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# Oral health and its determinants among elderly immigrant Canadians

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**Abstract**
**Objective:** To compare the self-reported oral health status of elderly immigrant to Canadian-born (non-immigrant) seniors in Canada.
**Materials and Methods:** This was a secondary data analysis of publicly available data from the 2008/09 Canadian Community Health Survey: Healthy Aging component (CCHS-HA). The sample consisted of 30,865 people aged 45 years and above. The outcome was self-reported oral health. We used predisposing (age, sex, marital status, immigrant status, time since immigration, smoking, alcohol use), enabling (education, household income, dental insurance, social support), need (self-reported health) and behavioural variables (brushing, physician and dentist visits) to compare the oral health status between immigrant and non-immigrant elders. Descriptive statistics and binary logistic regression were performed.
**Results:** 16.9% of elderly immigrants reported fair to poor self-rated oral health compared to 10.5% non-immigrants. The predictors influencing fair to poor oral health among immigrant and non-immigrant elders varied. Significant predictors for immigrant elders included age, gender, marital status, education, income and physician visits. For non-immigrant seniors, last dental visit, income and education played a role in how oral health status was reported.
**Conclusion:** An increasing influx of immigrants-coupled with an increasingly aging population, including elderly immigrants-has important public health policy implications. Policy approaches that incorporate oral health education, dental screening, awareness raising, and community-based initiatives in immigrant-concentrated areas would be beneficial when targeting the low-socio-economic status elderly immigrant population.

**Keywords:** Oral health, elderly immigrant Canadians, dental screening, awareness raising

## Introduction
An aging population-or shift in the age distribution of the population toward old age-is a current and pressing concern of governments in many high-income countries, including Canada. Recent data shows that seniors now represent a more significant share of Canada's population than children (16.9% vs. 16.6%, respectively) [1]. An aging population and lower fertility rates have also resulted in net immigration being responsible for most of Canada's population growth [2]. The 2016 census showed that 21.9% of Canadians report being or having been an immigrant or permanent resident.[3] More immigrant families are bringing their parents into Canada, as well [3]. Consequently, senior Canadians are becoming more diverse, as immigrants age in Canada and as increasing numbers of immigrants are older upon arrival [3]. These immigrant seniors have unique needs, and it is necessary to identify ways to maintain or improve the health and oral health of this steadily growing group.

Comprehensive information on immigrants' general health is available, and the literature shows that recent immigrants to Canada can enjoy better health than the general population, a phenomenon called "the healthy immigrant effect [4-9]. Yet immigrant health can also deteriorate post-arrival to levels equal to or worse than Canadian-born [4-9] Very few studies have examined the oral health of immigrants to Canada, and even fewer on the elderly [10-13]. These studies suggest that immigrants have a higher rate of oral disease, which may lessen with longer residency in Canada [8].

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Conversely, other studies have shown that immigrants arrive with better oral health status, which can deteriorate post-migration [12].

Factors that may worsen elderly immigrants' oral health include immigration policies and features of the Canadian dental care system, which excludes most socially marginalized groups [8, 13] For example, integration into Canadian society has its challenges and can be difficult, much less the fact that the use of dental services in Canada has long been considered discretionary, with little provision for publicly funded care. As a result, treatment for many seniors can be sporadic and sparse [14]. Recent analyses have shown that immigrants have more self-reported untreated dental conditions, untreated periodontal disease, less dental insurance coverage, and more self-reported cost barriers to dental care than people born in Canada [16-18].

Sex, income, social status, employment and working conditions, health practices, social and physical environments, and culture are some of the broader social determinants affecting the health of Canadians [19]. These factors may have a greater effect on immigrants, as they are more likely to experience a lower socioeconomic status (SES) than the Canadian-born (non-immigrant) population [8]. Similar income-and-education gradients, in both oral and general health, have also been shown. The relationship between income/education and oral health-with people of lower SES having poorer oral health [20] -results in different exposures and vulnerabilities for immigrants. One recent study, for instance, showed that immigrants had poorer oral health than Canadian-born, and that ethnicity, low income and lack of dental insurance were predictors of unmet dental care needs [21]. Yet, another study of a mixed sample of immigrants and Canadian-born respondents found that better-educated respondents were more likely than their counterparts to report dental problems [22].

In summary, the elderly immigrant population will likely continue to grow in Canada, with their own unique oral health-related needs, and dental care policy should take such needs into consideration. Since very little information is available on the oral health of senior immigrants, this study is thus timely, as it investigates differences between elderly immigrants' and non-immigrants' oral health status, and the various determinants that affect the oral health status of each group. Its findings have implications for dental care policies that aim to improve the oral health of older Canadians in general and older immigrant populations in particular.

## Methods
### Conceptual Framework
The conceptual framework used in this study is a modified version of Andersen's Healthcare Utilization model (Figure 1). This framework defines variables-classed as predisposing (demographics, immigrant status), enabling (income, education, insurance, social support), need (health status) and behavioural (toothbrushing, physician visits, dental visits)-that influence the oral health of immigrant seniors [23-25].
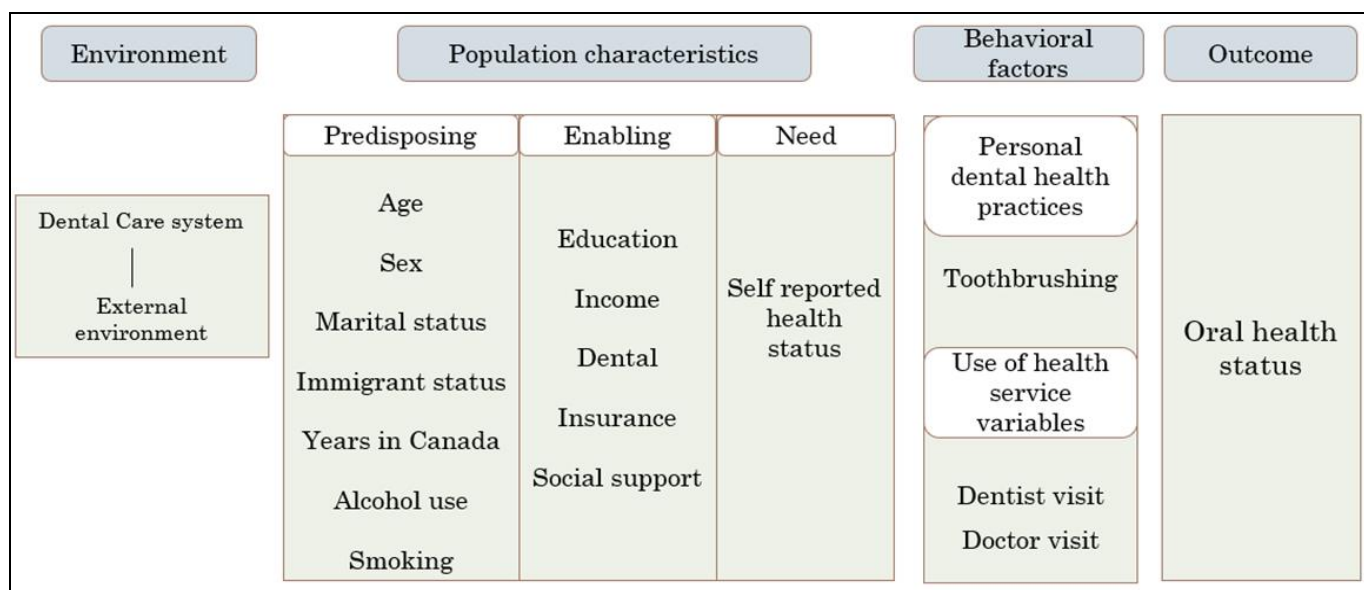


**Fig 1:** Conceptual framework of the study

### Data Source
This study uses data from the 2008/09 Canadian Community Health Survey: Healthy Aging component (CCHS-HA) component, a cross-sectional survey administered by Statistics Canada. The CCHS-HA comprised of people aged 45 and older, and examined various factors that impact healthy aging: general health and well-being, physical activity, use of health-care services, social participation, and the work and retirement transitions of people above the age of 45 [26]. In this analysis, the immigrant population excludes non-permanent residents, persons born outside Canada, people living in institutions, full-time members of the Canadian Armed Forces, and residents of the three territories, Aboriginal reserves, Crown lands, and some remote regions. No ethical review was sought for the study, as this was a secondary data analysis of anonymous data that contained no personal identifiers, nor that was linked to any other data source. The tri-council policy statement regarding ethical conduct for research involving humans states that "REB review is not required for research that relies exclusively on secondary use of anonymous information, or anonymous human biological materials, so long as the process of data linkage or recording or dissemination of results does not generate identifiable information [27].

### Study Variables
### Dependent Variables
Self-reported oral health (SROH) is the outcome measure used to measure oral-health status. SROH is a convenient, cost-effective indicator used in the assessment of oral-health

status, and reflects each individual's oral-health status and needs [28]. In the CCHS, SROH is operationalized as: "In general, would you say the health of your mouth is? SROH was measured using a five-point Likert scale, and dichotomized into "excellent /very good /good" and "fair/ poor.

## Exposure Variables
One exposure variable is used in this study: "immigrant status." This is coded as 0 = no (reference), 1 = yes.

## Other Predisposing Variables
Other predisposing variables include age, sex, marital status, alcohol frequency, "smoking," and "time in Canada since immigration." We have included four categories for marital status ranging from "married" (reference) through "single", while sex is coded as "male" and "female" (reference). Age is measured as 45 to 54 years (reference), 55 to 64 years, 65 to 74 years, 75 to 84 years, and 85 years and above. Smoking status was defined by the question: "At the present time, do you smoke cigarettes daily, occasionally, or not at all?" and was dichotomized into "yes" (daily/occasional/always occasional) and "no" (former daily/former occasional) (reference). The frequency of drinking alcohol-is categorized into "regular," "occasional," and "non-drinker" (reference). For the variable "time in Canada since immigration," the coding is 0 to 19 years, 20 to 29 years, 30 to 39 years, 40 to 49 years, and 50 years and above.

## Enabling and Disabling Variables
"Enabling variables" refers to resources or means that allow individuals to obtain services, as well as resources or means that may impede service use. These include "dental insurance," "education," "social support," and "household income." The variable-household income is coded from 1 ("less than $20,000 / year") through 5 ("$80,000 and above"), while the coding for education ranges from "less than secondary," through "post-secondary graduate degree." To assess social support, we use the variables "have someone to take them to a doctor" and "have someone to help them understand a situation." The variable "have someone to take them to a doctor" is coded as: "none of the time," "a little of the time" and "some of the time," "most of the time," and "all of the time." Similarly, for "have someone to help them understand a situation," the coding is: "none of the time," "a little of the time" and "some of the time," "most of the time," and "all of the time." For this study, The Medical Outcomes Survey Social Support Scale (MOS-SSS) is used to evaluate the amount of available social support according to individual perception.[29,30] Nineteen items that measure five dimensions of social support are included in the MOS-SSS: tangible support (minimum = 0, maximum = 16), emotional support (minimum = 0, maximum = 32), informational support (minimum = 0, maximum = 32), affection (minimum = 0, maximum = 12) and positive social interaction (minimum = 0, maximum = 16).

## Need Variable
Need was evaluated using the variable "self-reported health." Self-Reported Health is operationalized as: "In general, would you say your health is?" The variable was dichotomised into "excellent to good" and "fair to poor."

## Lifestyle (Behavioural) Variables
The coding for one behavioural variable "daily brushing" was dichotomised into "brushing twice / day or more" (reference) and "brushing less than twice / day." Dental-care utilization is based on the question: "When was the last time you saw a dental professional?" The coding for measurement ranges from "less than one year" to "never." For this study, we used the coding: "less than one year" (reference) and "more than one year." Health-care utilization is based on the question: "[Not counting when you were an overnight patient], in the past 12 months, have you seen or talked to any of the following health professionals about your physical, emotional, or mental health? A family doctor or general practitioner." The answers were coded as "yes" and "no."

## Statistical Analysis
Survey weights were used in all statistical calculations on the estimates produced from the CCHS-HA and represented close to 14 million people after weighting. Descriptive statistics and binary logistic regression were then performed on weighted data using IBM SPSS Statistics 23.0 software. First, the characteristics of the sample were described by conducting simple descriptive analyses. Further, to explore the association between categorical independent variables and categorical dependent variables, a chi-square test was performed. Additionally, binary and multivariable logistic regression was used to test the significant variables, to assess the independent association between the variables and outcomes. Differences between comparison groups were considered significant below the 5% level. The study utilized a full population model as well as a model stratified by immigration status (immigrant/non-immigrant).

## Results
### Descriptive Data
Table 1 presents sample characteristics for the population covered by CCHS-HA (aged 45 and above) in 2008/09. The majority share (38.5%) of participants were 45 to 54 years of age. Women represented 51.9% of the total population, 73.7% were married, 52.6% had post-secondary education, and more than half (55.6%) responded positively to having dental insurance. The majority (87.9%) said that they have excellent to good oral health and visited a dentist in the past year (67.2%).

Among the immigrant population, there was a higher percentage of immigrants in the oldest age group than in the youngest. Most immigrants (76.6%) reported being married and a slight majority (55.0%) reported having the highest level of educational attainment. A higher proportion of immigrants reported fair to poor self-rated oral health (16.9%), although most (71.2%) reported seeing a dentist in the previous year. Slightly less than half (49.1%) reported being uninsured for dental care. Among the Canadian-born population, 39.9% were between 45 to 54 years of age, 52.4% were women and the majority (72.4%) were married. A higher proportion of non-immigrants reported having excellent to good oral health (89.5%), although lower proportions visited dentist in the last year (65.8%) and more than half (57.2%) responded positively to having a dental insurance.

**Table 1:** Characteristics of the 2008/09 CCHS-HA population (aged 45+), stratified by immigrant status

| Determinant | Non-Immigrant | | Immigrant | | Total Population | |
|---|---|---|---|---|---|---|
| | N weighted (10,145770) | % | N weighted (3,307,606) | % | N weighted (13,635,506) | % |
| **Age** | | | | | | |
| 45 to 54 years | 4,049,546 | 39.9 | 1,121,243 | 33.9 | 5,247,633 | 38.5 |
| 55 to 64 years | 2,965,143 | 29.2 | 1,005,103 | 30.4 | 4,020,434 | 29.5 |
| 65 to 74 years | 1,723,279 | 17.0 | 657,757 | 19.9 | 2,40,7389 | 17.7 |
| 75 to 84 years | 1,065,527 | 10.5 | 387,327 | 11.7 | 1,468,364 | 10.8 |
| 85 and older | 342,275 | 3.4 | 136,176 | 4.1 | 491,687 | 3.6 |
| **Sex** | | | | | | |
| Male | 4,826,718 | 47.6 | 1,633,832 | 49.4 | 6,557,587 | 48.1 |
| Female | 5,319,052 | 52.4 | 1,673,774 | 50.6 | 7,077,919 | 51.9 |
| **Marital status** | | | | | | |
| Married / Common-law | 7,379,669 | 72.7 | 2,532,936 | 76.6 | 10,051,901 | 73.7 |
| Widowed | 975,696 | 9.6 | 354,849 | 10.7 | 1,353,035 | 9.9 |
| Divorced / Separated | 1,055,229 | 10.4 | 287,417 | 8.7 | 1,356,906 | 10.0 |
| Single | 734,241 | 7.2 | 132,258 | 4.0 | 872,413 | 6.4 |
| **Education** | | | | | | |
| < Secondary | 2,298,551 | 23.0 | 698,002 | 21.3 | 3,038,332 | 22.6 |
| Secondary | 1,982,278 | 19.8 | 646,606 | 19.8 | 2,664,487 | 19.8 |
| Other post-secondary | 538,498 | 5.4 | 128,511 | 3.9 | 670,114 | 5.0 |
| Post-secondary graduate | 5,189,619 | 51.8 | 1,799,618 | 55.0 | 7,082,043 | 52.6 |
| **Income** | | | | | | |
| < $20,000 | 834,949 | 9.7 | 271,080 | 10.4 | 1,111,197 | 9.8 |
| $20,000–39,999 | 1,719,146 | 19.9 | 581,405 | 22.2 | 2,308,986 | 20.5 |
| $40,000–59,999 | 1,541,883 | 17.9 | 529,259 | 20.2 | 2,078,532 | 18.4 |
| $60,000–79,999 | 1,465,958 | 17.0 | 357,553 | 13.7 | 1,827,910 | 16.2 |
| > $80,000 | 3,064,959 | 35.5 | 876,134 | 33.5 | 3,956,494 | 35.1 |
| **Dental insurance** | | | | | | |
| Yes | 5,792,983 | 57.2 | 1,681,832 | 50.9 | 7,575,743 | 55.6 |
| No | 4,337,937 | 42.8 | 1,620,896 | 49.1 | 6,037,789 | 44.4 |
| **Self-reported oral health** | | | | | | |
| Excellent / Very good / Good | 9,070,851 | 89.5 | 2,748,754 | 83.1 | 11,982,784 | 87.9 |
| **Fair / Poor** | 1,069,134 | 10.5 | 558,052 | 16.9 | 1,644,917 | 12.1 |
| **Last dentist visit** | | | | | | |
| Less than 1 year | 6,665,827 | 65.8 | 2,353,501 | 71.2 | 9,145,729 | 67.2 |
| More than 1 year | 3,459,489 | 34.2 | 949,725 | 28.8 | 4,461,589 | 32.8 |
| **Self-reported Health** | | | | | | |
| Excellent / Very good / Good | 8603667 | 84.8 | 2711940 | 82.1 | 11462343 | 84.1 |
| **Fair / Poor** | 1540151 | 15.2 | 592204 | 17.9 | 2167749 | 15.9 |
| **Daily Brushing** | | | | | | |
| More than twice/Twice/ day | 7081979 | 70.4 | 2525253 | 77.4 | 9730917 | 72.1 |
| Less than twice/ day | 2977894 | 29.6 | 737220 | 22.6 | 3768705 | 27.9 |

**Table 2:** Unadjusted and adjusted odds of reporting fair to poor oral health- Full population (N= 13,635,506)

| Determinants | Unadjusted full population | | | | Adjusted full population | | | |
|---|---|---|---|---|---|---|---|---|
| | Or | 95% ci of or | | P value | Adj or | 95% ci of or | | P value |
| | | L | R | | | L | U | |
| Immigrant (ref: non-immigrant) | 1.72 | 1.71 | 1.73 | <.001 | 1.83 | 1.82 | 1.84 | <.001 |
| **Age (ref:45-55)** | | | | | | | | |
| 55-64 | 0.99 | 0.99 | 1.00 | <.001 | .84 | .84 | .85 | <.001 |
| 65-74 | 0.81 | 0.80 | 0.82 | <.001 | .51 | .51 | .51 | <.001 |
| 75-84 | 1.02 | 1.01 | 1.03 | <.001 | .60 | .59 | .60 | <.001 |
| 85 and over | 1.34 | 1.00 | 1.02 | <.001 | .60 | .59 | .61 | <.001 |
| Sex- male (ref: female) | 1.22 | 1.21 | 1.22 | <.001 | 1.20 | 1.20 | 1.21 | <.001 |
| **Marital status (ref: single)** | | | | | | | | |
| Married | 0.67 | 0.66 | 0.67 | <.001 | 1.05 | 1.04 | 1.06 | <.001 |
| Widowed | 0.96 | 0.95 | 0.97 | <.001 | 1.02 | 1.01 | 1.04 | <.001 |
| Divorced/separated | 1.02 | 1.01 | 1.03 | <.001 | .95 | .95 | .96 | <.001 |
| **Education (ref: post-secondary)** | | | | | | | | |
| <secondary | 1.75 | 1.74 | 1.75 | <.001 | 1.12 | 1.11 | 1.12 | <.001 |
| Secondary | 1.21 | 1.20 | 1.22 | <.001 | .96 | .95 | .96 | <.001 |
| Other post-secondary | 1.25 | 1.24 | 1.26 | <.001 | 1.18 | 1.17 | 1.20 | <.001 |
| **Income (ref 80,000 and above)** | | | | | | | | |
| <20,000 | 3.34 | 3.31 | 3.40 | <.001 | 1.83 | 1.81 | 1.84 | <.001 |
| 20000-39,000 | 2.22 | 2.21 | 2.23 | <.001 | 1.71 | 1.70 | 1.72 | <.001 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 40,000-59,000 | 1.50 | 1.49 | 1.51 | <.001 | 1.33 | 1.33 | 1.34 | <.001 |
| 60,000-79,000 | 1.40 | 1.39 | 1.41 | <.001 | 1.33 | 1.32 | 1.34 | <.001 |
| Dental insurance- no (ref: yes) | 1.40 | 1.35 | 1.40 | <.001 | .96 | .96 | .97 | <.001 |
| Smoker (ref: non-smoker) | 2.18 | 2.17 | 2.19 | <.001 | 1.72 | 1.71 | 1.73 | <.001 |
| **Health (ref: excellent/very good/good)** | | | | | | | | |
| Fair/poor | 3.65 | 3.64 | 3.66 | <.001 | 3.07 | 3.05 | 3.08 | <.001 |
| Affectional support (ref: high) | 1.21 | 1.20 | 1.21 | <.001 | 1.26 | 1.25 | 1.27 | <.001 |
| Tangible support (ref: high) | 1.11 | 1.10 | 1.11 | <.001 | 1.12 | 1.11 | 1.12 | <.001 |
| Emotional/ information support (ref: high) | 1.21 | 1.21 | 1.22 | <.001 | 1.18 | 1.17 | 1.19 | <.001 |
| Visit doctor- no (ref: yes) | 1.30 | 1.29 | 1.31 | <.001 | 1.36 | 1.35 | 1.37 | <.001 |
| Dentist visit (ref: less than 1 year) | 1.87 | 1.86 | 1.88 | <.001 | 1.32 | 1.31 | 1.32 | <.001 |

## Logistic Regression Analyses

### Association of Predisposing Factors with Fair to Poor Oral Health

In the fully adjusted model, the likelihood of reporting fair to poor oral health increased for immigrants compared to non-immigrants (AOR=1.83; CI: 1.82-1.84). Men had a higher likelihood of reporting fair to poor oral health compared to women (AOR=1.20; CI: 1.20-1.21). All the age groups in the model showed lower likelihood of reporting fair to poor self-reported oral health. Those respondents who reported being married had a 5% higher likelihood of reporting fair to poor health (AOR=1.05; CI: 1.04, 1.06) compared to the respondents who were single.

After stratification by immigrant status and comparing to those aged 45 to 54 years, the likelihood of reporting oral health as fair or poor decreased as age increased, except for elderly immigrants. For elderly immigrants, there was a variable pattern with age, and their risk profile differed with age. Immigrants aged 55-64 had an 18% higher likelihood (AOR=1.18; CI: 1.17, 1.19) compared to those aged 45-54. Also, immigrant seniors aged 75 to 84 had 7% (AOR = 1.07; CI: 1.06-1.09) higher likelihood of reporting fair to poor oral health compared to the youngest age group. In the model, immigrant and Canadian-born men showed a higher likelihood of reporting their oral health as fair or poor (AOR=1.37; CI:1.36-1.38 versus AOR=1.13%; CI:1.13-1.14) compared to women. Also, irrespective of marital status, elderly immigrants had higher odds of reporting fair or poor oral health compared to elderly non-immigrants ("Married" AOR=2.21; CI:2.16- 2.25, "Widowed" AOR=2.15; CI:2.10-2.20). Among those who answered "yes" to smoking, elderly immigrants had a higher likelihood (AOR=1.68; CI:1.67-1.70) compared to non-immigrant seniors (AOR=1.67; CI:1.66-1.68) of reporting fair to poor oral health.

### Association of Enabling Factors with Fair to Poor Oral Health

Respondents in the adjusted full population model with less than secondary education had an increased likelihood (AOR=1.12; CI:1.11-1.12) of reporting fair or poor oral health compared to those with post-secondary degrees. The adjusted odds for income implied that the higher the income, the lower the likelihood of reporting fair or poor oral health. Participants whose household earned less than $20,000 annually had increased odds (AOR=1.83; CI:1.81-1.84) of fair to poor oral health compared to those who reported earning $80,000 and more. In the model, respondents without dental insurance had a lower likelihood (AOR=.96; CI:.96-.97) of reporting fair to poor oral health compared to those with dental insurance.

In the fully adjusted stratified model, elderly immigrants showed a positive trend, with the highest odds of reporting fair or poor oral health (AOR=1.38, CI:1.37-1.39) in the lowest level of education. For household income, elderly immigrants' in the less than $20,000 group (AOR=2.07; CI:2.04-2.10) had the highest likelihood of reporting fair to poor oral health, while those in the $40,000 to $59,999 group had the lowest likelihood of reporting fair to poor oral health compared to the reference group. Canadian-born seniors in the "$20,000 to $39,999" group had a 91% higher likelihood (AOR=1.91; CI:1.89-1.93) of reporting fair to poor oral health compared to the reference group. Elderly immigrants with low tangible social support had a higher likelihood (AOR=1.48; CI:1.46-1.49) of reporting fair to poor oral health compared to the reference group. Canadian-born seniors with low positive social interaction (AOR=1.30; CI:1.28-1.31), low emotional/ information social support (AOR=1.14; CI:1.13-1.15) and low affectional support (AOR=1.26; CI:1.25-1.27) had a higher likelihood of reporting fair to poor oral health compared to the reference groups.

### Association of Need Variables with Fair to Poor Oral Health

In the fully adjusted model, respondents reporting fair to poor health had higher odds (AOR=3.07; CI:3.05-3.08,) of reporting fair to poor oral health compared to the reference group. In the fully adjusted stratified model (Table 3), elderly immigrants who reported fair to poor health (AOR=3.14; CI:3.11-3.16) had the highest likelihood of reporting fair to poor oral health compared to the reference group.

**Table 3:** Adjusted odds of reporting fair to poor oral health stratified by immigration status (N= 13,635,506)

| Determinants | Non-immigrant | | | | Immigrant | | | |
|---|---|---|---|---|---|---|---|---|
| | Adj Or | 95% c.i. For or | | P value | Adj Or | 95% c.i. For or | | P value |
| | | Lower | Upper | | | Lower | Upper | |
| **Age (ref:45-54)** | | | | | | | | |
| 55-64 | .72 | .71 | .72 | <.001 | 1.18 | 1.17 | 1.19 | <.001 |
| 65-74 | .45 | .45 | .46 | <.001 | .64 | .64 | .65 | <.001 |
| 75-84 | .44 | .43 | .44 | <.001 | 1.07 | 1.06 | 1.09 | <.001 |
| 85 and over | .50 | .49 | .51 | <.001 | .87 | .85 | .89 | <.001 |
| **Marital status (ref: single)** | | | | | | | | |
| Married | .93 | .92 | .94 | <.001 | 2.21 | 2.16 | 2.25 | <.001 |
| Widowed | .91 | .90 | .92 | <.001 | 2.15 | 2.10 | 2.20 | <.001 |
| Divorced/separated | .89 | .88 | .90 | <.001 | 1.63 | 1.60 | 1.67 | <.001 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sex- male (ref: female) | 1.13 | 1.13 | 1.14 | <.001 | 1.37 | 1.36 | 1.38 | <.001 |
| **Education (ref: post-secondary)** | | | | | | | | |
| <secondary | 1.03 | 1.02 | 1.03 | <.001 | 1.38 | 1.37 | 1.39 | <.001 |
| Secondary | .92 | .91 | .92 | <.001 | 1.02 | 1.01 | 1.03 | <.001 |
| Other post-secondary | 1.27 | 1.26 | 1.28 | <.001 | .85 | .83 | .86 | <.001 |
| **Income (ref 80,000 and above)** | | | | | | | | |
| <20,000 | 1.77 | 1.76 | 1.79 | <.001 | 2.07 | 2.04 | 2.10 | <.001 |
| 20000-39,999 | 1.91 | 1.89 | 1.93 | <.001 | 1.34 | 1.33 | 1.36 | <.001 |
| 40,000-59,999 | 1.64 | 1.63 | 1.66 | <.001 | .85 | .84 | .86 | <.001 |
| 60,000-79,999 | 1.26 | 1.25 | 1.27 | <.001 | 1.63 | 1.61 | 1.65 | <.001 |
| Dental insurance- no (ref: yes) | .93 | .93 | .94 | <.001 | .99 | .99 | 1.00 | <.001 |
| Ss affection- low (ref: high) | 1.26 | 1.25 | 1.27 | <.001 | 1.24 | 1.23 | 1.26 | <.001 |
| Ss emotional/information- low (ref: high) | 1.14 | 1.13 | 1.15 | <.001 | .86 | .84 | .87 | <.001 |
| Ss positive social interaction- low (ref: high) | 1.30 | 1.28 | 1.31 | <.001 | 1.01 | .99 | 1.02 | 0.32 |
| Ss tangible- low (ref: high) | 1.00 | .99 | 1.01 | 0.52 | 1.48 | 1.46 | 1.49 | <.001 |
| **Alcohol (ref: non-drinker)** | | | | | | | | |
| Regular | .73 | .73 | .74 | <.001 | .90 | .89 | .91 | <.001 |
| Occasional | .92 | .91 | .92 | <.001 | 1.05 | 1.04 | 1.06 | <.001 |
| Brushing (ref: more than twice/twice) | | | | | | | | |
| Once/day/never | 1.42 | 1.41 | 1.43 | <.001 | 1.01 | 1.00 | 1.02 | .13 |
| Smoker (ref: non-smoker) | 1.67 | 1.66 | 1.68 | <.001 | 1.68 | 1.67 | 1.70 | <.001 |
| **Health (ref: excellent/ v.good/ good)** | | | | | | | | |
| Fair/poor | 2.98 | 2.96 | 2.99 | <.001 | 3.14 | 3.11 | 3.16 | <.001 |
| Visit doctor- no (ref: yes) | 1.26 | 1.25 | 1.27 | <.001 | 1.54 | 1.52 | 1.56 | <.001 |
| Dentist visit -more than 1 year (ref: < than 1 year) | 1.52 | 1.51 | 1.53 | <.001 | 1.00 | .99 | .98 | 1.00 |

**Association of Behavioural Variables with Fair to Poor Oral Health**

In the fully adjusted stratified model, for those who answered no to a physician visit in the past year, immigrant seniors had a 54% (AOR=1.54; CI:1.52-1.56) higher likelihood of reporting fair to poor oral health compared to those who answered yes. In the same model, for the question about the last dentist visit, elderly immigrants who had not visited a dentist in more than a year had the same likelihood of reporting fair or poor oral health, as those who saw a dentist less than a year previously. Conversely, Canadian-born seniors had 52% higher odds (AOR=1.52; CI:1.51-1.53) of reporting fair or poor oral health compared to the reference group. Also, in the model, non-immigrant seniors who brushed less than twice a day had more than 40% likelihood (AOR=1.42; CI: 1.41-1.43) of reporting fair to poor oral health.

To summarise, immigrant status, sex, education, income, affectional support, positive social interaction, tangible support, smoking status, self-reported health, physician and dentist visits were significant predictors of fair to poor oral health for the entire population. After stratification, we noticed that the predictors for immigrant and non-immigrant seniors to report fair to poor oral health were different. Elderly immigrants were influenced more by older age, marital status, sex, level of education, income, tangible support, smoking status, health status and by physician visits. The significant predictors for the non-immigrant seniors were income, education, affectional support, emotional/ informational support, positive social interaction, brushing and dental visits.

**Discussion**

In this study, we compared the oral-health status of elderly immigrants to Canadian-born seniors to identify differences in their oral-health status and predictors that influenced this status in both groups. The study identified immigrant status, gender, education, income, affectional support, positive social interaction, tangible support, smoking status, self-reported health, physician and dentist visits as significant predictors for the entire population. The data shows that different predictors influenced the reporting of fair to poor oral health among the immigrant and non-immigrant senior population. Significant predictors on how oral-health status was reported for elderly immigrants included older age, marital status, sex, level of education, income, tangible support, smoking status, health status and by physician visits. For non-immigrant seniors, income, education, affectional support, emotional/ informational support, positive social interaction, brushing and dental visits played a role in how oral-health status was reported. Certain factors-such as education and household income-appeared to play equally significant roles in different categories for both groups.

Our results for age suggest a non-linear gradient relationship that may be explained by the effect of age on self-reported oral health. Immigrant adults between the ages of 55 to 64 self-reported a higher rate of fair to poor oral health status which improved with age. An age-dependent shift of perception may be one possible explanation. Another explanation could be that older people perceive a higher number of filled teeth with good oral health [31, 32]. Studies have also shown that a significant proportion of seniors do not view oral-health care as an essential part of their overall health and well-being [33]. In contrast to the above studies, in our study, elderly immigrants between the ages of 75 to 84 showed a higher likelihood of reporting fair to poor oral health. This could be influenced by additional factors including low income, education and lack of dental insurance.

In our study, senior immigrant men were those most likely to report fair to poor oral health. A potential explanation is that the immigration process may lead to differential stress responses in men and women, which could be linked to dental problems. However, stress-mediated explanations of oral-health inequality have yet to be fully understood [34].

Our results suggest an inverse relationship between SES (represented by income and education) and poor SROH. Sabbah *et al*. showed that self-reported levels of oral and general health differed depending on income and education [35]. Lower levels of income and education increase the probability of reporting poor oral and general health.

Self-rated conditions of general health have been shown to be valid and reliable predictors of morbidity [37] and studies have shown that older adults with existing health problems and functional limitations are more likely to self-report both poor general and oral health [32, 36]. Our findings show a similar result, with seniors who reported fair to poor general health more likely to report fair to poor oral health. Our results suggest that self-rated oral health may capture a different set of perceived health attributes in immigrant and Canadian-born seniors. Non-immigrants with poor health had the highest likelihood of reporting fair to poor oral health while immigrant seniors showed a higher likelihood in every other category. This may be of interest to providers as we see that, with differences in risk profile, it would be necessary to have different ways of approaching the health issues in both these cohorts.

Our study design was cross-sectional and does not imply any causal relationships. Longitudinal studies will be needed to elucidate the associations we have reported. Additionally, the oral health of populations experiencing significant socio-economic disadvantages and vulnerabilities may be much greater due to under-representation in population health surveys. Another limitation was the inability to utilize the variable "time of immigration," which would have been beneficial for observing changes in the oral-health status of the senior immigrant population from their time of arrival in Canada. We had one specific problem regarding this variable; the coding of the variable in the CCHS-HA component started from 0 to19 years of age. Studies have shown that the significant changes in immigrants' oral health would be present in the initial years post arrival, [8, 12] and the unavailability of this information limited our understanding of the changes during these missing years.

This study highlights a potentially substantial burden of poor oral health in elderly immigrants, which has significant implications for public-health policy. An increasingly diverse and aging immigrant population will require a multi-pronged approach to address their oral-health problems, particularly for those with lower SES. Policies and approaches incorporating oral-health education, dental screening, awareness raising, and community-based initiatives would be beneficial, particularly if they are targeted to the low-SES elder population in areas where they reside. Policy-makers must also move beyond funding health-promotion programs that mainly target children and adolescents in schools to develop programs that are relevant and accessible to the increasing numbers of adults and seniors, including the growing number of foreign-born adults.

## Conclusion
Canada is expected to see an increase in the number of immigrants and an already growing proportion of seniors (both Canadian-born and immigrant). Information on the oral health of immigrant seniors is scarce, and this study hopes to increase the understanding of this issue. Further longitudinal analyses incorporating such things as the time elapsed since arrival in Canada would be a step toward understanding factors that affect healthy aging in a newly adopted home.

## Acknowledgements

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