ACCESS TO HEALTH CARE IN CANADIAN IMMIGRANTS: A LONGITUDINAL STUDY OF THE NATIONAL POPULATION HEALTH SURVEY

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Introduction

Canada, admitting more than 200,000 new permanent residents every year, is a major destination for immigrants in the world. [266] These new immigrants have fewer chronic conditions and better health compared with the average for the Canadian-born population at the time of entry in the country - the healthy immigrant effect. [5, 116] However, as these immigrants are exposed to the physical, social, environmental and cultural effects of the new adopted country, they start losing this health advantage; the average health of immigrants' starts becoming similar to the average health of the Canadian population - the convergence paradigm of acculturation. [4]

Among the possible explanations for the adverse effects on health that lead to convergence is poor access to health care for new immigrants. Riedel has discussed three important types of barriers to health care access among immigrants: structural and institutional, financial, and personal and cultural. [131] However, while we can conceptually distinguish these barriers, in practice, things often do not operate singly. For instance, adjusting to a new country is in itself a stressful process, and understanding the inner workings of a new health care system can be even more challenging. This may be particularly true if individuals have arrived from a health care system vastly different than the one in the adopted country. These institutional and cultural barriers may be compounded by financial concerns, as it has also been shown

that immigrants have lower income levels than the native born population on arrival, [9, 87] particularly if they are from developing countries. [88] Thus, upon immigration, economic stability may be a priority and these financial constraints may influence individual's need for seeking health care. Further, personal beliefs, [140–141, 267] linguistic problems, [133, 268] and other cultural issues [142] may hamper health care access. A combination of these factors along with other barriers at the health-system level (e.g. racism) makes the visible minority immigrants particularly vulnerable for poor health access. [11, 132, 144, 269] However, as immigrants gradually 'learn the ropes' in the new society, their access should concomitantly improve. Thus, though immigrants may initially have lower access, it should potentially become similar to the Canadians over a period of time.

Previous research on health care access by immigrants in Canada has provided mixed results. While Laroche [203] did not find significant differences between health care utilisation by immigrants and Canadian-born adults, others have found differences between these populations, in both directions. For example, Wu and colleagues [230] found that immigrants had fewer unmet health care needs compared with the native born, and Newbold, [162] found greater use of health services by the immigrant population. In contrast, Wen and co-workers [159] found that immigrants, especially recent Asian immigrants, were less likely to report use of emergency services. Interestingly, Glazier and colleagues, [89] using the Census and administration data on hospitalizations in Toronto in 1996, found that hospital use and serious morbidity were highest in areas with high rates of recent immigration particularly in family class immigrants and refugees.

Study design may help explain some of these discrepancies. Indeed, the estimates for these analyses were primarily from cross-sectional data, pooled cross-sectional data, or the first event of health care utilisation. With time, however, the health care access may potentially change in individuals, particularly immigrants. However, the post-immigration changes may be experienced differently by male and female immigrants. [12, 200] Thus, a longitudinal design that accounts for these changes in individuals is therefore necessary to assess the differences in health care access of Canadians and immigrants over time.

To address these issues, we designed the present study to evaluate health care access over a 12-year period according to immigrant status in Canada (separately in males and females), and the socio-economic factors associated with it.

Methods

This study is a longitudinal analysis of secondary data originally collected by Statistics Canada as a part of the National Population Health Survey (NPHS). [228]

Data Source

The target population for the NPHS was household residents of ten provinces in Canada; it excluded residents of health institutions, those living on the Canadian Forces bases, and those living on Indian Reserves and Crown lands and in remote areas of Ontario and Québec. Thus, it represents a nationally representative longitudinal survey of individuals, and provides information on social, demographic, economic, occupational, environmental,

and health characteristics of these individuals. The first wave of data for NPHS was collected in 1994/95, and biennial surveys have been carried on since then, resulting in 12 years of follow-up (seven waves: 1994/95, 1996/97, 1998/99, 2000/01, 2002/03, 2004/5, and 2006/7). The households were selected in the first cycle (1994/95) and one individual above the age of 12 years was randomly selected from each household to be the longitudinal respondent for all the seven waves of the survey (they were traced for all the subsequent waves). The NPHS initial longitudinal panel composed of 17,276 individuals; the attrition rates (numbers) for cycles 1996/97, 1998/99, 2000/01, 2002/03, 2004/5, and 2006/7 (compared with the previous cycle) were 9.3% (1604), 6.6% (1041), 7.1% (1034), 7.6% (1038), 7.5% (940), and 5.4% (627) respectively. Thus, our initial longitudinal sample was of 10,992 individuals; of these 8968 were more than or equal to 18 years of age at baseline. We excluded 1663 individuals who died during the course of the follow-up and 33 individuals for whom there were no data for the variables included in the models in all the seven waves of data collection. Thus, a total of 3081 males and 4187 females were included for the present analysis (refer to as cohort for future discussion). We have described the details of the sample size in Figure 1. We had a total of 21567 observations (mean 6.3) for males and 29309 (mean 6.4) observations for females across the seven assessment times.

Outcomes

We used two measures of health care access as outcome variables: 1) whether or not the respondent had a regular doctor, 2) self-reported perceived unmet health care need in the past 12 months. Both outcomes were measured as binary indicators (yes/no). The independent variable of primary interest was the Canadian-born or immigrant status of the individual. Immigrants were further categorised as White and Non-white.

Independent variables

Based on the acculturation framework described by Berry, [10] we included the following socio-demographic independent variables in the statistical models: age (categorised as 18/34 years, 35/54 years, 55/74 years. 75 years), education (primary, secondary, post-secondary, and graduate), income adequacy category (classified by Statistics Canada into four categories according to the total household income and total number of individuals in the household as: highest, upper middle, lower middle, and lowest), living conditions (single, with a partner, family with both parents, family with single parent, and other types) marital status (single, married, separated [included widowed or divorced]), province of residence (Ontario, Québec, British Columbia, and others), and a binary indicator of linguistic minority (individuals living in Québec and unable to speak/understand French, individuals living in other provinces and unable to speak/understand English). The behavioural variables were: alcohol intake (never, regular, or former), smoking pattern (never, daily, occasional, or former), and physical activity (infrequent, occasional, and regular). In addition, presence of a chronic condition was used as a covariate in the models. For the unmet health care need outcome, we added 'having a regular doctor' as an explanatory variable in the model. A calendar 'time' variable measured in years since 1994 was also included in the models to account for the longitudinal changes across the seven cycles during the 12 year follow-up period. Finally, we estimated models that included only the immigrant sub-population to assess the effect of time since immigration on the health care access outcomes. Since 'time-

since-immigration' would have had no value for Canadian born individuals, the variable could not be used in the models that included all the individuals.

Statistical Analyses

We stratified all analyses by gender. Descriptive statistics compared the frequency of reporting of the two outcome variables in the immigrant sub-groups, socio-demographic categories and distribution of lifestyle variables for each cycle of data.

We used random effects (RE) extensions of multiple logistic regression models to analyse this longitudinal dataset for repeated measures binary outcomes. RE models can estimate both within-individual and between-individual effects, accounting for correlation of the repeated outcomes in the same individual. [251] This is a better model than the conventional logistic regression models, which may underestimate variance from data with repeated within-subject measures over time. The RE models for the two health care access outcomes were built in the following sequence: 1) null model with no explanatory variables for level-2 residual variance (at the level of individuals in our study); 2) simple unifactorial models that yielded unadjusted estimates of association of the health care outcomes with each explanatory variable separately, and: 3) a complete model with all the variables. These RE models accounted for random intercepts i.e. for an individual's systematically higher or lower probability of a specific outcome. We performed linear contrast tests across the four income categories. [270] This test assessed the trend of increased (or decreased) odds for these income categories. We also tested the interaction between immigrant status and 'time' to assess if the differences in health care outcomes between these three groups varied over the 12-year period of data collection. For each model, the intra-class correlation (ICC) was estimated using the formula described by Snijders and Bosker [251] ($\tau^2/[\tau^2 + \pi^2/3]$); here, the τ^2 represents the variance of the random intercept. The ICC indicates the proportion of variance explained by the group level; however, this definition may also indicate the intraclass correlation controlled for the effects of the independent variables as discussed by the authors. [251] We used the Akaike Information Criteria (AIC) to assess the fit of various logistic RE models (such as the null model, unifactorial models, and the complete model, model with interaction terms). [252]

In our cohort about 91% of observations in males and in females had complete values, for all the variables included in these models. Among males, 7.8% observations had one, 0.5% had two, and 1.0% had between three and seven missing values; among females, 7.5% observations had one, 0.4% had two and 1.1% had between three and nine missing values. To account for missing information in the remaining 9% of observations, we performed 20 imputations of the dataset (using all seven waves), using the 'Multiple Imputations with Chained Equations' (MICE) method. [253–254] The difference of the estimates between the models with imputed values and the original analyses with missing data was < 0.5*standard error, for each of the primary independent variable of interest. Therefore, we are only reporting the results from the original analysis with missing data. Finally, we performed sensitivity analyses including males and females who had died during the course of data collection.

We used Stata (version 10) (StataCorp, College Station, Texas, USA) for all the analyses (*xtlogit* for the longitudinal data), including the imputations (using the *ice* command). 255–257

The study was approved by the Institutional Review Board of McGill University.

Results

Descriptive data

In our sample of 3081 males, 2703 (88%) were non-immigrants, 266 (9%) were white immigrants, and 112 (4%) were non-white immigrants. Among the 4187 females, 3696 (88%) were non-immigrants, 377 (9%) were white immigrants, and 114 (3%) were non-white immigrants. Among the 226 non-white immigrants; 34% were ethnically South Asian, 29% were ethnically Chinese, and 22% were ethnically Black. Certain baseline demographic characteristics of Canadian born individuals and immigrants are presented in Table 1.

Access to a regular doctor

The unadjusted estimates demonstrated higher odds of access to a regular doctor in male immigrants (white and non-white) and female white immigrants than for Canadian born individuals. However, after adjusting for all covariates, immigrant men and women (white and non-white) had similar odds of having a regular doctor as the Canadian born individuals. The estimates for the unifactorial and complete models are shown in Table 2. In general, men and women in higher age groups were more likely to have a regular doctor. Men in the lowest income category had a similar odds of having a regular doctor as those in highest income category (OR: 1.09, 95% CI: 0.84–1.42). In contrast, women in the lowest income category were less likely to have a regular doctor than those in the highest income category (OR: 0.66, 95% CI: 0.50 – 0.87); and the odds of having a regular doctor decreased with decreasing income (p < 0.001, for test of trend). Men and women living in the province of Québec had the lowest odds of access to a regular doctor.

The interaction between immigrant category and time of data collection was not significant, indicating that the association did not change with time across different immigrant categories.

Unmet health care need in the past 12 months

All the estimates for unifactorial and complete models of unmet health care need, are shown in Table 3. White male immigrants were less likely to report an unmet health care need in the past 12 months compared with Canadian born men (OR: 0.66, 95% CI: 0.47–0.95) once adjustment for all the other characteristics were made for; however, there was no significant difference between non-white immigrant and Canadian born men. The relationship was reversed in women, where only non-white immigrant women reported fewer unmet health care needs than Canadian women (OR: 0.32, 95% CI: 0.17–0.59), a feature not seen in white immigrant women. Overall, unmet health care needs at any assessment time were lower in older than younger subjects (both for men and women). However, the odds increased with increasing calendar time in both men and women. Thus, between-subject comparison

suggested that older subjects are less likely to have unmet needs in a given year, whereas the 'time' effect suggested secular trends toward increasing odds of unmet needs among subjects of the same age. The interaction terms between immigrant categories and time of data collection were not significant, suggesting that the secular trends in unmet health care needs did not differ by immigrant category. Men and women in the lowest income category were more likely to have an unmet health care need than those in the highest income category; and there was a significant trend for higher odds of unmet health care needs with decreasing income in both men and women (test for trend p < 0.01). Individuals who did not have a regular doctor were more likely to report having an unmet health care need in the past 12 months.

Among men, care for physical health (range 68% to 78%) and injuries (range 8% to 22%) were the most common types of unmet needs over these 12 years; in women it was care for physical health (range 66% to 79%) and mental health (range 9% to 15%). Detailed reasons for having unmet health care needs were collected from the 1996 wave onwards. Some of these reasons were: long waiting times and care not available when required. We have shown some important reasons for unmet health needs (1996–2006) in Figures 2 and 3.

In our sensitivity analyses, the difference in the estimates for each of the primary variable of interest between the models with dead individuals and our original models without dead individuals (both males and females) was less than one standard error; the odds ratios in the models with dead individuals changed in both directions i.e. increased and decreased for different outcomes (data not shown).

Immigrant only models

White and non-white immigrants reported similar access to a regular doctor (OR for non-white immigrants: 1.06, 95% CI: 0.54–2.09). However, increasing time since immigration was associated with better access to a regular doctor (OR per year after immigration: 1.02, 95% CI: 1.00 – 1.04). As with the general population, immigrants in Québec were less likely to report having a regular doctor (OR: 0.30, 95% CI: 0.11–0.80) than immigrants in other provinces. Female immigrants were more likely to have a regular doctor than males (OR: 2.25, 95% CI: 1.33–3.83). Immigrants living in Ontario had less frequent unmet health care needs compared to other provinces (OR: 0.59, 95% CI: 0.38–0.91). Similar to the findings observed in the general population, the odds of unmet health needs increased in immigrants with every additional year of data collection (OR: 1.09, 95% CI: 1.05–1.13). None of the interactions between time-since-immigration and sex, age, and immigrant categories were statistically significant.

Discussion

Immigrant men and women (white and non-white) reported better access to a regular doctor than did the Canadian born individuals in our population, over the 12-year period; with access increasing with duration of stay in Canada for all immigrants. White male immigrants and non-white female immigrants reported fewer unmet health care needs in the past 12 months.

Having a regular doctor may be considered a measure of 'potential health care access', meaning that those who have a regular doctor may be more likely to access care. [271–272] Our data showed some evidence of higher access to a regular doctor in immigrants; however, these effects were not statistically significant. Thus, immigrants in our sample reported similar, if not better, access to a regular doctor as the Canadian born population over these 12 years. But, in contrast, Lasser and co-workers [157] had reported slightly lower access to a regular doctor among immigrants in a cross-sectional national telephone survey in Canadians in 2002/03. In our data, access to a regular doctor improved in immigrants as the length of stay in Canada increased. Recent immigrants are less likely to have a regular doctor - a feature highlighted by immigrant women in Ontario. [145] Certain visible minority immigrants may prefer having health care professionals of their own ethnicity or who speak their language; [240] such preferences may potentially explain some delay in finding a regular doctor for these immigrants. However, after adjusting for time since immigration, we found that white and non-white immigrants had similar access to a regular doctor. Nevertheless, linking new immigrants to a regular doctor early on in their immigration process is potentially an important intervention point and may facilitate easy transition to a new health care system. It will also increase immigrants' knowledge about health programmes in Canada and help in maintenance of their health and ultimately the health of the Canadian population in the long term.

Concerning unmet health needs, Wu and co-workers, [230] using the 2000/2001 cycle of Canadian Community Health Survey, found that fewer immigrants reported unmet health care needs compared to non-immigrants, as was also reported by Dunn & Dyck. [161] This finding was also replicated in our study, albeit only among white male immigrants and non-white female immigrants. Although previous qualitative studies and reports have shown that visible minority immigrant women report difficulties in accessing care, and are not satisfied about the care received, [142, 145, 273–274] we found that they reported fewer unmet health care needs. Shi & Stevens[275] in the United States found that visible minority women (African-American, Asian, and Hispanic) were less likely to report a delayed or an unmet health care need. It is plausible that non-white immigrant women may actually have fewer unmet health care needs in Canada particularly if they migrate from countries with poor health care infrastructure or low gender equality ratios. However, it is also possible that these women have lower expectations of the health care systems, poor health literacy, or they tend to understate the lack of appropriate health care. Canadian born women and certain white immigrants who potentially are more aware of their health needs and vocal about the lack of it may therefore report higher unmet health needs. [275] Generally, long waiting times was one of the most common reasons for having an unmet health need - an issue that has been previously highlighted as one of the structural hindrances for accessing health. [149] However, personal reasons as 'being too busy' or 'never got around it' also featured in our population over these years; these were also reported as important barriers in a population study in Ontario. [276]

Although immigrants in the province of Québec were less likely to have a regular doctor compared to immigrants in other provinces, this mirrored the reports of the general population of men and women in Québec in our study. This suggests that lack of access to a regular doctor may be a structural issue in Québec. [277] This would accord with reports that

there is a doctor shortage in Québec; about 25% of Québec residents do not have a regular doctor as compared to the national average of 15%. [146] Despite a lack of access to a regular doctor, individuals in Québec did not report proportionally higher unmet health care needs than residents of other provinces. This may be due to the presence in Québec of alternative resources to access health care such as Centre de Santé et de Services Sociaux and Family Medicine Groups. [278] Nevertheless, in general we did find that after adjusting for all covariates, individuals who did not have a regular doctor were more likely to report an unmet health care need. This may be due to the 'gate-keeping' role of the primary physician.

As with other studies, this one also had its limitations. The sample size, especially for immigrants, was small. In addition, we had to aggregate heterogeneous groups of immigrants particularly non-white immigrants (e.g. Asian, South Asian, African, etc.) because of the small sample size. Thus, we recommend that future general population Canadian surveys should oversample visible minority immigrants: this will help us understand the differences within these groups. Further, we did not have information on the 'class of immigration' *i.e.*, the type of immigrant category on which that had entered Canada (such as Economic class, Family class, Refugees to name some), so refugees, economic class, and family class were all treated as one group. Potentially, refugees are typically more disadvantaged than economic class immigrants when they enter Canada; however, they are typically provided with health care access, which may introduce a bias in our analyses.

This study has several strengths. First, our analyses take into account the within- and between-subject correlation over time, thus adding the longitudinal component to existing literature on health care access; this analyses period of 12-years is the maximum period for this national dataset. Second, we compared two measures of health care access (potential access and realised access) in the same group of individuals; thus providing a broader picture of health care access over the 12-year period. We find that immigrants (both white and non-white) have at least similar, if not better, access to a regular doctor as the Canadian born throughout the period of data collection. The access to a regular doctor in immigrants, improved with the duration of stay in Canada for both white and non-white immigrants throughout the 12 year period. An interesting finding was that, non-white female immigrants were the least likely to report an unmet health care need; however, it could not be ascertained whether it was due to excellent health coverage or lower expectations of the health care system [275] - an issue that needs to be explored further among visible minority women.

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Total population at baseline:
17276

Males: 8046, Females: 9230

→ 6284 not in our longitudinal
sample due to attrition

Total longitudinal sample for all
the 7 waves in our sample:
10992
Males: 4919, Females: 6073

Total individuals ≥ 18 years at
baseline: 8968
Males: 3906, Females: 5062

→ Total of 1663 individuals (809
males and 854 females) died
during the follow-up period

Total living individuals ≥ 18
years at baseline: 7305
Males: 3097, Females: 4208

→ Excluded 33 individuals due to
missing data for the outcome
and/or covariates for all the
7 cycles of data collection

Final cohort of living individuals
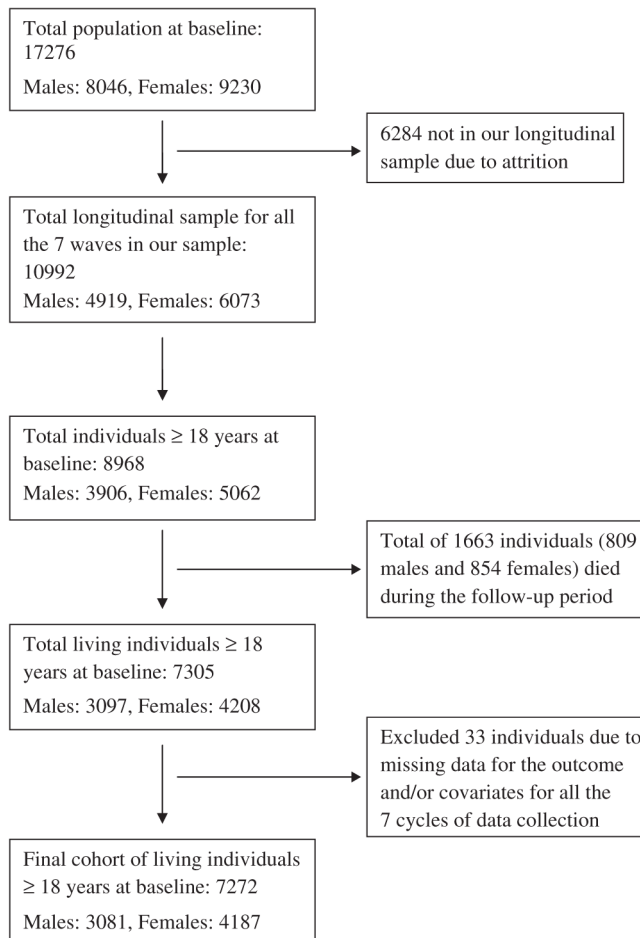≥ 18 years at baseline: 7272
Males: 3081, Females: 4187

Figure 1.
The sample size for this study to assess the health-care access in Canadians according to immigrant status over a 12-year period, National Population Health Survey, Canada (1994–2006).

Figure 2.
Common reasons for unmet healthcare needs among those reporting an unmet care need in 3081 men (1996–2006), Canada. *The number of women reporting unmet health needs who were 'too busy' was <15; hence exact number could not be reported as per Statistics Canada guidelines. The value for 'too busy' at this data point is <6%.

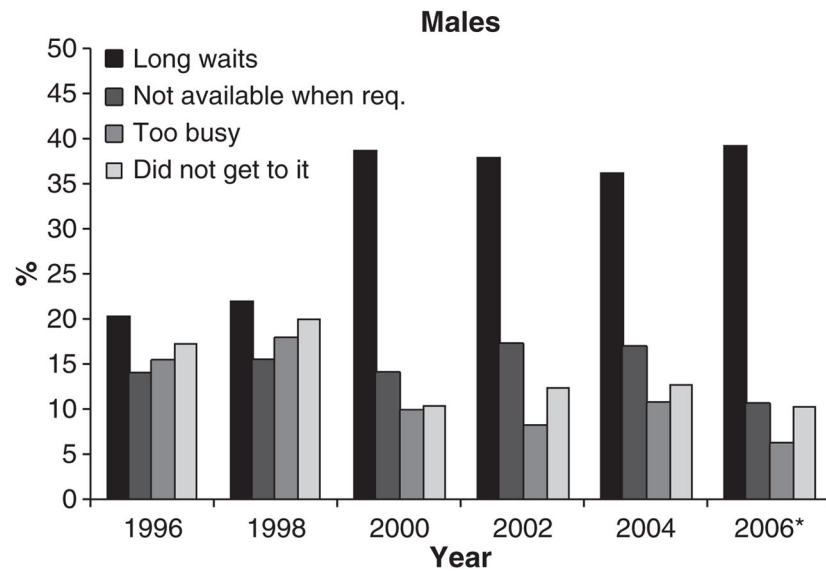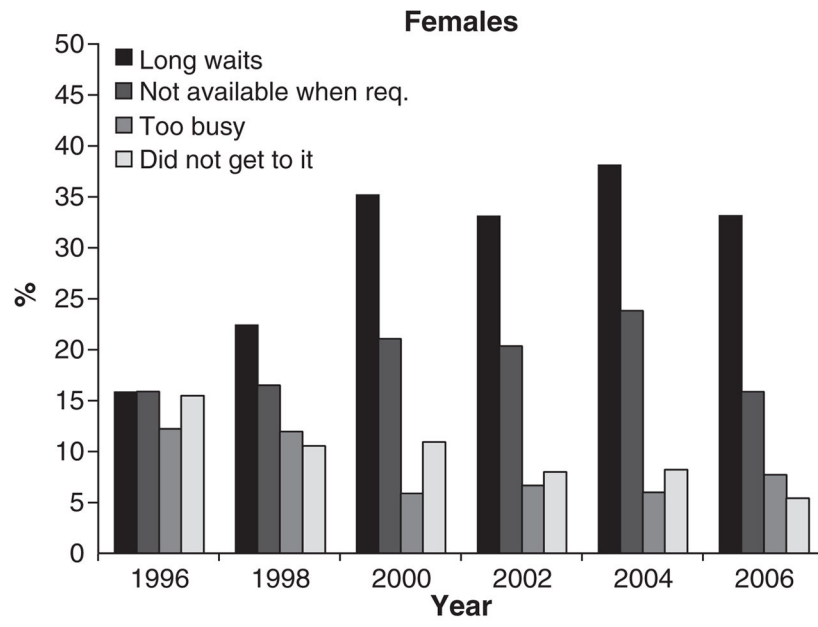**Figure 3.**
Common reasons for unmet healthcare needs among those reporting an unmet care need in 4187 women (1996–2006), Canada.

Table 1

Certain baseline demographic characteristics according to immigrant status in 3081 males and 4187 females (1994), Canada

Characteristics	Canadian born (*N* = 6399) *n* (%)	White immigrants (*N* = 643) *n* (%)	Non-white immigrants (*N* = 226) *n* (%)
Mean age (SD), years	42.8 (15.5)	50.9 (15.3)	39.8 (11.9)
Sex			
Males	2703 (42)	266 (41)	112 (50)
Females	3696 (58)	377 (59)	114 (50)
Marital status			
Single	1335 (21)	60 (9)	49 (22)
Married	4011 (63)	448 (70)	152 (67)
Separated *	1053 (16)	135 (21)	25 (11)
Education			
Primary	1504 (24)	131 (20)	35 (16)
Secondary	991 (15)	102 (16)	35 (16)
Postsecondary	1684 (26)	163 (25)	55 (24)
Graduate	2209 (35)	247 (38)	100 (44)
Missing	11 (0.2)	0 (0)	1 (0.4)
Income adequacy category†			
Highest	888 (14)	128 (21)	21 (10)
Upper middle	2393 (37)	217 (35)	77 (36)
Lower middle	1798 (28)	175 (29)	72 (33)
Lowest	1088 (17)	93 (15)	46 (21)
Missing	232 (4)	30 (5)	10 (4)

*
Includes widowed or divorced.

†
Income adequacy was according to the categorisation by Statistics Canada based on the total household income and number of people in the household.

Table 2

Random effects models showing the unadjusted and adjusted estimates of odds ratios (OR) and their 95% confidence intervals (C.I.) for 'having a regular doctor' in 3081 males and 4187 females in Canada (1994–2006)

	Unadjusted estimates		Adjusted estimates	
	Males OR (95% C.I.)	Females OR (95% C.I.)	Males OR (95% C.I.)	Females OR (95% C.I.)
Immigrant status				
Canadian born	Reference	Reference	Reference	Reference
White immigrants	2.52 (1.69–3.76)	1.91 (1.32–2.79)	1.32 (0.89–1.94)	1.14 (0.78. 1.66)
Non-white immigrants	2.14 (1.19–3.64)	1.61 (0.85–3.04)	1.28 (0.73–2.23)	1.23 (0.64–2.36)
Age categories (years)				
18–34	Reference	Reference	Reference	Reference
35–54	2.61 (2.24–3.06)	1.31 (1.10–1.55)	2.25 (1.89–2.68)	1.05 (0.87–1.27)
55–74	6.94 (5.57–8.66)	2.76 (2.20–3.46)	6.58 (5.06–8.55)	2.21 (1.69–2.91)
75	7.27 (4.96–10.67)	3.89 (2.73–5.51)	11.36 (6.79–19.01)	2.86 (1.85–4.42)
Time	1.06 (1.05–1.07)	1.04 (1.02–1.05)	1.01 (0.99–1.02)	1.00 (0.98–1.02)
Education				
Primary	Reference	Reference	Reference	Reference
Secondary	0.86 (0.61–1.20)	0.89 (0.65–1.24)	1.10 (0.80–1.53)	1.05 (0.75–1.46)
Postsecondary	0.74 (0.56–0.97)	0.79 (0.60–1.03)	0.86 (0.66–1.13)	0.88 (0.67–1.17)
Graduate	0.75 (0.58–0.97)	0.74 (0.57. 0.95)	0.87 (0.66–1.13)	0.80 (0.60–1.05)
Income category				
Highest	Reference	Reference	Reference	Reference
Upper middle	0.84 (0.73–0.96)	0.92 (0.77–1.10)	1.06 (0.91–1.24)	0.95 (0.79–1.13)
Lower middle	0.65 (0.55–0.78)	0.77 (0.63–0.94)	0.89 (0.73–1.08)	0.74 (0.59–0.92)
Lowest	0.67 (0.53–0.85)	0.70 (0.55–0.88)	1.09 (0.84–1.42)	0.66 (0.50–0.87) [*]
Marital status				
Single	Reference	Reference	Reference	Reference
Married	2.54 (2.12–3.06)	2.08 (1.69–2.55)	1.36 (1.05–1.76)	1.82 (1.34–2.48)
Separated	1.58 (1.21–2.05)	2.68 (2.08–3.45)	1.01 (0.76–1.35)	1.64 (1.24–2.17)
Province				
Other provinces	Reference	Reference	Reference	Reference
Ontario	1.93 (1.52–2.47)	2.06 (1.61–2.64)	1.79 (1.40–2.28)	1.82 (1.42–2.36)
Quebec	0.37 (0.29–0.48)	0.32 (0.25–0.40)	0.44 (0.33–0.58)	0.32 (0.25–0.42)
British Columbia	1.27 (0.92–1.76)	1.18 (0.87–1.61)	1.21 (0.87–1.68)	1.10 (0.81–1.51)
Linguistic major				
No	Reference	Reference	Reference	Reference
Yes	2.29 (1.79–2.91)	2.26 (1.76–2.90)	1.31 (0.99–1.74)	1.21 (0.91–1.61)
Has a chronic condition				
No	Reference	Reference	Reference	Reference
Yes	2.32 (2.05–2.62)	2.31 (2.02–2.65)	1.95 (1.71. 2.22)	2.13 (1.84–2.47)
Intra-class correlation (rho)			0.70	0.70

	Unadjusted estimates		Adjusted estimates	
	Males OR (95% C.I.)	Females OR (95% C.I.)	Males OR (95% C.I.)	Females OR (95% C.I.)
AIC			12 938.75	11 651.63
Interaction terms				
White immigrant × time			1.01 (0.96–1.07)	0.99 (0.93–1.05)
Non-white immigrant × time			0.97 (0.90–1.05)[‡]	1.09 (0.98–1.21)[‡]

AIC, Akaike Information Criteria.

The adjusted models also include living conditions and behavioural variables (smoking, alcohol use and physical exercise).

[*] Test for trend: $P < 0.001$.

[‡] The interaction terms were not significant in both men and women.

Table 3

Random effects models showing the unadjusted and adjusted estimates of odds ratios (OR) and their 95% confidence intervals (C.I.) for reporting an unmet healthcare need in 3081 males and 4187 females in Canada (1994–2006)

	Unadjusted estimates		Adjusted estimates	
	Males OR (95% C.I.)	Females OR (95% C.I.)	Males OR (95% C.I.)	Females OR (95% C.I.)
Immigrant status				
Canadian born	Reference	Reference	Reference	Reference
White immigrants	0.59 (0.42–0.82)	0.78 (0.60–1.02)	0.66 (0.47–0.95)	0.93 (0.71–1.22)
Non-white immigrants	0.74 (0.46–1.20)	0.31 (0.17–0.55)	0.78 (0.48–1.28)	0.32 (0.17–0.59)
Age categories (years)				
18–34	Reference	Reference	Reference	Reference
35–54	1.19 (0.99–1.43)	1.22 (1.05–1.43)	0.90 (0.73–1.11)	0.91 (0.77–1.08)
55–74	0.94 (0.75–1.18)	0.97 (0.80–1.17)	0.58 (0.44–0.76)	0.58 (0.46–0.73)
75	0.61 (0.41–0.91)	0.84 (0.64–1.09)	0.28 (0.17–0.45)	0.38 (0.27–0.54)
Time	1.08 (1.06–1.09)	1.09 (1.08–1.10)	1.09 (1.07–1.11)	1.09 (1.08–1.11)
Education				
Primary	Reference	Reference	Reference	Reference
Secondary	0.85 (0.63–1.15)	0.99 (0.77–1.28)	0.90 (0.66–1.24)	0.95 (0.73–1.25)
Postsecondary	1.34 (1.05–1.70)	1.63 (1.33–2.01)	1.26 (0.97–1.63)	1.44 (1.15–1.81)
Graduate	1.14 (0.91–1.43)	1.59 (1.30–1.94)	1.21 (0.94–1.56)	1.39 (1.11–1.74)
Income category				
Highest	Reference	Reference	Reference	Reference
Upper middle	0.91 (0.77–1.08)	0.83 (0.71–0.96)	1.11 (0.93–1.33)	1.03 (0.88. 1.21)
Lower middle	0.92 (0.75–1.12)	0.79 (0.67–0.94)	1.26 (1.00–1.57)	1.12 (0.92–1.35)
Lowest	1.13 (0.87–1.47)	1.05 (0.87–1.28)	1.58 (1.21–2.17) [*]	1.59 (1.26–2.01) [**]
Marital status				
Single	Reference	Reference	Reference	Reference
Married	0.89 (0.73–1.10)	0.86 (0.72–1.04)	0.96 (0.70–1.33)	0.84 (0.63–1.13)
Separated	1.32 (1.00–1.74)	1.06 (0.86–1.32)	1.13 (0.84–1.53)	0.98 (0.78–1.24)
Province				
Others	Reference	Reference	Reference	Reference
Ontario	0.91 (0.74–1.13)	0.95 (0.79–1.14)	1.01 (0.81–1.27)	1.01 (0.84–1.22)
Quebec	0.92 (0.72–1.16)	1.15 (0.94–1.41)	0.84 (0.62–1.12)	1.02 (0.81–1.30)
British Columbia	1.09 (0.82–1.45)	1.33 (1.05–1.68)	1.17 (0.86–1.57)	1.40 (1.10–1.78)
Linguistic major				
No	Reference	Reference	Reference	Reference
Yes	0.90 (0.69–1.19)	0.78 (0.62–0.99)	0.82 (0.58–1.16)	0.81 (0.61–1.08)
Has a chronic condition				
No	Reference	Reference	Reference	Reference
Yes	2.36 (2.02–2.75)	2.81 (2.41–3.28)	2.34 (2.00–2.79)	2.69 (2.29–3.17)
Does not have a regular doctor				

	Unadjusted estimates		Adjusted estimates	
	Males OR (95% C.I.)	Females OR (95% C.I.)	Males OR (95% C.I.)	Females OR (95% C.I.)
No	Reference	Reference	Reference	Reference
Yes	1.25 (1.05–1.49)	1.74 (1.46–2.08)	1.27 (1.05–1.54)	1.83 (1.51–2.21)
Intra-class correlation (rho)			0.55	0.57
AIC			8804.80	13 513.44
Interaction terms				
White immigrant × time			0.98 (0.92–1.05)	0.99 (0.95–1.04)
Non-white immigrant × time			1.02 (0.93–1.12)[‡]	1.10 (0.97–1.26)[‡]

AIC, Akaike Information Criteria.

The adjusted models also include living conditions and behavioural variables (smoking, alcohol use, and physical exercise). Test for trend:

[*]
$P = 0.002$,

[**]
$P < 0.001$.

[‡]The interaction terms were not significant in both men and women.