

## Accepted Manuscript

Cervical cancer screening in Montreal: Building evidence to support primary care and policy interventions

Geetanjali D. Datta, Alexandra Blair, Marie-Pierre Sylvestre, Lise Gauvin, Mylene Drouin, Marie-Helene Mayrand



PII: S0091-7435(18)30081-1  
DOI: doi:[10.1016/j.ypmed.2018.02.037](https://doi.org/10.1016/j.ypmed.2018.02.037)  
Reference: YPMED 5334

To appear in: *Preventive Medicine*

Received date: 3 October 2017  
Revised date: 1 February 2018  
Accepted date: 28 February 2018

Please cite this article as: Geetanjali D. Datta, Alexandra Blair, Marie-Pierre Sylvestre, Lise Gauvin, Mylene Drouin, Marie-Helene Mayrand , Cervical cancer screening in Montreal: Building evidence to support primary care and policy interventions. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Ypmed(2017), doi:[10.1016/j.ypmed.2018.02.037](https://doi.org/10.1016/j.ypmed.2018.02.037)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## **Cervical cancer screening in Montreal: Building evidence to support primary care and policy interventions**

### **Authors**

Geetanjali D. Datta\*, gddatta@gmail.com

1. Centre de recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM)
2. L'École de Santé Publique de l'Université de Montréal (ESPUM), Department of Social and Preventive Medicine

Alexandra Blair, MSc, alexandra.blair@umontreal.ca

1. Centre de recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM)
2. L'École de Santé Publique de l'Université de Montréal (ESPUM), Department of Social and Preventive Medicine

Marie-Pierre Sylvestre, PhD, marie-pierre.sylvestre@umontreal.ca

1. Centre de recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM)
2. L'École de Santé Publique de l'Université de Montréal (ESPUM), Department of Social and Preventive Medicine

Lise Gauvin, PhD, lise.gauvin.2@umontreal.ca

1. Centre de recherche du Centre Hospitalier de l'Université de Montréal (CRCHUM)
2. L'École de Santé Publique de l'Université de Montréal (ESPUM), Department of Social and Preventive Medicine

Mylene Drouin, MD, MSc, mylene.drouin.1@umontreal.ca

1. Regional Integrated Health and Social Services Center (CIUSSS) of the Regional Directorate of Public Health (PRSP) of the Center-Sud-de-l'Île-de-Montréal

Marie-Helene Mayrand, MD, PhD, Marie-helene.mayrand@umontreal.ca

1. Centre de recherche du Centre Hospitalier de l'Université de Montréal
2. Université de Montréal, Faculty of Medicine, Departments of Obstetrics and Gynecology

\*Corresponding author

Abstract: In Canada, over 40% of invasive cervical cancers occur among women who have never been screened. Although 12% of Canadian women have never been screened, this number can be as high as 43% among certain social groups. Little is published on factors associated with screening uptake and inequalities among women residing in Quebec.

Four waves of the Canadian Community Health Survey (2003, 2005, 2008, 2012, N= 6,393) were utilized to assess lifetime screening and screening in the previous 3 years among women residing in Montreal. Chi-squared statistics were calculated, Poisson regression was utilized to model prevalence ratios, and prevalence differences were calculated.

In total, 13.6% of women had never been screened and 12.1 % had not been screened in the previous 3 years. Immigrant status was the strongest predictor of never being screened [recent vs non-immigrant: Prevalence Ratio (PR), 3.9 (95% Confidence Interval (CI): 2.9-5.4)] and not having a primary care physician (PCP) was the strongest predictors of not being screened recently [PR=3.0 (95% CI: 2.3-3.9)]. The two most common reasons for not being screened were not "know[ing] it was necessary" and not "get[ting] around to it."

These results provide a description of sub-populations which might benefit from cervical screening interventions: immigrants and women without a PCP. Interventions targeting access to PCPs, expanding training of non-physicians to conduct screening, organized screening, or autoadministered screening test may mitigate inequalities. Future work should assess their acceptability and feasibility, and evaluate the impact of these types of primary care and policy interventions.

Keywords: Cancer prevention, Screening, Inequalities, Epidemiology, Women's Health, Primary Care, Public Health, Health Policy

## Introduction

In Canada, over 40% of invasive cervical cancer cases occur among women who have never been screened and 10% among those screened infrequently.<sup>1-3</sup> Up to 12% of Canadian women have never been screened, but this number can be as high as 43% among certain social groups.<sup>4</sup> Several factors are associated with a lower likelihood of being screened including older age,<sup>5</sup> being single,<sup>5,6</sup> lower education,<sup>5,6</sup> having a primary language which is not English or French,<sup>5,7</sup> not being born in Canada,<sup>5-7</sup> limited or no access to a regular doctor,<sup>6</sup> lower area-level income,<sup>7,8</sup> and residing in Montreal (in comparison to Toronto or Vancouver).<sup>6</sup>

Quebec is the only province in Canada which has not implemented any component of an organized cervical cancer screening program.<sup>9</sup> Instead, cervical cancer screening is conducted opportunistically when women visit a health care provider, usually a physician. Though there is a peer-reviewed literature on cervical cancer screening in Canada, very little is published on factors associated with screening among women residing in Quebec overall and in large urban areas such as Montreal specifically.<sup>9</sup> This is an important gap since health care services are planned and managed at provincial and regional levels.

In order to inform interventions, the purpose of this manuscript is threefold, 1) to describe screening coverage in the greater Montreal region (where approximately 50% of the Quebec population resides)<sup>10</sup> according to established risk factors, 2) to assess the associations between established risk factors and two cervical cancer screening outcomes (never screened and not recently screened), and 3) describe the reported reasons for not being screened in the previous three years.

## Methods

### Study setting

Quebec is the second most populous of the ten Canadian provinces (approximately 8.4 million residents in 2017; of Canada's 36.7 million),<sup>11</sup> known especially for its French heritage. Though English and French are both recognized as official national languages in Canada, French is the only recognized official language at the provincial level in Quebec.<sup>12</sup> Between 2006 and 2012, landed immigrants represented 13% of the Quebec population, and most (87%) lived in Montreal, the province's largest city.<sup>13</sup> According to 2001 Canadian Census estimates, 27% of immigrants to Quebec were from countries in Asia, 17% were from Central and South America and the Caribbean, 11% were from Africa, 4% were from the United States, and less than 1% were from Oceania.<sup>14</sup>

All health care, including primary care, is covered by the province's public Health Insurance Plan.<sup>15</sup> Primary and secondary prevention strategies are employed in Quebec in regards to cervical cancer. The human papilloma virus (HPV) is a necessary cause of cervical cancer, and vaccines to prevent infection by several types are available.<sup>16</sup> A primary prevention, school-based HPV vaccination program was established in Quebec in 2008. This program currently targets girls and boys in grade 4.<sup>16</sup> Free catch-up is available for girls up to 17 years of age in various settings and for certain groups up to 26. HPV vaccine coverage has varied by year and target group but is overall around 78% in Quebec.<sup>17</sup> Secondary prevention is conducted via screening Papanicolaou (pap) smear. In 2011, Quebec's Public Health Institute (*Institut National de Santé Publique du Québec* - INSPQ) established guidelines which recommend cervical cancer screening for women 21-65 years of age at 2-3 year intervals.<sup>18</sup>

### Study sample

Four waves of data (2003, 2005, 2008, 2012) from the population-based Canadian Community Health Survey (CCHS) were utilized for this study. The Canadian Community Health Survey (CCHS) is a cross-sectional, nationally-based survey implemented by Statistics Canada, Canada's national statistics agency. The CCHS targets approximately 98% of the Canadian population age 12 years and older.<sup>19</sup> Excluded from the survey's target population are individuals living on First Nation reserves, Crown lands, or in very remote regions, as well as individuals who reside in clinical or carceral institutions, or who are members of the Canadian Armed Forces.<sup>19</sup> Response rates for the CCHS were 80.7% in 2003,<sup>20</sup> 78.9% in 2005,<sup>21</sup> 78% in 2008,<sup>22</sup> and 68.9% in 2012.<sup>23</sup>

Analyses were conducted among women residing in the Montreal Metropolitan Area according to their residential postal code<sup>9</sup> (pooled unweighted N=6,393, weighted N=3,650,999). In accordance with Quebec cervical screening guidelines,<sup>24</sup> we included women who were between the ages of 21 and 65 years. We excluded women who reported having a hysterectomy, who were missing data on pap screening (3%) or other covariates (see Predictors). In 2005, Statistics Canada erroneously skipped the question which ascertains history of hysterectomy among women 50 years and older.<sup>25</sup> In lieu of excluding this wave of data in its entirety, only women 50+ were excluded from our analyses.

The study protocol was approved by the Ethics Review Committee of the Centre Hospitalier de l'Université de Montréal.

### Outcomes

We assessed two outcomes. The first was not having been screened in one's lifetime, and in line with many cervical screening guidelines,<sup>24,26</sup> the second was not receiving a screen in the three years previous to the administration of the survey, given that the women had received at least one screening test in her lifetime. Participants who had not been screened in the previous 3 years were asked to select all reasons that apply among the 16 enumerated by the CCHS questionnaire.<sup>23</sup> We computed estimates for responses to the 5 most frequently reported reasons. We collapsed three responses ("not available at the time required," "not available in the area," and "wait time was too long" into one we describe as "problems with availability."

### Predictors

We assessed relationships with age (21-29, 30-49, and 50+ years), marital status (single, married/common law, and widowed/separated/divorced: 0.1% missing), education (less than high school; at least high school graduation, trade certificate, or non-university diploma; university graduation: 3.1% missing), immigrant status, having a primary care physician (yes/no: 3.7% missing), and household income in categories (1: 0 < 30,000, 2: 30,000 < 52,000, 3: 52,000 < 80,000, and 4: 80,000 +). Because the income variable is known to have an elevated level of non- or partial-response (in our sample 12% and 19% respectively) Statistics Canada provides imputed values for CCHS surveys after 2003.<sup>27</sup> We used Hotdeck imputation in SAS-callable SUDAAN<sup>28</sup> for missing income values in the 2003 data.

Evidence indicates there are inequalities in screening according to immigrant status,<sup>29</sup> thus we created two classifications and ran separate models for each. In the first classification, we created four categories based on immigration and time since immigration. Recent immigrants were defined as those who had been in Canada less than 5 years, medium-term immigrants as those who had been in Canada for between 5 and 9 years, and long-term immigrants as those

who had been in Canada for 10 years or more. In the second classification, immigrants were classified according to region of birth: North America and Oceania; Africa; Asia; South and Central America, and Caribbean; and European. As initial models indicated that there were no differences between immigrants and non-immigrants in terms of non-recent screening, we collapsed the variable into two categories: immigrant vs non-immigrant for analyses involving that outcome.

### Statistical analysis

Chi-squared statistics were calculated for the cross-tabulated associations. Because of data privacy agreements, only weighted sample sizes and proportions are presented for sub-groups. Poisson regression was utilized to model prevalence ratios and we calculated prevalence differences. All models were implemented in STATA version 13.<sup>30</sup> Confidence intervals were estimated using bootstrap variance weights. All analyses were conducted at the Quebec Inter-university Center for Social Statistics.

### **Results**

In total, 25.7% of women in the survey had not been screened in the previous three years, including 13.6% who had never been screened and 12.1 % who had not been screened in the previous 3 years, but who had been screened in their lifetime. These prevalence estimates did not differ across survey years (data not shown). However, the prevalence varied widely according to personal characteristics. A gradient was observed according to duration since immigration with 43.9% of recent immigrants, 33.4% of mid-term immigrants, 23.7% of long-term immigrants, and 8.9% of non-immigrants reporting lifetime never screening, respectively ( $\chi^2$  p-value < 0.05) (Table 1). Women from Canada, North America and Oceania reported statistically significantly lower rates of having never been screened (8.9%) than women originating from other regions (estimates ranging from 15.5% to 36.5%). Though, immigrant women comprises a smaller proportion of the population, a similar number of immigrants and non-immigrants had never been screened: 244, 066 and 251, 093 (weighted Ns), respectively.

Women with a primary care physician reported lower rates of having never been screened (10.5%) than women who did not have a PCP (21.5%). Differences were also observed according to educational attainment (25.4% among women with less than a high school education versus 11.7% among women with post-secondary education) and income (25% for women in the lowest income category versus 8.3% among women in the highest income category). Higher proportions of younger women reported having never been screened (19.7%) than older women (13.0% among women 50 or older), and single women reported higher rates (18.8%) than married women (11.3%).

In fully adjusted models of lifetime screening, being an immigrant of any duration was the strongest predictor of never receiving a screening test in one's lifetime (Prevalence Ratios (PRs) ranging from 2.7 (95% confidence interval (CI): 2.1-3.5) to 3.9 (95% CI: 2.9-5.4)) (Table 2). This is reflected in the prevalence differences (PDs) ranging from 0.19 (95% CI: 0.12-0.27) to 0.36 (95% CI: 0.22-0.50). Regions of origin other than Canada, North America, and Oceania were also predictors of never receiving a screening test (PRs ranging from 1.8 (95% CI: 1.3-2.5) among immigrants from Europe to 4.1 (95% CI: 3.0-5.7) among immigrants from Asia. Not having a primary care physician, lower educational attainment, lower income, and being single were also significant predictors of lifetime screening.

The observed pattern was slightly different for screening in the previous 3 years. No

difference was observed by immigrant status, income, or marital status (Table 1). However, differences according to having a PCP (22.3% vs 8.7%) and education (24.5% for less than high school versus 9.5% for post-secondary) were again observed. The pattern according to age was different than that for lifetime screening with 3.4% of women age 21-29 years, and 19.2% of women 50 years and older reporting non-recent screening, respectively. Results from fully adjusted models for recent screening indicated that not having a PCP (PR=3.0, 95% CI: 2.3-3.9; PD: 0.17, 95% CI: 0.12-0.22), older age (PR: 7.8, 95% CI: 4.4-14.0; PD: 0.56, 95% CI: 0.22-0.89), and lower educational attainment (PR: 2.3, 95% CI: 1.7-3.2; PD: 0.14, 95% CI: 0.04-0.23) were significantly associated with the outcome (Table 3). However, immigrant status, income, and marital status did not predict non-recent screening.

Approximately 80% of women who have never been screened have at least one risk factor among those studied, which included being an immigrant to Canada, being in the lowest income category, and having attained less than a high school diploma (Table 4). Among those who had not been screened recently, approximately 70.0% also had at least one risk factor. Among women who had never been screened, 48.9% reported that they did not think it was necessary, 20.3% reported they had not gotten around to it, and 10.5% because their physician did not think it was necessary (Table 5). Among women who had been screened in their lifetime, but who were not screened recently, 33.0% reported they did not think it was necessary, 32.6% reported the reason to be they had not gotten around to it, 13.4% reported problems with availability, and 5.8% reported their doctor did not think it was necessary.

## Discussion

In total 25.7% of women residing in the Montreal metropolitan area had not been screened for cervical cancer in the previous 3 years, including 13.6% who had never been screened, and 12.1% who had been screened in their lifetime but not according to guidelines. These two sub-populations have distinct risk factor profiles. Immigrant status and lower educational attainment are the strongest predictors among women who have never been screened whereas, not having a family physician, older age and lower educational attainment are the strongest predictors of not being screened recently, among those who have had a screen in their lifetime.

The findings related to never being screened are consistent with other findings from Canada, which have also shown recent immigrant status and lack of access to a primary care physician to be risk factors for never being screened.<sup>4-6,29</sup> The current findings on recent screening are distinct from previous examinations in that we did not observe an association between immigrant status and non-recent screening. This is likely due to the fact that we distinguished between women who had never been screened from those who have not been screened in the previous three years, but who had been screened at some point in their lifetimes. This distinction proved to be important as the groups have different risk-factor profiles. Our findings are also consistent with a recent study of women diagnosed with cervical cancer, set in Montreal,<sup>31</sup> which indicated that immigrants and women who spoke neither French nor English were at highest risk of being diagnosed with cervical cancer and were at higher risk of being diagnosed with regional or distant, as opposed to local, disease.

These results should be carefully considered in the context of Quebec and the current cervical cancer control paradigm, which has changed with the introduction of HPV vaccines.<sup>32</sup> In Quebec, although there is 78% vaccine coverage in general, coverage is significantly lower among those who are socially deprived, immigrants, and/or Anglophones.<sup>17</sup> If our findings

related to social inequalities in lifetime screening remain unchanged, many of these women will be at once less likely to be vaccinated and less likely to be screened in their lifetime. Thus, further highlighting the need to develop and implement efficacious interventions that reduce social inequalities in screening in Quebec.

There are several interventions that could potentially improve screening uptake, such as, implementation of an organized screening program, integration of HPV self-sampling strategies, increasing accessibility to primary care physicians, and training non-physician health care providers to conduct cervical cancer screening. It is likely that some combination of these approaches will be necessary to increase uptake among those women most at risk for developing invasive cervical cancer. Although organized screening programs have been shown to increase uptake and improve efficiency of cervical cancer screening on a population-level,<sup>33</sup> more studies are necessary in Canada to assess their impact on inequalities as existing studies are limited.<sup>34,35</sup> Apart from organized screening, there have been some calls to integrate self-sampled HPV testing into the screening toolkit in Canada<sup>36</sup> as has been done elsewhere,<sup>37</sup> since this method appears to be an especially useful approach for increasing uptake in vulnerable women in some settings.<sup>38,39</sup> Additionally, some studies have shown that enrolment with a primary care physician is associated with screening uptake among immigrant women.<sup>40</sup> In Quebec, 27% of women do not have a primary care physician<sup>41</sup> and recent reforms<sup>42</sup> seek to increase the proportion of the population enrolled with a PCP to 85% by the end of 2017.<sup>43</sup> It is unclear what influence, if any, this might have on the provision of preventive services, such as cervical cancer screening. Any changes to primary care access should be monitored for their potential impact in this regard. In order to reduce the burden of preventive care among physicians, training non-physician health care providers to conduct cervical cancer screening has been utilized,<sup>44</sup> and has been shown to increase screening uptake in various contexts.<sup>45</sup> Expanding the training of non-physicians to conduct cervical cancer screening might also be an intervention that could increase screening uptake, without necessitating increased access to physicians.

Nearly 50% of women who had never been screened indicated that they were unaware that screening is necessary, suggesting there is an opportunity for public health planners and health care providers to improve women's understanding of standard practice for cervical cancer screening. Additionally, we demonstrate that being an immigrant is not associated with recent screening among women who have been screened at least once in their lifetime. Future studies could assess if immigrant women who are screened simply differ in various ways from immigrant women who are not screened, or if once the initial barrier to being ever screened is surmounted, regular screening is maintained, thus, potentially informing new avenues of interventions.

This study has some limitations. Given that the *Régie de l'assurance maladie du Québec (RAMQ)* Medical Procedures File does not contain a specific code for receiving a cervical cancer screening procedure, self-reported screening data were utilized for these analyses. Although the measure is imperfect, it is the best available measure on a population-level in Quebec and is likely an over-estimate of actual screening rates. Women tend to over-report receipt of cervical cancer screening within a given time-frame.<sup>46-49</sup> This tendency is thought to be more pronounced among women from lower-income and non-white ethnic backgrounds<sup>46,50</sup> and may influence results by underestimating the number of women in need of screening and the magnitude of existing inequalities.

The study additionally had some notable strengths. The CCHS is a population-based survey which allows for estimation of screening rates in the general population. The study



distinguished between women who had never been screened and those who have been screened, but not in the previous 3 years, which permitted more detailed understanding of the association between the covariates and the outcomes. Additionally, difference measures were presented alongside ratio measures. This more easily permits an evaluation of the underlying screening rates, which can be important for public health planning purposes and comparison across studies.

These results provide a description of which sub-populations might benefit most from cervical cancer screening interventions, immigrants and women without a PCP. The challenges around ensuring PCP access to all residents of Quebec are many. Fortunately, several interventions which women could use without access to a physician exist, such as being screened by a non-physician health care provider, receiving reminders from an organized screening program, or in the form of an auto-administered screening test. Little is known about which of these interventions might have the greatest impact, if any, on increasing uptake among women who have never been screened in Quebec. Future work should assess the acceptability, feasibility, and evaluate these types of interventions in order to increase screening among women who would most benefit.

## Conflicts of Interest

The authors have no conflicts of interest to report.

## Acknowledgements

*The analysis presented in this paper was conducted at the Quebec Interuniversity Centre for Social Statistics which is part of the Canadian Research Data Centre Network (CRDCN). The services and activities provided by the QICSS are made possible by the financial or in-kind support of the Social Sciences and Humanities Research Council (SSHRC), the Canadian Institutes of Health Research (CIHR), the Canada Foundation for Innovation (CFI), Statistics Canada, the Fonds de recherche du Québec - Société et culture (FRQSC), the Fonds de recherche du Québec - Santé (FRQS) and the Quebec universities. The views expressed in this paper are those of the authors, and not necessarily those of the CRDCN or its partners.*

## Funding

This project was funded by the Canadian Institutes of Health Research (CIHR) (POH 123775). G.D.D. is supported by a career award from the Canadian Cancer Society Research Institute (# 703946), A.B is supported by a Vanier doctoral training award from CIHR, M-P Sylvestre is supported by a Career Award from the Fonds de Recherche du Québec-Santé, and M-H Mayrand is supported by a Career Award from the Fonds de Recherche du Québec-Santé.

## References

1. Freeman H, Wingrove B. *Excess Cervical Cancer Mortality: A Marker for Low Access to Health Care in Poor Communities*. Rockville, MD: National Cancer Institute;2005.

2. Spence AR, Goggin P, Franco EL. Process of care failures in invasive cervical cancer: systematic review and meta-analysis. *Prev Med.* 2007;45:93–106.
3. Cervical Cancer. *Division of Cancer Prevention and Control* 2014; <http://www.cdc.gov/cancer/cervical/>. Accessed September 12 2014, 2014.
4. Xiong H, Murphy M, Mathews M, Gadag V, Wang PP. Cervical cancer screening among Asian Canadian immigrant and nonimmigrant women. *Am J Health Behav.* 2010;34(2):131-143.
5. Maxwell CJ, Bancej CM, Snider J, Vik SA. Factors important in promoting cervical cancer screening among Canadian women: findings from the 1996-97 National Population Health Survey (NPHS). *Can J Public Health.* 2001;92(2):127-133.
6. Woltman KJ, Newbold KB. Immigrant women and cervical cancer screening uptake: a multilevel analysis. *Can J Public Health.* 2007;98(6):470-475.
7. Lofters A, Glazier RH, Agha MM, Creatore MI, Moineddin R. Inadequacy of cervical cancer screening among urban recent immigrants: a population-based study of physician and laboratory claims in Toronto, Canada. *Prev Med.* 2007;44(6):536-542.
8. Ng E, Wilkins R, Fung MF, Berthelot JM. Cervical cancer mortality by neighbourhood income in urban Canada from 1971 to 1996. *CMAJ.* 2004;170(10):1545-1549.
9. Goggin P, Mayrand M-H. *Recommendations on optimizing cervical cancer screening in Quebec*. Direction des risques biologiques et de la santé au travail, Institut national de santé publique du Québec;2009.
10. Focus on Geography Series, 2011 Census: Province of Quebec. *Census Program* 2011; <http://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-pr-eng.cfm?LANG=Eng&GK=PR&GC=24>. Accessed January 25, 2018.
11. CANSIM Table 051-0001: Estimates of population, by age group and sex for July 1, Canada, provinces and territories (persons). Ottawa, Ontario: Statistics Canada; 2017.
12. Ghosh R. Public Education and Multicultural Policy in Canada: The Special Case of Quebec. *International Review of Education.* 2004;50(5):543-566.
13. CANSIM Table 282-0101: Labour Force Survey estimates (LFS), by immigrant status, age group, Canada, regions, provinces and Montreal, Toronto, Vancouver census metropolitan areas, three-month moving average, unadjusted for seasonality. Ottawa, Ontario: Statistics Canada; 2017.
14. English-French bilingualism. *2001 Census Topic-based tabulations* 2013; <http://www12.statcan.gc.ca/english/census01/products/analytic/companion/lang/bilingual.cfm>. Accessed December 6, 2017.
15. Learning about healthcare services: Health Insurance Plan. *Immigration to Quebec: Living in Quebec* 2016; <http://www.immigration-quebec.gouv.qc.ca/en/living-quebec/health/index.html>. Accessed January 23, 2018.
16. *Vaccination contre les virus du papillome humain (VPH): Nouveautés et mise à jour des connaissances*. Quebec, Quebec: Gouvernement du Québec, Ministère de la Santé et des services sociaux (MSSS);2017.
17. Drolet M, Deeks SL, Kliwer E, Musto G, Lambert P, Brisson M. Can high overall human papillomavirus vaccination coverage hide sociodemographic inequalities? An ecological analysis in Canada. *Vaccine.* 2016;34(16):1874-1880.
18. *Guidelines on cervical cancer screening in Quebec*. Quebec, Quebec: Institut National de Santé Publique du Québec (INSPQ);2011.
19. Béland Y. Canadian community health survey: Methodological Overview. *Health*

- Reports*. 2002;13(3):9.
20. *CCHS Cycle 2.1 (2003), Public Use Microdata File Documentation*. Ottawa, Canada: Statistics Canada;2003.
  21. *CCHS 3.1 (2005) Public Use Microdata File User Guide*. Ottawa, Canada: Statistics Canada;2005.
  22. *CCHS Cycle 2008 Public Use Microdata File Documentation*. Ottawa, Canada: Statistics Canada;2008.
  23. Canadian Community Health Survey - Mental Health (CCHS). 2013; <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=5015>. Accessed December 18, 2015.
  24. *Lignes directrices sur le dépistage du cancer du col utérin au Québec* Quebec: Institut National de Sante Publique du Quebec (INSPQ);2011.
  25. *Canadian Community Health Survey (CCHS) - Errata*. Ottawa, Canada: Statistics Canada;2011.
  26. *Ontario cervical screening cytology guidelines summary*. Toronto, ON: Cancer Care Ontario; 2012.
  27. Yeung CW, Thomas S. *Income imputation for the Canadian Community Health Survey*. Ottawa, ON: Statistics Canada;2013.
  28. Shah BV, Barnwell BG, Bieler GS. *SUDAAN, Software for the Statistical Analysis of Correlated Data: User's Manual, Release 7.0, April 1996*. Research Triangle Institute; 1996.
  29. Lofters AK, Moineddin R, Hwang SW, Glazier RH. Low Rates of Cervical Cancer Screening Among Urban Immigrants: A Population-Based Study in Ontario, Canada. *Medical Care*. 2010;48(7):611-618
  30. StataCorp L. *Stata Statistical Software: Release 13*. College Station, TX. 2013.
  31. Spence A, Alobaid A, Drouin P, et al. Screening histories and contact with physicians as determinants of cervical cancer risk in Montreal, Quebec. *Current Oncology*. 2014;21(6):294.
  32. Franco EL, Harper DM. Vaccination against human papillomavirus infection: a new paradigm in cervical cancer control. *Vaccine*. 2005;23(17-18):2388-2394.
  33. Miles A, Cockburn J, Smith RA, Wardle J. A perspective from countries using organized screening programs. *Cancer*. 2004;101(S5):1201-1213.
  34. Tavasoli SM, Pefoyo AJK, Hader J, Lee A, Kupets R. Impact of invitation and reminder letters on cervical cancer screening participation rates in an organized screening program. *Preventive Medicine*. 2016;88:230-236.
  35. Mema SC, Nation J, Yang H, et al. Screening History in 313 Cases of Invasive Cancer: A Retrospective Review of Cervical Cancer Screening in Alberta, Canada. *Journal of Lower Genital Tract Disease*. 2017;21(1):17-20.
  36. Lofters A, Vahabi M. Self-sampling for HPV to enhance uptake of cervical cancer screening: Has the time come in Canada? *CMAJ*. 2016;188(853-854).
  37. Arbyn M, Castle PE. Offering Self-Sampling Kits for HPV Testing to Reach Women Who Do Not Attend in the Regular Cervical Cancer Screening Program. *CEBP*. 2015;24(5):769-772.
  38. Vahabi M, Lofters A. Muslim immigrant women's views on cervical cancer screening and HPV self-sampling in Ontario, Canada. *BMC public health*. 2016;16(1):868.
  39. Gottschlich A, Rivera-Andrade A, Grajeda E, Alvarez C, Montano CM, Meza R.

- Acceptability of Human Papillomavirus Self-Sampling for Cervical Cancer Screening in an Indigenous Community in Guatemala. *Journal of Global Oncology*.0(0):JGO.2016.005629.
40. Lofters AK, Moineddin R, Hwang SW, Glazier RH. Predictors of low cervical cancer screening among immigrant women in Ontario, Canada. *BMC Women's Health*. 2011;11(1):20.
  41. *Health Fact Sheet: Access to a regular medical doctor, 2014*. Ottawa, Canada: Statistics Canada;2015.
  42. Barrette G. Loi édictant la Loi favorisant l'accès aux services de médecine de famille et de médecine spécialisée et modifiant diverses dispositions législatives en matière de procréation assistée *Bill 20/ Projet de loi 20*. Québec, Québec: 41st Assemblée Nationale du Québec; 2015:24.
  43. Entente avec la Fédération des médecins omnipraticiens du Québec: Le ministre Barrette dévoile les résultats quant aux cibles intermédiaires [press release]. Quebec, Quebec: Gouvernement du Quebec: Ministère de la Santé et des services sociaux2016.
  44. Linos A, Riza E. Comparisons of cervical cancer screening programmes in the European Union. *European Journal of Cancer*. 2000;36(17):2260-2265.
  45. Mandelblatt J, Traxler M, Lakin P, et al. A nurse practitioner intervention to increase breast and cervical cancer screening for poor, elderly black women. *Journal of General Internal Medicine*. 1993;8(4):173-178.
  46. McPhee SJ, Nguyen TT, Shema SJ, et al. Validation of recall of breast and cervical cancer screening by women in an ethnically diverse population. *Prev Med*. 2002;35(5):463-473.
  47. Howard M, Agarwal G, Lytwyn A. Accuracy of self-reports of Pap and mammography screening compared to medical record: a meta-analysis. *Cancer Causes Control*. 2009;20(1):1-13.
  48. Rauscher GH, Johnson TP, Cho YI, Walk JA. Accuracy of self-reported cancer-screening histories: a meta-analysis. *Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology*. 2008;17(4):748-757.
  49. Lofters A, Vahabi M, Glazier RH. The validity of self-reported cancer screening history and the role of social disadvantage in Ontario, Canada. *BMC public health*. 2015;15:28.
  50. Lofters AK, Moineddin R, Hwang SW, Glazier RH. Does social disadvantage affect the validity of self-report for cervical cancer screening. *Int J Womens Health*. 2013;5(2):29-33.

Table 1: Prevalence of lifetime never screening and non-recent screening by demographic and socioeconomic characteristics among women residing in the Montreal Metropolitan Area (CCHS 2003, 2005, 2008, 2012)

	Proportion of the population	Weighted N	Prevalence proportion, Never screened		Prevalence proportion, Non-recently screened	
			%	95% CI	%	95% CI
<b>Overall</b>	100	3,650,999	13.6	(12.1-15.2)	12.1	(10.6-13.7)
<b>Age</b>						
21-29	23.4	853,279	19.7	(16.5-23.4)	3.4	(2.0-5.7)
30-49	53.4	1,948,932	11.1	(9.4-13.4)	12.5	(10.5-14.8)
50+	23.2	848,788	13.0	(9.5-17.5)	19.2	(15.6-23.3)
<b>Immigration status</b>						
Immigrant <5 yrs	4.6	169,641	43.9	(34.6-53.6)		
Immigrant 5-9yrs	4.0	146,958	33.4	(24.6-43.4)	12.5 *	(8.7-17.6)
Immigrant 10+yrs	14.0	509,788	23.7	(18.2-30.2)		
Non-immigrant	77.4	2,824,612	8.9	(7.7-10.3)	12.0	(10.5-13.7)
<b>Region of Origin</b>						
Canada, North	77.0	2,812,547	8.9	(7.7-10.2)		
America, Oceania						
Europe	5.5	200,810	15.5	(11.1-21.1)		
South America, Central America, Caribbean	5.4	196,557	31.1	(22.3-42.4)		
Africa	4.3	157,436	36.5	(23.8-51.5)		
Asia	6.5	238,029	33.6	(24.8-43.7)		
Missing	1.3	45,618	36.0	(25.4-48.0)		
<b>Primary care physician</b>						
No	27.6	1,009,354	21.5	(18.2-23.2)	22.3	(18.5-26.6)
Yes	72.4	2,641,646	10.5	(9.0-12.3)	8.7	(7.3-10.3)
<b>Education<sup>†</sup></b>						
< HS Degree	9.9	361,673	25.4	(18.6-33.6)	24.5	(18.5-31.6)
HS Graduate	18.3	668,730	14.7	(11.6-18.3)	16.8	(12.4-22.3)
Post-sec Graduate	71.8	2,620,596	11.7	(10.2-13.3)	9.5	(8.1-11.1)
<b>Income</b>						
0 < 30,000	19.1	698,876	25.0	(20.4-30.4)	15.3	(11.5-20.1)
30,000 < 52, 000	24.0	874,012	14.7	(12.2-17.6)	13.3	(10.4-16.7)
52,000 < 80,000	21.1	770,600	10.9	(8.3-14.2)	11.4	(8.7-14.6)
80,000 +	35.8	1,307,510	8.3	(6.5-10.4)	10.4	(8.1-13.3)
<b>Marital Status<sup>†</sup></b>						
Single	25.8	941,324	18.8	(15.9-22.2)	11.6	(9.3-14.4)
Div/wid/sep	11.8	430,598	14.2	(9.0-21.6)	13.6	(10.2-17.9)
Married/com-law	62.4	2,279,078	11.3	(9.6-13.2)	12.0	(10.0-14.3)

<sup>†</sup>Immigrant status was not associated with non-recent screening thus the categories were collapsed for this outcome

<sup>†</sup> “HS” stands for High School; “Post-sec” stands for Post Secondary Education; “Div” stands for divorced; “Wid” stands for widowed; “Sep” stands for separated; “Com-Law”

stands for in Common Law relationship.

ACCEPTED MANUSCRIPT

Table 2: Age-adjusted bivariate, and fully-adjusted Poisson regression models of no lifetime cervical carcinoma screening among women residing in the Montreal Metropolitan Area (CCHS 2003, 2005, 2008, 2012)

	Bivariate age-adjusted*				Fully-adjusted			
	PR <sup>†</sup>	95% CI	PD <sup>‡</sup>	95% CI	PR <sup>†</sup>	95% CI	PD <sup>‡</sup>	95% CI
<b>Age</b>								
21-29	1.0		0		1.0		0	
30-49	0.6	(0.5-0.7)	-0.08	(-0.11, -0.05)	0.7	(0.5-0.9)	-0.05	(-0.08, -0.02)
50+	0.7	(0.5-0.1)	-0.05	(-0.09, -0.01)	0.9	(0.6-1.2)	-0.02	(-0.06, 0.02)
<b>Immigration status</b>								
Immigrant <5 yrs	4.5	(3.5-5.9)	0.42	(0.28, 0.56)	3.9	(2.9-5.4)	0.36	(0.22, 0.50)
Immigrant 5-9yrs	4.1	(3.0-5.6)	0.39	(0.23, 0.54)	3.7	(2.7-5.2)	0.34	(0.19, 0.49)
Immigrant 10+yrs	2.9	(2.2-3.8)	0.21	(0.13, 0.30)	2.7	(2.1-3.5)	0.19	(0.12, 0.27)
Non-immigrant	1.0		0		1.0		0	
<b>Origin<sup>§</sup></b>								
Canada, North America, Oceania	1.0		0		1.0		0	
Europe	1.8	(1.3-2.6)	0.11	(0.03-0.19)	1.8	(1.3-2.5)	0.10	(0.02-0.18)
South America, Central America, Caribbean	3.7	(2.6-5.1)	0.33	(0.18-0.47)	3.0	(2.2-4.1)	0.24	(0.14-0.36)
Africa	4.2	(2.8-6.3)	0.39	(0.19-0.60)	3.6	(2.4-5.4)	0.32	(0.15-0.50)
Asia	4.1	(3.0-5.5)	0.36	(0.23-0.49)	4.1	(3.0-5.7)	0.37	(0.23-0.52)
Missing	4.3	(3.0-6.3)	0.44	(0.24-0.64)	3.7	(2.6-5.3)	0.36	(0.19-0.53)
<b>Primary care physician</b>								
No	2.0	(1.6-2.5)	0.10	(0.07, 0.14)	1.5	(1.2-1.9)	0.06	(0.03, 0.09)
Yes	1.0		0		1.0		0	
<b>Education<sup>  </sup></b>								
< HS Degree	2.3	(1.6-3.2)	0.15	(0.07, 0.24)	1.9	(1.4-2.6)	0.11	(0.04, 0.18)
HS Graduate	1.3	(1.0-1.7)	0.04	(-0.001, 0.08)	1.4	(1.1-1.8)	0.05	(0.01, 0.10)
Post-sec Graduate	1.0		0		1.0		0	
<b>Income</b>								
0 < 30,000	2.8	(2.1-3.9)	0.19	(0.11, 0.27)	1.5	(1.1-2.1)	0.06	(0.004, 0.11)
30,000 < 52, 000	1.7	(1.3-2.3)	0.08	(0.03, 0.14)	1.2	(0.9-1.6)	0.03	(-0.02, 0.08)

52,000 < 80,000	1.3	(0.9-1.8)	0.04	(-0.02, 0.09)	1.2	(0.9-1.6)	0.02	(-0.03, 0.07)
80,000 +	1.0		0		1.0		0	
<b>Marital Status<sup>†</sup></b>								
Single	1.3	(0.8-2.1)	0.04	(-0.04, 0.12)	1.5	(1.2-1.9)	0.01	(-0.04, 0.06)
Div/wid/sep	1.4	(1.2-1.8)	0.05	(0.02, 0.09)	1.0	(0.7-1.5)	0.06	(-0.02, 0.09)
Married/com-law	1.0		0		1.0		0	

\*Bivariate prevalence ratios and differences of screening outcomes by each covariate, adjusted for age.

<sup>†</sup> Prevalence Ratio

<sup>‡</sup>Prevalence proportion Difference

<sup>§</sup> Adjusted PR and PD estimates for regions of origin were estimated in a separate model, adjusting for all covariates except time since immigration (covariate PR, PD information not shown). To maintain a consistent sample size, women missing region of birth were assigned a missing indicator instead of being excluded from the analyses. All other adjusted PR and PD estimates were obtained from the model adjusting for time since immigration (all are shown in Table). PR and PD estimates for covariates in both models were nearly identical.

<sup>||</sup> “HS” indicates High School; “Post-sec” indicates Post-Secondary Education; “Div” indicates divorced; “Wid” indicates widowed; “Sep” indicates separated; “Com-Law” indicates Common Law relationship.



Table 3: Age-adjusted bivariate, and fully-adjusted Poisson regression models of non-recent cervical carcinoma screening among women residing in the Montreal Metropolitan Area (CCHS 2003, 2005, 2008, 2012)

	Bivariate age-adjusted*				Fully-adjusted			
	PR <sup>†</sup>	95% CI	PD <sup>‡</sup>	95% CI	PR <sup>†</sup>	95% CI	PD <sup>‡</sup>	95% CI
<b>Age</b>								
21-29	1.0		0		1.0		0	
30-49	3.7	(2.2-6.2)	0.19	(0.08, 0.29)	4.7	(2.7-8.2)	0.25	(0.11, 0.39)
50+	5.6	(3.3-10.0)	0.39	(0.16, 0.61)	7.8	(4.4-14)	0.56	(0.22, 0.89)
<b>Immigration status</b>								
Immigrant	0.99	(0.7-1.5)	-0.001	-0.05, 0.05	0.9	(0.6-1.4)	-0.01	-0.05, 0.04
Non-immigrant	1.0		0		1.0		0	
<b>Primary care physician</b>								
No	3.1	(2.4-4.0)	0.17	(0.12, 0.22)	3.0	(2.3-3.9)	0.17	(0.12, 0.22)
Yes	1.0		0		1.0		0	
<b>Education<sup>§</sup></b>								
< HS Degree	2.3	(1.7-3.2)	0.15	(0.07, 0.22)	2.3	(1.5-3.4)	0.14	(0.04, 0.23)
HS Graduate	1.6	(1.1-2.3)	0.07	(0.01, 0.13)	1.6	(1.1-2.2)	0.06	(0.01, 0.12)
Post-sec Graduate	1.0		0		1.0		0	
<b>Income</b>								
0 < 30,000	1.6	(1.1-2.3)	0.07	(0.01, 0.13)	1.0	(0.6-1.6)	0.001	(-0.05, 0.06)
30,000 < 52, 000	1.4	(1.0-1.9)	0.04	(-0.01, 0.09)	1.2	(0.8-1.6)	0.02	(-0.03, 0.06)
52,000 < 80,000	1.1	(0.8-1.6)	0.01	(-0.03, 0.06)	1.0	(0.7-1.4)	-0.001	(-0.04, 0.04)
80,000 +	1.0		0		1.0		0	
<b>Marital Status<sup>§</sup></b>								
Single	0.93	(0.7-1.3)	-0.01	(-0.05, 0.03)	1.3	(1.0-1.7)	-0.02	(-0.06, 0.02)
Div/wid/sep	1.4	(1.1-1.9)	0.05	(0.01, 0.09)	0.9	(0.6-1.2)	0.03	(-0.01, 0.08)
Married/com-law	1.0		0		1.0		0	

\* Bivariate prevalence ratios and differences of screening outcomes by each covariate, adjusted for age.

<sup>†</sup> Prevalence Ratio

<sup>‡</sup>Prevalence proportion Difference

<sup>§</sup> “HS” indicates High School; “Post-sec” indicates Post-Secondary Education; “Div” indicates divorced; “Wid” indicates widowed; “Sep” indicates separated; “Com-Law” indicates

Common Law relationship.

ACCEPTED MANUSCRIPT

Table 4. Prevalence of never screening and non-recent screening risk factors (%) among women residing in the Montreal Metropolitan Area who have never been screened, not recently screened (CCHS 2003, 2005, 2008, 2012)

<b>Number of risk factors*</b>	<b>Ever screened</b>	<b>Never screened</b>	<b>Recently screened</b>	<b>Not recently screened</b>
<b>0</b>	51.9	20.6	55.1	29.8
<b>1</b>	31.3	33.5	29.8	42.4
<b>2</b>	13.0	27.5	11.7	22.3
<b>3</b>	3.8	18.5	3.5	5.5

\*Risk factors include being an immigrant to Canada, being of the 1<sup>st</sup> income quartile grouping, having a less than a high school educational attainment.

Table 5. Reported reasons for not screening in the previous 3 years according to lifetime screening practices among women residing in the Montreal Metropolitan Area (CCHS 2003, 2005, 2008, 2012)

	<b>Never screened</b>	<b>Not screened recently</b>
<b>Have not gotten around to it</b>	20.3	32.6
<b>Respondent did not think it necessary</b>	48.9	33.0
<b>Doctor did not think it necessary</b>	10.5	5.8
<b>Problems with availability*</b>	2.8	13.4
<b>Did not know where to go</b>	5.0	2.9
<b>Other - identified**</b>	0.7	2.7
<b>Other - unidentified</b>	14.8	17.0

\*Not available at the time required, in the area, or wait time was too long

\*\*Personal or family responsibilities, transportation problems, language problems, cost, fear, unable to leave the house because of health problems

## Highlights

- Two sub-populations exist: those never screened and those not screened according to guidelines
- Recent immigrant status is the strongest predictor for no lifetime screening
- Older age and lack of PCP are the strongest predictors of not being screened according to guidelines
- Nearly 50% of women who had never been screened were unaware that screening is necessary
- These findings imply several possible interventions to increase screening uptake