Assessing the Role of Individual and Neighbourhood Characteristics in HIV Testing: Evidence from a Population Based Survey

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Abstract: *Objectives*: Individuals living in deprived neighbourhoods have poor health outcomes, including human immunodeficiency virus (HIV) infection mortality. We assessed the association between individual and neighbourhood characteristics, and HIV testing across Canada.

Methods: We used logistic regression modelling to evaluate this association in 2219 men and 2815 women, aged 18-54 years, in Canada, using data from the National Population Health Survey (1996/7),. Socio-economic characteristics and presence of a sexually transmitted infection (STI) were the individual level characteristics. Small area of residence was classified according to categories of material and social deprivation; these were the 'neighbourhood' variables in the model.

Results: Ethnic minority women were less likely to report an HIV test than white women (OR 0.44, 95% CI: 0.23 to 0.86). Women without a regular doctor were significantly less likely to report ever having had an HIV test (OR 0.57, 95% CI: 0.35 to 0.93). Adjusting for individual level characteristics, we found that men and women living in the most materially deprived neighbourhoods were slightly less likely to report HIV testing than those living in the least deprived neighbourhoods (Men - OR 0.61, 95% CI: 0.34 to 1.08; Women - OR 0.62, 95% CI: 0.38 to 1.00).

Discussion: Thus, living in poor neighbourhoods was associated with poor uptake of an HIV test. These economic disparities should be taken in account while designing future prevention strategies. Ethnic minority women were less likely to go for HIV testing and culturally appropriate messages may be required for prevention in ethnic minorities.

Keywords: HIV testing, ethnic minorities, neighbourhoods.

INTRODUCTION

The Public Health Agency of Canada has reported a total of 68,604 human immunodeficiency virus (HIV) infections until 2007 [1]. Men who have sex with men accounted for 62% of total new HIV infections in the period from 1985-1991, however, this proportion had reduced to 41% in 2007. There was a simultaneous increase in the number of infections due to heterosexual transmission (7% in 1985-1991 and 12% in 2007) [1]. The introduction of highly active antiretroviral therapy has resulted in reduction of complications and mortality in HIV infected individuals. However, HIV infected individuals will access the therapy and related prevention services only if they are aware of their HIV status. Thus HIV testing forms a core component of HIV prevention and care [2].

Canada has a universal health care system; the HIV testing facilities include nominal or name-based testing, non-nominal testing, and anonymous testing in various provinces [3]. However, it is estimated that about 27% of HIV infected Canadians are not aware of their status [4]. HIV testing may depend on various factors – perception of risk, clinical indicators, and access to health services. The testing pattern may also vary according to cultural practices; it may be different among those from ethnic minorities compared with the White Canadian population, and women may be particularly disadvantaged [5-7]. A recent review identified HIV testing patterns among women in Canada to be an important research area [8]. This may be useful to design prevention and care programmes for these communities in Canada. Another factor often discussed in health care access is the role of the neighbourhood in which individuals live. Studies have demonstrated that AIDS incidence and mortality is higher in economically deprived areas in non-industrialised as well as industrialised countries [9-14]. Although geographical mapping has shown that HIV services are less accessible in economically disadvantaged neighbourhoods in Toronto [15] an analysis of predictors of uptake of an HIV test in different neighbourhoods across Canada has never been done.

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Thus, the present study was designed to evaluate the association between socioeconomic factors and HIV testing in men and women in Canada, both at the individual and neighbourhood level.

METHODS

This study is a cross-sectional analysis of data from the National Population Health Survey (NPHS; 1996/97) [16]. Though NPHS is a longitudinal survey with seven data waves with 12 years of follow-up, the variable on HIV testing was available only in the 1996/7 wave. It is nationally representative dataset and provides information on the social, demographic, economic, occupational, environmental, and health characteristics of the Canadian population. We linked these data from the NPHS to information relating to Dissemination areas (DA) of residence in 1996 - the smallest unit of disseminating census data – using composite small area classifications for corresponding areas derived from the Canadian Census data (2001). The data included 2219 men and 2815 women, aged 18-54 years, residing in 1945 (mean 1.1) and 2460 (mean 1.1) DAs respectively.

The outcome variable of interest was whether individuals have had an HIV test other than for insurance or blood donation. The individual variables use as explanatory of this outcome were for 1996: socio-demographic variables - age, the living condition of individuals, educational level, income category, the province of residence, and ethnicity; clinical indicator - presence of a sexually transmitted infection (STI) in the past two years; and access indicator - whether they have a regular doctor or not. Ethnic minority status was determined by self-reporting of ethnicity. Two geographic variables describing the individual's 1996 area of residence were also used as explanatory variables in the model; the material deprivation index and the social deprivation index, developed by Pampalon and colleagues, using 2001 census data for each of the DAs in Canada [17]. The material deprivation indicator takes into account the education level, employment status, and income; thus, reflects the economic poverty in the concerned populations. The social deprivation measure, takes into account the living condition of individuals (alone, separated, single parent families) and represents the level of social isolation or social cohesion in the population in the respective areas. As discussed earlier, economically deprived neighbourhoods reported higher AIDS cases and related mortality [9-14]. Based on the Postal Code correspondence file [18] we identified the DA in which the respondent lived in 1996. The DA identifier was used to link the individual data with geographical information on local material and social deprivation indicators.

We used STATA (version 10) (StataCorp, College Station, Texas, USA) to conduct the logistic regression analysis for the present study. The 'boot strap' method with 500 replications was used for calculating standard errors to allow for representativeness of this complex survey design. We initially analysed the proportion of HIV testing in the various individual and geographic level predictor categories; these were population weighted proportions. The modelling was conducted in the following sequence: 1) we initially performed analysis between the outcome and each of the explanatory variables (individual and geographic); 2) a multivariate analysis of the outcome and each of the individual level explanatory variables; 3) The next group of models were to test if the geographic level variables (separately for material and social deprivation indices)were associated with the outcome after controlling for individual level attributes. These data were not analysed in a multi-level model because the average number of individuals in each DA was 1.1, but options in STATA were used to adjust errors for any effects of clustering of some individuals in the same areas. We performed the linear contrast tests for trend to asses for any trends in the material and social deprivation quintiles [19]. All the models were initially built for the whole cohort, followed by models for men and women separately. The latter was done to assess if any of the explanatory variables had different effects in these two genders.

The study was approved for secondary data analysis by the Institutional Review Board of McGill University.

RESULTS

Descriptive data

The mean ages (standard deviation) of men and women were 37.1 ($\pm$ 9.6) and 36.3 ($\pm$ 9.6) years respectively. Overall, more women had tested for HIV than men (20% versus 15%, $p<0.01$) in our sample. Of the 146 ethnic minority men, 25% were Chinese, 23% were black, and 17% were South Asian. However, among the 139 ethnic minority women, 22% were South Asian, 21% were Chinese, and 16% were Black. The proportion of HIV testing was highest in men (21%) and women (27%) aged 25 to 34 years. However, 36% of men and 44% of women reporting a STI in the past two years had tested for HIV (Table **1**). The most common reason reported for HIV testing was 'peace of mind' in both men (43%) and women (32%). About 19% of women reported 'pregnancy' as a reason for getting tested. However, only 5% of men and women reported 'risky sexual behaviours' as the reason for the HIV test.

Complete Cohort Models

Crude associations and adjusted associations between various individual and neighbourhood level characteristics are presented in Table **2**. We are only referring to the adjusted estimates in the subsequent discussion.

In the complete model with individual level characteristics we found that women were more likely to have had an HIV test than men. People who had an STI in the past two years were more likely to report an HIV test than those who had not. After adjusting for all individual level variables, we found that people living in the most materially deprived neighbourhoods reported a lower HIV test uptake than those living in the least deprived neighbourhoods. However, the reverse was true for social deprivation. Thus, people living in the most socially deprived neighbourhoods were more likely to report an HIV test than those living in the least socially deprived

Table 1. Proportion of People Reporting HIV Testing (Total = 5034; 2219 Males and 2815 Females) from the National Population Health Survey, Canada*

Characteristics	Total N=5034 [Population = 11540425]		Separated by Gender			
			Males N=2219 [population=5756447]		Females N=2815 [population = 5783978]	
	n	Proportion HIV Tested	n	Proportion HIV Tested (%)	n	Proportion HIV Tested
All	5034	18	2219	15	2815	20
Individual level Variables						
Age groups (years)						
18-24	658	19	264	13	394	24
25-34	1452	24	618	21	834	27
35-44	1666	17	736	13	930	20
45-54	1258	10	601	11	657	9
		$p < 0.00$		$p < 0.00$		$p < 0.00$
Living conditions						
Living with partner/children	3815	16	1733	14	2082	19
Single parent with dependent children	773	20	387	21	386	21
Living alone/unattached	446	25	99	0.18	347	27
		$p < 0.00$		$p=0.03$		$p=0.02$
Education						
Less than secondary	619	12	304	12	315	13
Secondary education	703	12	315	9	388	15
Some post-secondary	1406	22	624	19	782	24
College/University	2306	18	976	15	1330	21
		$p < 0.00$		$p=0.01$		$p < 0.00$
Income group						
Lowest	704	23	240	19	464	26
Low-Mid	1399	17	591	12	808	20
Upper-Mid	2141	18	1011	17	1130	19
Upper	790	15	377	12	413	19
		$p = 0.02$		$p=0.05$		$p=0.18$
Province						
Others	2486	13	1071	12	1415	15
Ontario	1163	21	519	17	644	25
Quebec	904	16	425	16	479	17
British Columbia	481	18	204	15	277	20
		$p < 0.00$		$p=0.15$		$p < 0.00$
Ethnicity						
White	4749	18	2073	15	2676	21
Ethnic minorities	285	14	146	15	139	13
		$p=0.18$		$p=0.94$		$p=0.05$
Has a regular doctor						
Yes	4288	18	1746	15	2542	21
No	746	15	473	16	273	13
		$p = 0.13$		$p=0.68$		$p=0.01$

(Table 1) contd…..

Characteristics	Total N=5034 [Population = 11540425]		Separated by Gender			
			Males N=2219 [population=5756447]		Females N=2815 [population = 5783978]	
	n	Proportion HIV Tested	n	Proportion HIV Tested (%)	n	Proportion HIV Tested
Had an STI in the past						
Yes	114	41	37	36	77	44
No	4920	17	2182	15	2738	19
		p < 0.00		p < 0.00		p < 0.00
Geographic Variables Material deprivation quintile						
1st (least deprived)	799	20	317	20	482	21
2nd	917	19	411	15	506	23
3rd	1041	17	492	14	549	20
4th	1116	18	513	14	603	23
5th (most deprived)	1161	13	486	13	675	13
		p = 0.05		p=0.29		p=0.03
Social deprivation quintile						
1st (least deprived)	1019	13	450	10	569	16
2nd	1104	16	491	13	613	18
3rd	1018	17	463	16	555	18
4th	955	19	443	14	512	24
5th (most deprived)	938	24	372	23	566	25
		p < 0.00		p < 0.00		p = 0.03

* = The proportions are weighted for the population, hence only proportions are provided.

neighbourhoods. The tests for trend were significant for the material and social deprivation quintiles. The correlation between the material and social deprivation indices represented in our data was -0.07 in our data.

Models in Men and Women

We have described the crude and adjusted associations in men and women separately in Table **3**. We refer to the adjusted association (Table **3**, Models II and III) in the subsequent discussion.

We found that ethnic minority women were less likely to report an HIV test than white women, although this difference was not seen in ethnic minority men. Women without a regular doctor were less likely to report ever having had an HIV test, a feature again not seen in men. Women living in Ontario were more likely to have ever had an HIV test than other Canadian provinces. After adjusting for individual level characteristics, we found that men and women living in most materially deprived neighbourhoods reported lower HIV testing than those living in least deprived neighbourhoods, although the OR in the males was not significant. However, men and women living in most socially deprived neighbourhoods were significantly more likely to report an HIV test than those living in the least socially deprived neighbourhoods.

DISCUSSION

Women were more likely to have had an HIV test than men in Canada in 1996/7. However, ethnic minority women reported lower HIV testing than white women. Further, women who did not have a regular doctor were less likely to report ever having an HIV test. About 36% of men and 44% of women who reported having an STI in the past two years had been tested for HIV. Adjusting for all the individual level predictor variables, people living in the most materially deprived neighbourhoods in Canada were about 40% less likely to have ever had an HIV test compared with those living in the least deprived neighbourhoods.

HIV testing by individuals may depend on various factors: perception of risk, access to testing services, and perception of social stigma associated with the infection as well as practical implications of testing positive, emotional trauma, and fear of social rejection [5]. HIV testing is higher in individuals who perceive themselves to be at risk [20]. Ethnic minorities often present late to HIV clinics as they are less likely to undergo HIV testing, a feature common to most

Table 2. Models Showing Crude and Adjusted Association between Individual and Geographic Characteristics, and Outcome (HIV Testing) in 5034 Individuals from the National Population Health Survey, Canada

Characteristics	Model I: Crude Association for Individual and Geographic Characteristics	Model II: Adjusted Association for Individual Characteristics	Model III: Adjusted Association for Individual and Geographic Characteristics	
			Material Deprivation	Social Deprivation
Individual level Variables				
Gender				
Male	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Females	1.42 (1.18 - 1.71)	1.33 (1.10 - 1.61)	1.32 (1.09 - 1.61)	1.32 (1.08 - 1.60)
Age groups (years)				
18-24	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
25-34	1.36 (1.01 – 1.85)	1.49 (1.10 - 2.03)	1.49 (1.10 - 2.02)	1.47 (1.08 - 2.00)
35-44	0.86 (0.61 – 1.21)	0.97 (0.69 - 1.36)	0.96 (0.68 - 1.34)	0.98 (0.70 - 1.38)
45-54	0.47 (0.33 – 0.67)	0.53 (0.37 - 0.77)	0.52 (0.36 - 0.75)	0.54 (0.37 - 0.77)
Living with partner/children	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Single parent with dependent children	1.69 (1.31 – 2.18)	1.57 (1.19 - 2.07)	1.56 (1.18 - 2.05)	1.42 (1.06 - 1.90)
Living alone/unattached	2.01 (1.44 – 2.81)	1.71 (1.21 - 2.42)	1.73 (1.22 - 2.43)	1.62 (1.15 - 2.30)
Education				
Less than secondary	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Secondary education	1.00 (0.64 - 1.56)	0.91 (0.57 - 1.43)	0.87 (0.55 - 1.39)	0.91 (0.57 - 1.44)
Some post-secondary	1.96 (1.35 - 2.84)	1.73 (1.17 - 2.56)	1.64 (1.11 - 2.44)	1.71 (1.15 - 2.53)
College/University	1.58 (1.09 - 2.30)	1.38 (0.93 - 2.06)	1.29 (0.86 - 1.92)	1.38 (0.92 - 2.05)
Income group				
Lowest	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Low-Mid	0.65 (0.47 - 0.92)	0.70 (0.50 - 0.99)	0.69 (0.49 - 0.97)	0.71 (0.50 - 0.99)
Upper-Mid	0.71 (0.52 - 0.95)	0.79 (0.58 - 1.07)	0.75 (0.54 - 1.03)	0.81 (0.59 - 1.09)
Upper	0.60 (0.41 - 0.87)	0.68 (0.46 - 1.02)	0.62 (0.41 - 0.95)	0.72 (0.48 - 1.07)
Province				
Others	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Ontario	1.74 (1.38 - 2.19)	1.81 (1.42 - 2.32)	1.75 (1.36 - 2.25)	1.81 (1.41 - 2.31)
Quebec	1.27 (0.99 - 1.64)	1.38 (1.05 - 1.80)	1.36 (1.04 - 1.79)	1.31 (0.99 - 1.73)
British Columbia	1.40 (1.04 - 1.89)	1.41 (1.04 - 1.93)	1.39 (1.02 - 1.89)	1.38 (1.00 - 1.89)
Ethnicity				
White	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Ethnic minorities	0.76 (0.49 - 1.18)	0.65 (0.41 - 0.1.01)	0.66 (0.42 - 1.03)	0.65 (0.41 - 1.02)
Has a regular doctor				
Yes	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
No	0.80 (0.59 - 1.08)	0.81 (0.58 - 1.12)	0.79 (0.57 - 1.09)	0.78 (0.56 - 1.09)
Had an STI in the past				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	3.38 (2.12 - 5.37)	2.73 (1.71 - 4.36)	2.73 (1.69 - 4.40)	2.65 (1.67 - 4.22)
Geographic Variables				
Material deprivation quintile				
1st (least deprived)	1.00 (reference)		1.00 (reference)	
2nd	0.91 (0.66 - 1.25)		0.91 (0.65 - 1.28)	
3rd	0.78 (0.58 - 1.06)		0.73 (0.52 - 1.01)	
4th	0.89 (0.65 - 1.22)		0.85 (0.61 - 1.19)	
5th (most deprived)	0.61 (0.45 - 0.83)		0.61 (0.43 - 0.88)*	
Social deprivation quintile				
1st (least deprived)	1.00 (reference)			1.00 (reference)
2nd	1.26 (0.92 - 1.72)			1.17 (0.85 - 1.62)
3rd	1.34 (0.94 - 1.91)			1.31 (0.91 - 1.88)
4th	1.54 (1.10 - 2.14)			1.42 (1.01 - 2.01)
5th (most deprived)	2.09 (1.51 - 2.89)			1.66 (1.17 - 2.34)**

* Test for trend p=0.01, ** Test for trend p=0.004.

Table 3. Models Showing Crude and Adjusted Association between Individual and Geographic Characteristics, and Outcome (HIV Testing) in 2219 Males and 2815 Females Separately from the National Population Health Survey, Canada

Characteristics	Model I: Crude Association between Individual and Geographic Characteristics		Model II: Adjusted Association for Individual Level Characteristics	
	Males OR (95% CI)	Females OR (95% CI)	Males OR (95% CI)	Females OR (95% CI)
Individual level Variables				
Age groups (years)				
18-24	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
25-34	1.69 (1.01 - 2.83)	1.32 (0.88 - 1.99)	1.90 (1.11 – 3.25)	1.32 (0.88 - 1.99)
35-44	1.00 (0.58 - 1.72)	0.88 (0.57 - 1.35)	1.22 (0.69 – 2.16)	0.88 (0.57 - 1.35)
45-54	0.74 (0.43 - 1.28)	0.35 (0.22 - 0.56)	0.90 (0.51 - 1.61)	0.35 (0.22 - 0.56)
Living conditions				
Living with partner/children	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Single parent with dependent children	1.89 (1.32 - 2.71)	1.59 (1.11 - 2.28)	1.58 (1.06 - 2.36)	1.59 (1.11 - 2.28)
Living alone/unattached	1.70 (0.90 - 3.22)	1.70 (1.13 - 2.55)	1.73 (0.87 - 3.43)	1.70 (1.13 - 2.55)
Education				
Less than secondary	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Secondary education	0.75 (0.37 - 1.52)	0.95 (0.49 - 1.86)	0.78 (0.38 - 1.60)	0.95 (0.49 - 1.86)
Some post-secondary	1.72 (1.00 - 2.94)	1.68 (0.92 - 3.08)	1.66 (0.94 - 2.96)	1.68 (0.92 - 3.08)
College/University	1.30 (0.74 - 2.28)	1.39 (0.77 - 2.53)	1.25 (0.68 - 2.27)	1.39 (0.77 - 2.53)
Income group				
Lowest	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Low-Mid	0.58 (0.33 - 1.00)	0.78 (0.50 - 1.21)	0.59 (0.33 - 1.00)	0.78 (0.50 - 1.21)
Upper-Mid	0.82 (0.50 - 1.32)	0.73 (0.49 - 1.09)	0.85 (0.50 - 1.44)	0.73 (0.49 - 1.09)
Upper	0.54 (0.31 - 0.95)	0.76 (0.44 - 1.30)	0.59 (0.32 - 1.11)	0.76 (0.44 - 1.30)
Province				
Others	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Ontario	1.53 (1.08 - 2.17)	2.15 (1.55 - 2.99)	1.45 (1.00 - 2.11)	2.15 (1.55 - 2.99)
Quebec	1.47 (1.03 - 2.12)	1.36 (0.94 - 1.97)	1.44 (0.97 - 2.13)	1.36 (0.94 - 1.97)
British Columbia	1.37 (0.84 - 2.23)	1.56 (1.06 - 2.29)	1.27 (0.76 - 2.11)	1.56 (1.06 - 2.29)
Ethnicity				
White	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Ethnic minorities	1.02 (0.59 - 1.76)	0.44 (0.23 - 0.86)	0.97 (0.56 - 1.70)	0.44 (0.23 - 0.86)
Has a regular doctor				
Yes	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
No	1.09 (0.72 - 1.64)	0.57 (0.35 - 0.93)	0.99 (0.65 - 1.53)	0.57 (0.35 - 0.93)
Had an STI in the past				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	3.21 (1.49 - 6.93)	3.16 (1.76 - 5.69)	2.56 (1.07 - 6.14)	3.16 (1.76 - 5.69)
Geographic Variables				
Material deprivation quintile				
1st (least deprived)	1.00 (reference)	1.00 (reference)		
2nd	0.73 (0.43 – 2.24)	1.12 (0.76 – 1.66)		
3rd	0.65 (0.38 – 1.10)	0.93 (0.65 – 1.33)		
4th	0.64 (0.38 – 1.08)	1.16 (0.79 – 1.70)		
5th (most deprived)	0.63 (0.38 – 1.03)	0.60 (0.41 – 0.89)		
Social deprivation quintile				
1st (least deprived)	1.00 (reference)	1.00 (reference)		
2nd	1.43 (0.86 – 2.40)	1.13 (0.73 – 1.75)		
3rd	1.65 (0.93 – 2.94)	1.15 (0.73 – 1.80)		
4th	1.48 (0.86 – 2.51)	1.62 (1.05 – 2.50)		
5th (most deprived)	2.63 (1.61 – 4.30)	1.73 (1.12 – 2.66)		

(Table 3) contd…..

Characteristics	Model I: Crude Association between Individual and Geographic Characteristics		Model II: Adjusted Association for Individual Level Characteristics	
	Males OR (95% CI)	Females OR (95% CI)	Males OR (95% CI)	Females OR (95% CI)
Individual level Variables				
Age groups (years)				
18-24	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
25-34	1.89 (1.10 - 3.25)	1.33 (0.88 - 1.99)	1.90 (1.10 - 3.26)	1.32 (0.88 - 1.99)
35-44	1.20 (0.68 - 2.15)	0.86 (0.56 - 1.33)	1.24 (0.70 - 2.21)	0.89 (0.58 - 1.37)
45-54	0.87 (0.49 - 1.58)	0.34 (0.21 - 0.55)	0.93 (0.52 - 1.67)	0.35 (0.22 - 0.56)
Living conditions				
Living with partner/children	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Single parent with dependent children	1.56 (1.04 - 2.33)	1.61 (1.12 - 2.30)	1.39 (0.90 - 2.13)	1.46 (0.99 - 2.16)
Living alone/unattached	1.77 (0.88 - 3.55)	1.67 (1.12 - 2.49)	1.67 (0.85 - 3.29)	1.58 (1.04 - 2.39)
Education				
Less than secondary	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Secondary education	0.76 (0.37 - 1.57)	0.91 (0.46 - 1.79)	0.76 (0.36 - 1.57)	0.96 (0.49 - 1.86)
Some post-secondary	1.59 (0.90 - 2.81)	1.56 (0.85 - 2.86)	1.70 (0.95 - 3.03)	1.63 (0.89 - 2.98)
College/University	1.14 (0.63 - 2.06)	1.29 (0.70 - 2.37)	1.24 (0.68 - 2.26)	1.38 (0.76 - 2.51)
Income group				
Lowest	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Low-Mid	0.60 (0.32 - 1.11)	0.74 (0.48 - 1.15)	0.59 (0.33 - 1.15)	0.78 (0.51 - 1.20)
Upper-Mid	0.84 (0.49 - 1.46)	0.68 (0.45 - 1.01)	0.87 (0.51 - 1.46)	0.74 (0.50 - 1.10)
Upper	0.54 (0.28 - 1.05)	0.70 (0.40 - 1.22)	0.61 (0.33 - 1.15)	0.78 (0.46 - 1.34)
Province				
Others	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Ontario	1.39 (0.95 - 2.04)	2.08 (1.49 - 2.90)	1.44 (0.99 - 2.10)	2.17 (1.56 - 3.02)
Quebec	1.44 (0.97 - 2.16)	1.33 (0.92 - 1.92)	1.38 (0.91 - 2.07)	1.30 (0.89 - 1.92)
British Columbia	1.28 (0.76 - 2.13)	1.50 (1.02 - 2.21)	1.23 (0.73 - 2.08)	1.54 (1.04 - 2.27)
Ethnicity				
White	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Ethnic minorities	1.00 (0.56 - 1.77)	0.45 (0.23 - 0.87)	1.00 (0.56 - 1.79)	0.43 (0.22 - 0.82)
Has a regular doctor				
Yes	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
No	0.96 (0.62 - 1.50)	0.56 (0.34 - 0.92)	0.96 (0.62 - 1.50)	0.55 (0.33 - 0.89)
Had an STI in the past				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	2.72 (1.07 - 6.92)	3.09 (1.69 - 5.66)	2.44 (1.02 - 5.85)	3.08 (1.71 - 5.56)
Geographic Variables Material deprivation quintile				
1st (least deprived)	1.00 (reference)	1.00 (reference)		
2nd	0.70 (0.39 - 1.26)	1.09 (0.71 - 1.66)		
3rd	0.60 (0.33 - 1.08)	0.83 (0.56 - 1.24)		
4th	0.59 (0.35 - 1.02)	1.11 (0.73 - 1.71)		
5th (most deprived)	0.61 (0.34 - 1.08)*	0.62 (0.38 - 1.00)**		
Social deprivation quintile				
1st (least deprived)			1.00 (reference)	1.00 (reference)
2nd			1.39 (0.82 - 2.35)	1.08 (0.68 - 1.70)
3rd			1.72 (0.96 - 3.09)	1.11 (0.68 - 1.79)
4th			1.35 (0.77 - 2.37)	1.57 (1.00 - 2.49)
5th (most deprived)			2.12 (1.25 - 3.61)†	1.42 (0.89 - 2.27)††

*Test for trend p=0.07, ** Test for trend p=0.09.
†Test for trend p=0.02, †† Test for trend p=0.04.

industrialised countries [21-23]. In our population, although ethnic minority men had similar HIV testing rates as white men, the ethnic minority women reported significantly lower testing rates than white women. Gardezi and coworkers found that ethnic minority women in Toronto did not consider themselves at risk partly because of their religious beliefs and cultural norms [24]. Although we did not have information on perception of risk, HIV testing was lowest in ethnic minority women. These quantitative findings may echo qualitative reports risk perception may differ in ethnic minority men and women. Another aspect of healthcare access is the cultural relevance of these services for ethnic minorities [25]. The Toronto Public Health Department, for example, provides HIV counselling services in 16 languages other than the two official languages [26]. Culturally sensitive programmes may potentially increase the comfort and eventually the access for HIV related services [27, 28].

The overall higher HIV testing in women may be due to testing during pregnancy (19%). Indeed, women not having access to a regular doctor had lower HIV testing than those having a regular doctor, although a similar effect was not seen in men. Thus, potentially most of the HIV testing in these women appears to be physician driven. Massive community outreach programmes including HIV testing may increase the proportion of women undergoing an HIV test [29].

Apart from individual access to physician services; structural access barriers may potentially be responsible for low rates of testing. Spatial analysis of HIV services in Toronto neighbourhoods demonstrated that preventive services were concentrated in downtown areas and were less accessible in other areas [30]. Similarly another study from Toronto found fewer HIV services in economically disadvantaged and immigrant neighbourhoods [15]. These findings support our results that men and women living in most materially deprived neighbourhoods were less likely to report HIV testing. It has also been reported that people who have strong community ties may not access these services to avoid the 'gossip' in these communities [24]. Particularly, ethnic minorities may not go for HIV testing due to the fear of the stigma associated with it [5]. In our study, those living in most socially deprived neighbourhoods (increased social isolation) were more likely to report a test than those living in least socially deprived neighbourhoods. There is weak negative correlation at area level between social and material deprivation. These measures are proxies for different aspects of socio-economic conditions at the local level, and have been demonstrated to vary independently [17]. Thus improving the services in deprived neighbourhoods may potentially increase the HIV testing in individuals living in these areas. Stronger social cohesion and community ties in less socially deprived neighbourhoods should be used to improve the HIV prevention and care messages among individuals living in these areas.

Targeting individuals who access health care services with high risk behaviour is also a useful strategy to improve HIV testing. In our study, although, individuals with an STI had a higher proportion of HIV tests than the general population, only 36% of male and 44% of the females had had an HIV test.; however, the overall numbers for presence of an STI were small and these results should be evaluated in this context. Though the Canadian policy is to offer an HIV test to anyone with known risk behaviour [31] this is potentially an important area of intervention to improve HIV testing services among individuals at risk. Further, providing easy access to anonymous testing facilities may help to improve the testing in indiviudals at risk [3].

As is the case with many studies, this study also had its limitations. Though we used the presence of an STI in the past two years as a marker of high risk behaviour, we did not have information on the sexual behaviours or sexual preferences of individuals; a previous study though has demonstrated that HIV testing is higher in individuals who were more at risk [32]. Lack of information on risk behaviours other than STIs may be another potential limitation of the study. Ethnic minority status is not a homogenous entity - they represent multiple groups which may be missed in this category [33]. The area data applied to respondents' place of residence in 1996/7 were collected 5 years later than the survey data, which may have resulted in some inaccuracy in our estimate of likely area conditions in 1996/7. Data on HIV testing were collected in 1996/7, making them of historic rather than contemporary relevance. However, more recent data do suggest that ethnic minority women do not consider themselves to be at risk for HIV and fewer HIV services are available in economic deprived areas; this may influence testing [15, 24]. Since, NPHS is an ongoing survey; it will be useful to collect recent information on HIV testing again, and assess the changes, if any, in the testing patterns. Interestingly, it was around 1996 that highly active antiretroviral therapy was introduced in care of HIV patients, and massive information and treatment campaign was initiated globally. Further, Rapid tests for HIV were approved in 2005 in Canada for "Point of Care settings" [34]. This may have resulted in changes in the awareness and testing levels. Thus, recent information on HIV testing could then be used to compare the testing behaviours over time and design our prevention and care programmes accordingly.

In spite of the above limitations, the study provides useful information on HIV testing in Canada. First, the results show that living in economically deprived neighbourhoods was associated with lower HIV testing. These economic disparities should be taken in account while designing future prevention strategies and improving access for these individuals. Second, though HIV positivity has increased in ethnic minorities in the past few years as per National statistics in Canada [1], testing for HIV in these population groups was relatively low, particularly for women. Thus, ethnic minorities, particularly women, according to our results should have been the focus of active public health interventions. Assuming similar conditions still prevail now, this suggests that culturally appropriate and relevant messages be developed for HIV prevention in ethnic minorities and campaigns may need to be focused in deprived areas where minority groups tend to be concentrated. With increased immigration from Asian and African nations, these results assume added significance in current HIV prevention programmes in Canada. Further, though international studies have discussed disparities in AIDS cases and mortality according to neighbourhood; [9-14] testing has not been adequately addressed. Thus, these findings should also be

explored in nations with high immigration; results from these neighbourhood analyses will potentially help us formulate our prevention programmes through better access to HIV testing facilities.

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