The contributions of First Nations ethnicity, income, and delays in surgery on mortality post-fracture: A population based analysis.

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Keywords: Ethnicity; North American; Fracture; Income; Mortality

Word count: Manuscript: 3,593 Abstract: 250 Mini abstract: 50

Mini Abstract

We examined the independent contributions of First Nations ethnicity and lower income to post-fracture mortality. A similar relative increase in mortality associated with fracture appears to translate into a larger absolute increase in post-fracture mortality for First Nations compared to non-First Nations peoples. Lower income also predicted increased mortality post-fracture.

Abstract

*Purpose:*First Nations peoples have a greater risk of mortality than non-First Nations peoples. We examined the independent contributions of First Nations ethnicity and income to mortality post-fracture, and associations with time to surgery post-hip fracture.

*Methods:*Non-traumatic fracture cases and fracture-free controls were identified from population-based administrative data repositories for Manitoba, Canada(aged ≥50years). Populations were retrospectively matched for sex, age(within 5years), First Nations ethnicity, and number of co-morbidities. Differences in mortality post-fracture of hip, wrist or spine, 1996-2004(Population 1, n=63,081), and the hip, 1987-2002(Population 2, n=41,211) were examined using Cox proportional hazards regression to model time to death. For hip fracture, logistic regression analyses were used to model the probability of death within 30 days and one year.

*Results:*Population 1: First Nations ethnicity was associated with an increased mortality risk of 30-53% for each fracture type. Lower income was associated with an increased mortality risk of 18-26%. Population 2: lower income predicted mortality overall(OR 1.15, 95%CI 1.07-1.23) and for hip fracture cases(OR 1.18, 95%CI 1.05-1.32), as did older age, male sex, diabetes and >5 co-morbidities(all $p \leq 0.01$). Higher mortality was associated with pertrochanteric fracture(OR 1.14, 95%CI 1.03-1.27), or surgery delay of 2-3 days(OR 1.34, 95%CI 1.18-1.52) or ≥4 days(OR 2.35, 95%CI 2.07-2.67).

*Conclusion:*A larger absolute increase in mortality post-fracture was observed for First Nations compared to non-First Nations peoples. Lower income and surgery delay >2 days predicted mortality post-fracture. These data have implications regarding prioritization of health care to ensure targeted, timely care for First Nations peoples and/or individuals with lower income.

Introduction

An increased likelihood of mortality following a fracture of the hip or spine is well-documented (1), with significantly reduced one-year survival rates following hip fracture (2, 3). The Canadian Constitution recognizes three groups of Aboriginal (Indigenous or Native) peoples — First Nations ("Indians"), Métis and Inuit. First Nations peoples are the largest group of Aboriginal peoples in Canada. First Nations peoples have nearly twice the odds of experiencing a hip or spine fracture and three times greater likelihood of experiencing a wrist fracture compared to non-First Nations peoples (4). However, for First Nations peoples, distinctive factors exist which influence mortality risk post-fracture, including the heavy burden of medical and social problems (4, 5), and the greater rate of trauma-related fractures compared to non-First Nations peoples (4). Furthermore, First Nations peoples differ in terms of socioeconomic status, area of residence, and diabetes prevalence from non-First Nations peoples; factors of which are known to be associated with fractures of the hip (6-9).

There is a well-documented inverse association between social disadvantage and most causes of morbidity (10-12), and various lifestyle factors known to increase the risk of fracture are more consistently observed in those of greater social disadvantage, for instance poor diet, smoking and physical inactivity (13). In addition, socially disadvantaged individuals are less likely to undergo testing for poor bone health (14), increasing the likelihood that individuals of greater social disadvantage will remain untreated to prevent a fragility fracture. A further risk factor for earlier mortality post-fracture is the provision of timely health care. It is well-documented that an international 'osteoporosis care gap' exists (15, 16), and Canadian studies from Manitoba (17) and the Province of Quebec (18) reported that ~79% of patients received no intervention post-fragility fracture. Given that a hip fracture leads to an overall reduction in survival of 10-20% in the first 12 months, with excess deaths occurring primarily within the first 6 months (19), it is imperative that timely health care is provided post-fracture in the context of absolute increased mortality-risk. First Nations peoples have a higher baseline mortality risk than non-First Nations peoples, suggesting that First Nations peoples should have a proportionately amplified attention to timely health care. However, we have previously documented that First Nations peoples are eight times less likely to receive post-fracture treatment within six months post-fracture compared to non-First Nations peoples (20). Whilst the World Health Organization (WHO)

acknowledges that the socio-environmental determinants of mortality are not easy to unravel (21), it is imperative that the contribution of First Nations ethnicity and income to mortality post-fracture is understood. Given these considerations, we examined the contributions of First Nations ethnicity and lower income to mortality post-fracture of the hip, wrist, or spine, and the role played by delays in surgery post-hip fracture.

Materials and methods

Study Design:

We performed a retrospective case-control study matched for sex, age (within 5 years), First Nations ethnicity, and the number of Aggregated Diagnosis Groups (ADGs) in the year prior to case fracture as a measure of co-morbid conditions, to examine differences in mortality after non-traumatic fracture of (i) the hip, wrist or spine between 1 April 1996 and 31 March 2004 (Study Population 1, n=63,081), and (ii) the hip between 1 April 1987 and 31 March 2002 (Study Population 2, n=41,211), among First Nations and non-First Nations residents of Manitoba aged ≥50 years. Population 1 was divided into subgroups according to fracture type (hip, wrist or spine) to examine post-fracture mortality according to site. To improve power for analyses specific to hip fracture (e.g,. cervical versus pertrochanteric), Population 2 used 15 years of data whereas Population 1 used 8 years of data. Anonymized population-based administrative health data were extracted from the data repository housed at the Manitoba Centre for Health Policy (MCHP) at the University of Manitoba, Canada (22, 23). First Nations ethnicity was primarily determined from the Canadian Government's 1994-1999 Status Verification System maintained by the First Nations and Inuit Health Branch and Indian and Northern Affairs Canada, with the presence of a treaty status code in the Manitoba Health Registry file providing a secondary indicator of First Nations ethnicity (24, 25). This study was reviewed and approved by the Health Research Ethics Board for the University of Manitoba, the Health Information Privacy Committee of Manitoba Health, and the Health Information Research Committee of the Assembly of Manitoba Chiefs.

Data Sources and Fracture Case Identification for Study Populations 1 and 2:

Virtually all provincially reimbursed physician services and hospitalizations in Manitoba are recorded with patient demographics, and the date and type of service. During the time period of this study, diagnoses were coded using the International Classification of Disease-9th revision-Clinical Modification (ICD-9-CM). An encrypted personal identifier allows for linkage across data sets and the creation of person-specific longitudinal records of health service utilization. Validated fracture definitions were applied as previously published (4, 26). Annual medical records between 1 April 1987 and 31 March 2004 (the time period of which incorporated data for both Study Populations 1 and 2) were assessed for the presence of ICD-9-CM fracture codes involving the hip (with site specific fracture fixation code); forearm (with site specific fracture fixation or casting code); or clinical spine (without cord injury). High-trauma fractures, such as those related to transport injuries or motor vehicle accidents, were identified from external injury "E" codes and subsequently excluded from this analysis. A detailed list of the ICD-9-CM codes used for each type of fracture is available from the authors.

Mortality:

All mortality data were ascertained from the Manitoba Health provincial registry, which incorporates records of each resident's demographic information (including age, sex, six-digit postal code of residence, birth dates, dates of health insurance coverage, and reason for coverage termination) for those registered under the universal healthcare system for the province of Manitoba. Regular updates to the registration system are made through a data exchange with Vital Statistics.

Variables:

Area of residence (urban capital [Winnipeg], rural south of 53 degrees latitude, and rural north of 53 degrees latitude) and mean household income quintiles were defined as previously described (4, 26). Mean household income for dissemination areas, the smallest geographic unit for which Census data are made available, was obtained from Canada census public use files (2001 Census for Study Population 1, and 1996 Census for Study Population 2) and subsequently used to

define quintiles (five groupings of ~20% of the population in each which are assigned an income quintile grouping from 1 to 5, stratified separately for urban and rural residency) (27). For analytical purposes these were combined as quintiles 1-2 (lowest income quintiles) and 3-5 (highest income quintiles; reference category) as previously described (28).

The Johns Hopkins ACG(r) Case-Mix System (version 8) was used to develop an index of co-morbidity (29-31). This system has been previously validated by the MCHP to predict premature mortality and use of medical services in Manitoba (32, 33). ADGs represent 32 co-morbidity clusters of ICD-9-CM diagnostic codes. Depending upon the variety of ICD-9-CM codes an individual receives over a period of one year, the number of ADGs can range from 0 to 32. The number of ADGs were categorized as none (reference category), 1-2, 3-5 and >5 as previously published (20, 28).

Diabetes was also considered as a specific diagnosis since there is a higher prevalence and attributable risk percent for fracture among First Nations than non-First Nations peoples (34). The presence of current diabetes was based upon two physician office visits or a single hospitalization with a diagnosis of diabetes (ICD-9-CM code 250) in a three-year period (35), and subjects were categorized as diabetic prior to fracture. Records for the preceding five calendar years were used to sub-classify diabetics as long term (more than 5 years prior to fracture) and short term (less than five years prior to fracture) as previously described (36).

Statistical Analysis:

Descriptive analyses were conducted using means, standard deviations, frequencies, and percentages. Univariate associations between ethnicity and other variables were investigated using chi-squared tests of independence. Cox proportional hazards regression was used to model time to mortality post-fracture of the hip, wrist or spine. Multiple logistic regression analysis was used to model the probability of mortality one year and 30 days (results not displayed) post-fracture for the hip fracture cases and controls, and for the hip fracture cases only; both models using 1997-2002 as the index date. Predictor variables for both models were First Nations ethnicity and lower income quintile. Confounding covariates included age (based on 10-year

groups), gender, area of residence, diabetes diagnosis, and number of ADGs. We included age, sex and number of ADGs (none, 1-2, 3-5 and >5) (the latter variable only for models examining Study Population 2) as covariates in the models even though cases and controls had been matched for these factors, because these covariates are key predictors of mortality. The subgroup analysis of Study Population 2, which was restricted to hip fracture cases only, also included the covariates of fracture period (denoted as 1992-97 and 1987-92 versus 1997-2002), time to surgery (2-3 days or >4 days versus <2 days following fracture), and site of hip fracture (pertrochanteric versus cervical). For the Cox models, interactions between time to fracture and First Nations ethnicity were tested and none were statistically significant. All models converged. All analyses were performed using the PHREG and LOGISTIC procedures of SAS Releases 9.1 (Study Population 1) and 8.2 (Study Population 2) (SAS Institute Inc., Cary, NC), and a p-value of <0.05 was considered statistically significant for all analyses.

Results

Study Population 1:

A total of 15,792 fracture cases (26.2% hip, 52.0% wrist, 21.7% spine) were identified from 1996-2004 for this study population. Females comprised 71% of the study population and 5% (718) of all incident fractures occurred in First Nations peoples. The mean age (SD) at time of hip fracture was 64.8 (10.9) years for First Nations peoples and 73.4 (11.9) years for non-First Nations peoples. Descriptive statistics of the cases and controls, stratified by First-Nations ethnicity, are presented in Table 1. Compared to non-First Nations peoples, those of First Nations ethnicity had a lower prevalence of fractures at the spine (14.9% versus 22.1%, p<0.0001) and hip (23.8% versus 26.4%, p=0.13), but had a greater prevalence of wrist fracture (61.3% versus 51.6%, p<0.0001).

Relationships between First Nations ethnicity, income and time to death post-fracture at the hip, wrist and spine, accounting for the confounding covariates noted previous, are presented in Table 2. All fracture sites were associated with higher subsequent mortality risk; this association was greater with hip fracture ([Hazard Ratio (HR) 95% confidence intervals (95%CI)] HR 1.89,

95%CI 1.80-1.99) and vertebral fracture (HR 1.75, 95%CI 1.64-1.87) than with wrist fracture (HR 1.11, 95%CI 1.04-1.17). Older age, male sex, diagnosed diabetes, greater numbers of ADGs, income, and being of First Nations ethnicity were all significant predictors of higher mortality risk. No interactions were observed between First Nations ethnicity and fracture status at the hip (p=0.21), wrist (p=0.31), or spine (p=0.69). First Nations ethnicity was associated with an increased mortality risk of 37% for hip fracture (HR 1.37, 95%CI 1.16-1.62), 53% for wrist fracture (HR 1.53, 95%CI 1.31-1.79), and 30% for vertebral fracture (HR 1.30, 95%CI 1.01-1.67). HRs for First Nations ethnicity were similar when analyses were limited to the fracture cases, and were also similar for males and females in sex-stratified models. Lower income was associated with an increased mortality risk of 18% for hip and vertebral fracture (HR 1.18, 95%CI 1.11-1.26, HR 1.18, 95%CI 1.09-1.29, respectively), and 26% for wrist fracture (HR 1.26, 95%CI 1.18-1.35).

Study Population 2:

A total of 41,211 hip fractures were identified from 1987-2002; females comprised 71% of the study population and 3% of fractures occurred in First Nations peoples. Descriptive characteristics for the hip fracture cases and matched controls are presented in Table 3. Table 4 presents the logistic regression model for mortality one year post-hip fracture, including adjustment for the year period of fracture. Lower income was a significant predictor of mortality one year post-hip fracture ([Odds ratio (OR) 95% confidence intervals (95%CI)] OR 1.15, 95%CI 1.07-1.23). Similar to Study Population 1, no interactions were seen between First Nations ethnicity and fracture status (p=0.48). Older age, male sex, current diabetes and >5 ADG were all significant predictors of mortality (all $p \leq 0.01$). Furthermore, sustaining a fracture between the years of 1987-92 (versus 1997-2002) increased the odds of mortality (OR 1.20, 95%CI 1.10-1.31). When examining mortality 30 days post-hip fracture, results were similar, although lower income was not statistically significant (OR 1.16, 95%CI 0.98-1.38).

A subgroup analysis was performed in the hip fracture cohort (n=10,367) to further investigate factors influencing mortality within one year for cases, with specific interest in the contribution of time to surgery. Results are presented in Table 4. Covariates independently predicting

mortality in the fracture cohort were similar to those observed for the full cohort, and included lower income, older age, male sex, diabetes, and >5 ADG (all $p \leq 0.01$) but not First Nations ethnicity ($p=0.17$). Sustaining a pertrochanteric fracture (OR 1.14, 95% CI 1.03-1.27), time to surgery of 2-3 days (OR 1.34, 95%CI 1.18-1.52) or ≥4 days (OR 2.35, 95%CI 2.07-2.67) were also significant predictor of mortality.

Discussion

Given that First Nations peoples have a higher baseline mortality compared to non-First Nations peoples, a similar relative increase in mortality associated with fracture appears to translate into a larger absolute increase in post-fracture mortality. Lower income and surgery times of >2 days are predictors of an increased mortality risk post-fracture. Given these data, it appears that there are three independent effects on mortality post-fracture; the first two factors of which are located at the patient level (First Nations ethnicity, and lower income), and the third factor is located at the level of health care provision (time to surgery). We discuss each factor in turn, and speculate as to the implications of these data regarding the prioritization of health care delivery.

It is well-documented that mortality risk is higher for First Nations peoples compared to non-First Nations peoples, with the age-standardized ratio approximately 3:1 (37). Clearly, without appropriate and effective treatment post-fracture, and a health care gap which remains unchanged since 1991-8 (15), First Nations peoples will remain at greater absolute risk of mortality post-fracture. Taken in context with the heavy burden of medical and social problems experienced by First Nations peoples (5) and the documented greater rate of trauma (accidental and non-accidental) compared to non-First Nations peoples (4) (factors both resulting in a greater rates of fracture for First Nations peoples), we suggest that the prioritization of health care delivery toward these patients is urgently required to address inequities in mortality risk. Since establishment of the Manitoba Bone Density Program (38), there has been a focus toward building capacity within the Manitoba health sector, including the recent establishment of a notification system to enhance post-fracture care (39).

Despite Canada having a publicly accessible health care system, individuals of lower income experience an increased mortality risk of between 18-26% post-fracture; suggesting that unidentified mechanisms underlying the association between lower income and increased mortality risk post-fracture may exist. Given that the causal pathway between income and mortality is not linear, we speculate that individuals with lower income experience differential exposures and vulnerabilities to poorer health outcomes compared to those of greater income. For instance, economic hardship may result in differential exposures to mortality including poorer housing, residing in an area of environmental pollution or degradation, or less immediate access to a physician (most rural First Nations communities do not have on-site physicians), whilst differential vulnerabilities to mortality may include factors such as existing co-morbidities resulting in a higher absolute, and disproportionate, burden of mortality risk for those with lower income compared to those with greater income. Furthermore, lower income is often conflated with First Nations ethnicity; introducing much complexity when elucidating the risk of mortality post-fracture. Whilst the World Health Organization (WHO) acknowledges that the socio-environmental determinants of mortality are not easy to unravel (21), identifying the contribution of factors such as First Nations ethnicity and income to mortality post-fracture are imperative in order to inform policy formulation or review, and to respond to the call for action from the WHO Commission for the Social Determinants of Health (CSDH). In the final report from the WHO CSDH, released in 2009, Member States (which includes Canada) were urged to "… generate new, or make use of existing, methods and evidence, tailored to national contexts in order to address the social determinants and social gradients of health and health inequities" (action number 8) and "…develop, make use of, and if necessary, improve health information systems and research capacity in order to monitor and measure the health of national populations, with disaggregated data such as…ethnicity…[and] income…so that health inequities can be detected…" (action number 9) (21). Our current data argues for equity in post-fracture care by targeting efforts toward those of lower income; the underlying argument is one of the fundamental differences between equality and equity (11, 12). Furthermore, we suggest our findings provide an important contribution to the field of osteoporosis and fracture research, and may be relevant to other populations in addition to the Canadian context.

As discussed in the context of the increased mortality risk for First Nations peoples, improving the post-fracture care gap should also involve reducing time to surgery (15, 20). We have previously applied an evaluative framework to post-fracture care of First Nations peoples compared to non-First Nations peoples (20); a tool which examines the domains of reach, effectiveness, adoption, implementation and maintenance (RE-AIM) (40-42), and enables reflection on how best to promote post-fracture health care processes which are based on health care policies. We maintain our previously published suggestion for attention to be directed toward modifiable organization practice and policies (for instance time to surgery as examined in this current study), and also that health policy might be revised to ensure efficacy and equity of post-fracture care for First Nations peoples; an issue which gains further importance given our current results concerning the contribution of First Nations ethnicity and lower income to absolute mortality risk post-fracture. Our study showed that a delay in surgery of 4 or more days post-fracture resulted in nearly a 2.5 fold increase in the likelihood of mortality. Thus, in context of a higher baseline mortality rate for those of First Nations, and a clear inverse association between mortality and social disadvantage, we suggest that these data have implications for health care providers to ensure that timely care is prioritized for those of First Nations ethnicity and/or with lower income.

Our study has some limitations. First, we were unable to account for the cumulative effects of economic disadvantage; an issue which is important when considering sustained economic disadvantage over time and the impact this plays on the likelihood of mortality post-fracture. However, we suggest that this may increase the strength of the association we observed between reduced time to mortality and lower income, and perhaps with First Nations ethnicity. Second, the use of administrative health data limits our ability to determine the reason for fracture, some reasons of which may increase the risk of mortality compared to other reasons for fracture. Third, we also acknowledge that mortality associated with First Nations ethnicity, income and health-care delivery factors represents a complex, multifactorial relationship which is unlikely to be reduced to a single policy solution. However, that issue therefore provides strong rationale for a multidisciplinary approach to dialogue and cooperation among diverse public policy sectors to consider the social determinants of mortality in order to inform the revision of policies and future multidisciplinary action (21). Fourth, we were unable to accurately assess cause of death in our

data sources. Similarly, our administrative data cannot identify other factors potentially relevant to fracture incidence, recovery and mortality such as nutrition, obesity, smoking, alcohol use, physical activity and medications dispensed from First Nations community nursing stations. This does not affect our conclusions but limits our ability to determine the mechanisms contributing to higher mortality among First Nations peoples. Finally, in Study Population 1, our First Nations fracture cases were younger than our non-First Nations fracture cases, meaning that we speculate as to the larger absolute excess mortality in First Nations peoples. Our study also has some strengths. Ours are the first data to specifically examine the contribution of First Nations ethnicity, lower income, and delays in surgery to mortality post-fracture of the hip, wrist, or spine. We used a national population-based database which spans many years, and our analyses were based on robust numbers of patients and person-years.

In conclusion, and given that First Nations peoples have a higher baseline mortality compared to non-First Nations peoples, a similar relative increase in mortality associated with fracture appears to translate into a larger absolute increase in post-fracture mortality. Lower income and surgery times of >2 days are predictors of an increased mortality risk post-fracture. We suggest that these factors are located at the levels of the individual, and of health care service delivery, with the likelihood of both levels being interrelated. Targeted efforts should be directed towards First Nations peoples and patients with lower income to improve their level of care post-fracture and thereby impact positively upon their higher baseline risk of mortality. Our findings have clear implications regarding the (re)prioritization of health care service delivery, and we suggest, as an imperative, that further work examines (i) how best to promote the needs of those at greatest risk of mortality post-fracture, and (ii) time to surgery post-fracture and whether time can be effectively reduced, especially for those of First Nations ethnicity and patients with lower income.

Acknowledgements

The authors acknowledge the Manitoba Centre for Health Policy for use of data contained in the Population Health Research Data Repository (HIPC project # 2000/2001-08). The authors are indebted to the First Nations and Inuit Health Branch, and Aboriginal Affairs and Northern Development Canada, for permission to use the Status Verification System, and to the Health Information Research Committee of the Assembly of Manitoba Chiefs for actively supporting this work. The results and conclusions are those of the authors and no official endorsement by the Manitoba Centre for Health Policy, Manitoba Health, the Assembly of Manitoba Chiefs, or other data providers is intended, or should be inferred. This article has been reviewed and approved by the members of the Manitoba Bone Density Program Committee.

Funding

This research was funded through an operating grant (ACB-65731) from the Canadian Institutes of Health Research (CIHR). Sharon L Brennan was funded by a National Health and Medical Research Council (NHMRC) of Australia Early Career Fellowship (#1012472). Lisa M Lix was funded by a University of Saskatchewan Centennial Chairs Program.

Competing interests

Sharon L Brennan: No competing interests.

William D Leslie: Research grants from Merck Frosst Canada, Amgen Pharmaceuticals Canada, and Genzyme Canada, research honoraria and educational grants from Sanofi-Aventis, Procter & Gamble Pharmaceuticals Canada, and Novartis, and involvement with Advisory Boards for Genzyme Canada, Novartis, and Amgen Pharmaceuticals Canada.

Heather J. Prior: No competing interests.

Lisa M. Lix: Research grant from Amgen Pharmaceuticals Canada

Colleen Metge: Research grant from Amgen Pharmaceuticals Canada

Brenda Elias: No competing interests.

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Table 1: Descriptive characteristics of Study Population 1 stratified by First Nations ethnicity

	Cases			**Controls**		
	Non-First Nations	*First Nations*	*p-value*	*Non-First Nations*	*First Nations*	*p-value*
	N=15,074	N=718		N=45,154	N=2,135	
	n (%)	n (%)		n (%)	n (%)	
Fracture site						
Hip	3,974 (26.4)	171 (23.8)	0.13	-	-	
Wrist	7,776 (51.6)	440 (61.3)	**<0.0001**	-	-	
Vertebral	3,324 (22.1)	107 (14.9)	**<0.0001**	-	-	
Income quintile						
Quintile 1 (lower income)	3,535 (23.5)	452 (63.0)	**<0.0001**	9,520 (21.1)	1,278 (59.9)	**<0.0001**
Quintile 2	3,494 (23.2)	92 (12.8)	**<0.0001**	10,785 (23.9)	306 (14.3)	**<0.0001**
Quintile 3	3,385 (22.5)	84 (11.7)	**<0.0001**	9,915 (22.0)	252 (11.8)	**<0.0001**
Quintile 4	2,434 (16.1)	58 (8.1)	**<0.0001**	7,829 (17.3)	183 (8.6)	**<0.0001**
Quintile 5 (higher income)	2,004 (13.3)	22 (3.1)	**<0.0001**	6,731 (14.9)	88 (4.1)	**<0.0001**
Missing	222 (1.5)	10 (1.4)	0.86	374 (0.8)	28 (1.3)	**0.02**
Age group (years)						
50-59	2,484 (16.5)	271 (37.7)	**<0.0001**	7,550 (16.7)	843 (39.5)	**<0.0001**
60-69	2,919 (19.4)	223 (31.1)	**<0.0001**	8,703 (19.3)	637 (29.8)	**<0.0001**
70-79	4,376 (29.0)	136 (18.9)	**<0.0001**	13,340 (29.5)	409 (19.2)	**<0.0001**
80+	5,295 (35.1)	88 (12.3)	**<0.0001**	15,561 (34.5)	246 (11.5)	**<0.0001**
Female	10,612 (70.4)	484 (67.4)	0.09	31,773 (70.4)	1,436 (67.3)	**0.002**

Region of residence						
Urban	8,941 (59.3)	202 (28.1)	**<0.0001**	26,188 (58.0)	459 (21.5)	**<0.0001**
Rural North	267 (1.8)	279 (38.9)	**<0.0001**	759 (1.7)	844 (39.5)	**<0.0001**
Rural South	5,866 (39.0)	237 (33.0)	**0.001**	18,207 (40.3)	832 (39.0)	0.21
Diabetes status						
None	12,978 (86.1)	395 (55.0)	**<0.0001**	38,944 (86.2)	1,222 (57.2)	**<0.0001**
Short term	630 (4.2)	69 (9.6)	**<0.0001**	2,126 (4.7)	243 (11.4)	**<0.0001**
Long term	1,466 (9.7)	254 (35.4)	**<0.0001**	4,084 (9.0)	670 (31.4)	**<0.0001**
Numbers of ADGs						
None	1,187 (7.9)	56 (7.8)	0.94	3555 (7.9)	166 (7.8)	0.87
1-2	3,847 (25.5)	152 (21.2)	**0.01**	11,527 (25.5)	448 (21.0)	**<0.0001**
3-5	5,688 (37.7)	213 (29.7)	**<0.0001**	17,049 (37.8)	637 (29.8)	**<0.0001**
>5	4,352 (28.9)	297 (41.4)	**<0.0001**	13,023 (28.8)	884 (41.4)	**<0.0001**

ADGs =Aggregated Diagnosis Groups (comorbidity index). The p-values indicate differences for First Nations versus non-First Nations peoples. Statistically significant p-values in boldface.

Table 2: Hazard ratio (HR) and 95% confidence intervals (CI) for predicting time to mortality post-fracture at the hip, wrist and spine in Study Population 1

	Hip		**Wrist**		**Vertebral**	
	HR (95%CI)	*p*-value	HR (95%CI)	*p*-value	HR (95%CI)	*p*-value
Non-First Nations ethnicity	1.00 (ref)		1.00 (ref)		1.00 (ref)	
First Nations ethnicity	1.37 (1.16-1.62)	**0.0002**	1.53 (1.31-1.79)	**<0.0001**	1.30 (1.01-1.67)	**0.04**
Non-fracture Control	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Fracture Case	1.89 (1.80-1.99)	**<0.0001**	1.11 (1.04-1.17)	**0.001**	1.75 (1.64-1.87)	**<0.0001**
Higher income	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Lower income	1.18 (1.11-1.26)	**<0.0001**	1.26 (1.18-1.35)	**<0.0001**	1.18 (1.09-1.29)	**<0.0001**
50-59 years	1.00 (ref)		1.00 (ref)		1.00 (ref)	
60-69 years	1.64 (1.28-2.12)	**0.0001**	2.29 (2.02-2.60)	**<0.0001**	2.10 (1.71-2.58)	**<0.0001**
70-79 years	3.21 (2.54-4.05)	**<0.0001**	4.90 (4.35-5.51)	**<0.0001**	4.31 (3.57-5.21)	**<0.0001**
80+ years	8.48 (6.75-10.66)	**<0.0001**	14.92 (13.29-16.75)	**<0.0001**	11.46 (9.53-13.79)	**<0.0001**
Male	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Female	0.67 (0.63-0.70)	**<0.0001**	0.61 (0.58-0.65)	**<0.0001**	0.68 (0.63-0.72)	**<0.0001**
Urban (Winnipeg)	1.00 (ref)		1.00 (ref)		1.00 (ref)	

Rural North	1.26 (1.00-1.59)	0.05	1.25 (1.00-1.55)	**0.05**	1.17 (0.83-1.63)	0.37
Rural South	1.05 (0.97-1.13)	0.20	1.10 (1.01-1.19)	**0.02**	1.07 (0.97-1.17)	0.17
No diabetes	1.00 (ref)		1.00 (ref)		1.00 (ref)	
Short term diabetes	1.14 (1.02-1.28)	**0.02**	1.43 (1.28-1.59)	**<0.0001**	1.21 (1.05-1.38)	**0.007**
Long term diabetes	1.48 (1.38-1.58)	**<0.0001**	1.97 (1.83-2.12)	**<0.0001**	1.59 (1.45-1.73)	**<0.0001**
No ADG	1.00 (ref)		1.00 (ref)		1.00 (ref)	
1-2 ADGs	1.09 (0.97-1.23)	0.16	0.96 (0.85-1.10)	0.58	1.15 (0.92-1.43)	0.23
3-5 ADGs	1.13 (1.01-1.27)	**0.04**	1.06 (0.93-1.20)	0.40	1.31 (1.06-1.62)	**0.01**
> 5 ADGs	1.45 (1.29-1.62)	**<0.0001**	1.41 (1.24-1.60)	**<0.0001**	1.62 (1.31-2.00)	**<0.0001**
First Nations*Fracture Interaction	-	0.21	-	0.62	-	0.39

ADG =Aggregated Diagnosis Groups (comorbidity index). Statistically significant (α = .05) p-values are in boldface.

Table 3: Descriptive characteristics of Study Population 2

	Hip fracture cases	**Matched controls**
	N=10,367	N=30,844
	n (%)	**n (%)**
First Nations ethnicity	351 (3.4)	994 (3.2)
Income		
Quintile 1 (lower income)	3,090 (29.8)	8,811 (28.6)
Quintile 2	2,608 (25.2)	7,668 (24.9)
Quintile 3	2,054 (19.8)	6,310 (20.5)
Quintile 4	1,332 (12.8)	4,110 (13.3)
Quintile 5 (higher income)	964 (9.3)	3,336 (10.8)
Missing	319 (3.1)	609 (2.0)
Age group (years)		
<50	383 (3.7)	1,201 (3.9)
50-59	488 (4.7)	1,448 (4.7)
60-69	1,214 (11.7)	3,725 (12.1)
70-79	3,090 (29.8)	9,348 (30.3)
80+	5,192 (50.1)	15,122 (49.0)
Female	7,357 (71.0)	21,870 (70.9)
Region of residence		
Urban	6,206 (59.9)	18,381 (59.6)
Rural North	288 (2.8)	872 (2.8)
Rural South	3,873 (37.4)	11,591 (37.6)
Diabetic	1,285 (12.4)	3,061 (9.9)
Numbers of ADGs		
None	652 (6.3)	3,266 (10.6)

1-2	2,203 (21.3)	8,420 (27.3)
3-5	3,778 (36.4)	11,676 (37.9)
>5	3,734 (36.0)	7,482 (24.3)
*Mortality**		
Within 30 days of fracture	469 (4.5)	146 (0.5)
Within 1 year of fracture	1,835 (17.7)	1,880 (6.1)

ADGs =Aggregated Diagnosis Groups (comorbidity index).

* Based on the index date of 1997-2002

Table 4: Odds ratio (OR) and 95% confidence intervals (CI) for predicting mortality one year post-hip fracture in Study Population 2, according to ethnicity and income, and the year and site of fracture, and surgery delay

	Hip fracture cases and controls (n=41,211)		**Hip fracture cases only (n=10,367)**	
	OR (95%CI)	*p-value*	OR (95%CI)	*p-value*
Non-First Nation ethnicity	1.00 (ref)	-	1.00 (ref)	-
First Nation ethnicity	1.04 (0.75-1.46)	0.80	0.77 (0.53-1.12)	0.17
Higher income	1.00 (ref)	-	1.00 (ref)	-
Lower income	1.15 (1.07-1.23)	**0.0003**	1.18 (1.05-1.32)	**0.004**
Non-Fracture Case	1.00 (ref)	-	1.00 (ref)	-
Fracture Case	3.28 (3.05-3.53)	**<0.0001**	-	-
<50 years	1.00 (ref)	-	1.00 (ref)	-
50-59 years	3.81 (1.97-7.40)	**<0.0001**	2.61 (1.25-5.46)	**0.01**
60-69 years	5.44 (2.94-10.07)	**<0.0001**	4.01 (2.06-7.79)	**<0.0001**
70-79 years	11.66 (6.40-21.25)	**<0.0001**	7.62 (4.01-14.47)	**<0.0001**
80+ years	27.00 (14.85-49.08)	**<0.0001**	14.50 (7.66-27.47)	**<0.0001**
Male	1.00 (ref)	-	1.00 (ref)	-
Female	0.53 (0.49-0.57)	**<0.0001**	0.44 (0.40-0.50)	**<0.0001**
Urban	1.00 (ref)	-	1.00 (ref)	-
Rural North	1.02 (0.78-1.33)	0.89	0.92 (0.62-1.36)	0.67
Rural South	0.95 (0.88-1.02)	0.17	0.98 (0.87-1.09)	0.68
No diabetes	1.00 (ref)	-	1.00 (ref)	-
Current diabetes	1.51 (1.37-1.68)	**<0.0001**	1.54 (1.32-1.79)	**<0.0001**

No ADGs	1.00 (ref)	-	1.00 (ref)	-
1-2 ADGs	0.99 (0.84-1.16)	0.91	0.91 (0.70-1.18)	0.47
3-5 ADGs	1.14 (0.98-1.32)	0.10	0.95 (0.74-1.23)	0.71
> 5 ADGs	1.67 (1.43-1.94)	**<0.0001**	1.36 (1.06-1.74)	**0.01**
Fracture year 1997-2002	1.00 (ref)	-	1.00 (ref)	-
Fracture year 1992-97	1.08 (0.99-1.18)	0.07	0.92 (0.81-1.04)	0.19
Fracture year 1987-92	1.20 (1.10-1.31)	**<0.0001**	0.96 (0.84-1.09)	0.54
Time to surgery <2 days	-	-	1.00 (ref)	-
Time to surgery, 2-3 days	-	-	1.34 (1.18-1.52)	**<0.0001**
Time to surgery, 4+ days	-	-	2.35 (2.07-2.67)	**<0.0001**
Cervical fracture	-	-	1.00 (ref)	-
Pertrochanteric fracture	-	-	1.14 (1.03-1.27)	**0.01**
First Nations*Fracture Interaction	-	0.48	-	

ADG =Aggregated Diagnosis Groups (comorbidity index). Statistically significant ($\alpha = .05$) p-values are in boldface

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Title:
The contributions of First Nations ethnicity, income, and delays in surgery on mortality post-fracture: a population-based analysis

Date:
2013-04-01

Citation:
Leslie, W. D., Brennan, S. L., Prior, H. J., Lix, L. M., Metge, C. & Elias, B. (2013). The contributions of First Nations ethnicity, income, and delays in surgery on mortality post-fracture: a population-based analysis. OSTEOPOROSIS INTERNATIONAL, 24 (4), pp.1247-1256. https://doi.org/10.1007/s00198-012-2099-2.