012	-0.036	-0.028	-0.043