Curr Oncol, Vol. 21, pp. 294-304; doi: http://dx.doi.org/10.3747/co.21.2056

ORIGINAL ARTICLE

Screening histories and contact with physicians as determinants of cervical cancer risk in Montreal, Quebec

A.R. Spence PhD, A. Alobaid MD,† P. Drouin MD,‡ P. Goggin MD,§ L. Gilbert MD,|| D. Provencher MD,‡ P. Tousignant MD PhD,#** J.A. Hanley PhD,# and E.L. Franco DrPH*#*

ABSTRACT

Background

Cervical cancer (CCa) is largely a preventable disease if women receive regular screening, which allows for the detection and treatment of preinvasive lesions before they become invasive. Having been inadequately screened is a common finding among women who develop CCa. Our primary objective was to determine the Pap screening histories of women diagnosed with CCa in Montreal, Quebec. Secondary objectives were to determine the characteristics of women at greatest risk of CCa and to characterize the level of physician contact those women had before developing CCa.

Methods

The Invasive Cervical Cancer Study, a population-based case–control study, consisted of Greater Montreal residents diagnosed with histologically confirmed CCa between 1998 and 2004. Respondents to the 2003 Canadian Community Health Survey and a sample of women without CCa obtained from Quebec medical billing records served as controls.

Results

During the period of interest, 568 women were diagnosed with CCa. Immigrants and women speaking neither French nor English were at greatest risk of CCa. Most of the women in the case group had been screened at least once during their lifetime (84.8%–90.4%), but they were less likely to have been screened within 3 years of diagnosis. Having received care from a family physician or a medical specialist other than a gynecologist within the 5 years before diagnosis was associated with a greater risk of CCa development.

Conclusions

Our findings provide evidence of the need for an organized population-based screening program. They also underscore the need for provider education to prevent missed opportunities for CCa screening when at-risk women seek medical attention.

KEY WORDS

Cervical cancer, Papanicolaou test, screening

1. BACKGROUND

Invasive cervical cancer (CCa) is the third most common female malignancy worldwide, with the greatest burden being seen in developing countries[1]. The disease is less common in the Western world, where greater use of the Papanicolaou (Pap) test, which allows for early detection of preinvasive cervical lesions, and appropriate follow-up have rendered CCa a largely preventable disease. Efforts to prevent CCa have achieved great success in Canada: the incidence of CCa has declined to its current rate of 7.5 per 100,000[2] from an estimated 22 cases per 100,000 population in 1970[3]. Nevertheless, about 1450 Canadian women are diagnosed with CCa annually[2].

Despite the availability of cervical screening in more developed countries, an estimated 54% of women with CCa have either never been screened or have not been screened frequently enough before diagnosis[4]. Earlier studies that set out to estimate failures in screening among women with CCa[4] were often limited because many had few subjects, were hospital or clinic based, and did not interview subjects.

We audited Pap screening histories of all women diagnosed with CCa who resided in Montreal, Quebec, to obtain insights about the health care utilization characteristics that could have placed them at risk of developing the disease. We used survey and administrative health care data as control samples to

measure compliance with screening and physician visits in the general population.

2. METHODS

2.1 Study Setting

The Invasive Cervical Cancer Study (ICCAS), a population-based case–control investigation, was conducted in Montreal and Laval, Quebec. Pap screening in Quebec is opportunistic; no organized Pap screening program is in place. During the study period, annual Pap screening had been recommended for 2 consecutive years from age 18 or after initiation of sexual activity; screening frequency could then be extended to 3 years if all smears were normal[5,6]. Canada provides free universal health care to residents. Subsequently, physicians submit monetary claims to the government for remuneration of services provided. The Quebec government body responsible for payment to physicians is the Régie de l'assurance maladie du Québec (RAMQ).

2.2 Case Identification and Data Collection Methods

The case group consisted of women diagnosed with primary histologically confirmed CCa at a Montreal or Laval hospital between 1998 and 2004 (Table I). The women had been resident in those regions for a minimum of 5 years before and at diagnosis. Using the *International Classification of Diseases,* 9th revision, codes 180.0–180.9, cases were identified by the provincial tumour registry and by medical records departments at 18 hospitals that review Pap smears and that offer diagnostic and treatment services for CCa in greater Montreal. Recommendations state that screening can stop at age 70 if a woman has had at least 2 satisfactory, cytologically normal Pap smears in the preceding 9 years and has never had a biopsy-confirmed precursor lesion[5,6]. Nevertheless, inclusion of women into the case group was not restricted by age, because fulfillment of those criteria could not be determined with certainty based on data collected during the study. Data collected included dates and results of Pap tests, diagnostic procedures, and treatments for preinvasive cervical lesions (including names of physicians performing the services, and names of hospital laboratories where specimens were examined) and demographic characteristics of the study subjects.

Using a specially designed, pilot-tested form, trained abstractors initially collected data from medical charts at the hospital that diagnosed each case. The information from the charts then guided the abstractors to other hospitals at which to review charts. About 14% of charts were reviewed at least twice. The quality of data collection was assessed by determination of inter- and intra-abstractor reliabilities at several points during the data collection phase.

Hospital cytology and pathology laboratories provided reports of Pap tests and CCa-related procedures. Telephone interviews of patients in the case group (or their proxies) were conducted by trained interviewers using a structured questionnaire that was pilot-tested on women who were similar to the women in the case group and who had been diagnosed with CCa in 1997. To obtain a description of all cases of CCa occurring within the time and region of interest, an abbreviated version of the questionnaire (demographic information only) was administered to short-term residents of Montreal and Laval who met all other eligibility criteria.

Family physicians and gynecologists completed a self-administered questionnaire and provided copies of laboratory reports for Pap tests and other cervix-related procedures. Physician medical billing records obtained from the RAMQ consisted of all medical services reimbursed for each woman in the case group within the 5 years before diagnosis, including the date of each service and the medical specialty of the physician who performed the service. No RAMQ code specific to performance of a Pap test exists; hence, medical billing records could not be used to determine screening histories.

2.3 Auditing of Pap Screening History for the Case Group

Each case-specific observation window consisted of two periods, as depicted in Figure 1. The diagnostic period was bounded by the date of diagnosis (that is, date of the first procedure providing histologic proof of CCa) and the date of the first cytologically abnormal or equivocal Pap smear within 5 years preceding diagnosis. That Pap test was termed the "trigger Pap" because it initiated the ensuing cascade of follow-up procedures leading to the CCa diagnosis. To be categorized as the trigger Pap, the test had to be the only cervix-related procedure performed that same day. The pre-diagnostic period consisted of the time from the date of the trigger Pap to the beginning of the observation window—that is, the starting date of the 5 years preceding the diagnosis date. To avoid considering the Pap tests that formed part of the final work-up toward the CCa diagnosis, the determination of Pap screening histories was limited to screening that occurred during and preceding the pre-diagnostic period.

Women were categorized as "ever screened" if they had a Pap test classified as cytologically normal during the pre-diagnostic period or if they had Pap tests of any result before the pre-diagnostic period (or both). They were categorized as "never screened" if there was no evidence of Pap screening within or before the pre-diagnostic period *and* if the woman (or her proxy) said during the interview that she had never been screened during her lifetime. Women who

were classified as "ever screened" were further categorized based on the time interval between date of diagnosis and either the last Pap test considered normal (if it occurred during the pre-diagnostic period) or the last Pap test of any result (if it occurred before the pre-diagnostic period).

Classification of each woman's Pap screening history was based on at least one of the following sources

TABLE I Description of the case and control groups of the Invasive Cervical Cancer Study, Montreal, Quebec, 1998–2004

Descriptor	*Cases*	*Controls*	
		Group 1	*Group 2*
Subject identification	Quebec Tumour Registry and medical records departments at hospitals	Statistics Canada, 2003 CCHS (cycle 2.1)	Physician medical billing records from the RAMQ
Subject inclusion criteria	Diagnosed with a primary, histologically confirmed cervical cancer at a Montreal or Laval hospital during 1998–2004 Resident in the region for a minimum of 5 years before and at diagnosis	Female residents in Montreal or Laval who participated in the 2003 CCHS	Using each date of a histologic cervical cancer diagnosis (case) as an index date, the RAMQ provided a random sample of women without cervical cancer who were individually matched (1:1) to the women with cervical cancer by age (within 5-year age groups) and region of residence (Montreal or Laval)
Data sources	Abstraction of data from hospital medical charts Reports obtained from hospital cytology and pathology laboratories Telephone-based interviews of cases or proxies Self-administered questionnaire completed by family physicians and gynecologists Physician medical billing records from the RAMQ (dates and procedure codes for all medical visits by each patient in the 5 years preceding the index date, including the medical specialty of the physician handling the visit)	Responses to the 2003 CCHS	Physician medical billing records from the RAMQ (dates and procedure codes for all medical visits by each control subject in the 5 years preceding the index date, including the medical specialty of the physician handling the visit)

CCHS = Canadian Community Health Survey; RAMQ = Régie de l'assurance maladie du Québec.

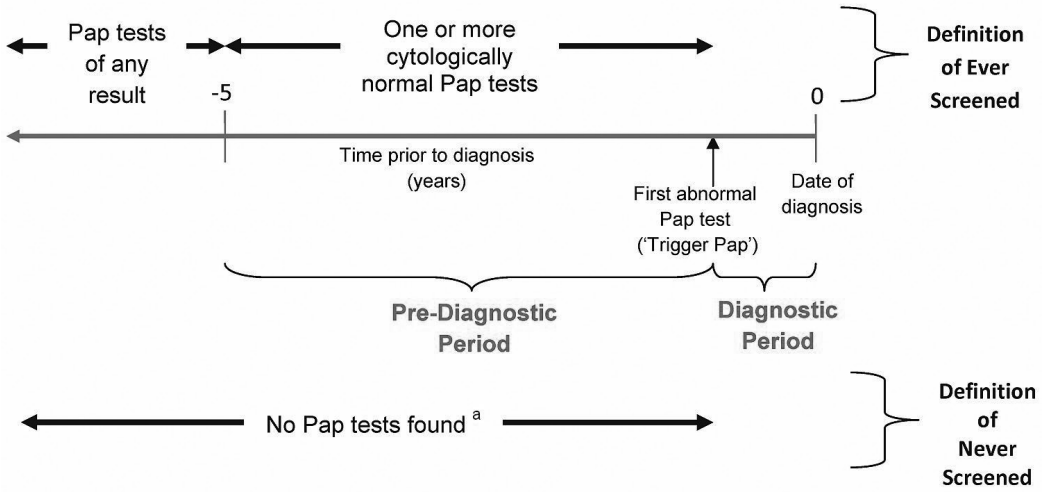

FIGURE 1 Periods of observation and operational definitions of "ever screened" and "never screened." [a] In addition, the woman in the case group (or her proxy) must have completed the subject questionnaire and must have stated that she was never screened.

(listed in declining order of reliability): laboratory report (obtained directly from a hospital laboratory, found in the hospital chart, or sent to us by a physician) and a secondary source (physician questionnaire, annotation within the medical chart, or case or proxy interview). Based on the sources of data available for a given woman and the concordance of results between them, the terms "definite," "probable," and "possible" were used to indicate the degree of confidence attained in the classification of each woman's screening history, with the first and last terms indicating the most and least degrees of confidence respectively. Histories deemed as "definite" were used in the analyses.

2.4 Control Identification and Data Collection Methods

Control subjects were derived from two sources, as noted in Table I. Women residing in Montreal or Laval who participated in the 2003 (cycle 2.1) Canadian Community Health Survey (CCHS) comprised one control group (control group 1). The CCHS is a government-initiated cross-sectional survey that obtains health information about Canadians[7]. These control subjects were not interviewed by our research staff; instead, their responses to CCHS questions about demographics and Pap screening utilization were compared with the same data for the women in the case group who responded to the ICCAS questionnaire. It should be noted that the pertinent questions in the CCHS and the ICCAS had essentially the same wording; any differences were inconsequential.

A second control group (control group 2) was derived from data held by the RAMQ. Using the date of histologic diagnosis with CCA for each woman in the case group as the index date, the RAMQ provided a random sample of women without CCA who were individually matched (1:1) to CCA cases by age (within 5-year age groups) and region of residence (Montreal or Laval). The RAMQ provided the dates and procedure codes of all medical services that the control subjects received in the 5 years before the index date, including the medical specialty of the physician who provided each service. Contacts with family physicians, gynecologists, and other medical specialists for the control subjects were then counted and compared with the medical contact profiles before diagnosis of the women in the CCA case group.

Ethics approval was obtained from pertinent institutions and hospitals, and signed informed consent was obtained from all subjects. Women in the case group or their proxies were contacted only if physicians provided signed permission. The Commission d'accès à l'information approved receipt of data from the Quebec tumour registry and RAMQ.

2.5 Statistical Analysis

Unconditional logistic regression was used to estimate odds ratios (ORS) and 95% confidence intervals (CIS) for associations between characteristics of the study subjects and CCA (overall and by cancer stage). The ORS were adjusted for age (±5 years) at diagnosis for the case group and at time of interview for control group 1. Degree of invasion was classified as localized (International Federation of Gynecology and Obstetrics stages IA1, IA2, IB), regional (stages IIA, IIB, IIIA, IIIB), or distant (stage IV)[8]. For modelling, the first two categories were grouped and compared with the third category.

Screening history was categorized in three ways:

- Lifetime screening history (never, ever, unclassified)
- Time since last Pap test (<3 years, 3 to <5 years, ≥5 years)
- Adequacy of screening history (adequate, inadequate)

With regard to screening history adequacy, "adequate" referred to being screened within 3 years before diagnosis for the case group and before CCHS interview for control group 1, and "inadequate" screening history included subjects in either group who were never screened, who were screened 3 to fewer than 5 years before diagnosis (case group) or before CCHS interview (control group 1), or who were screened 5 or more years before diagnosis (case group) or CCHS interview (control group 1). In addition, women in the case group were classified as inadequately screened when their "ever" or "never" screened status could not be determined, but when it could be determined that they definitely had not been screened in the 5 years before diagnosis.

Three age-adjusted models were created for each of the Pap screening history variables, with each model being restricted to a different case subgroup, based on the source of the screening histories. The first set of analyses were based on screening histories determined using all available sources of data. The second set of analyses included women in the case group whose screening histories were qualified as "definite." The third set of analyses were based solely on responses to the ICCAS questionnaire. The screening histories of control group 1, which were based on their CCHS responses, were used in the latter set of analyses.

Conditional logistic regression was used to examine associations between CCA and number of contacts with family physicians, gynecologists, and other medical specialists before diagnosis. For the two analyses focused on family physicians and gynecologists, the presence of billings for more than one medical service on the same day by the same type of medical professional was deemed to be one contact with that type of physician. Similarly, the presence of billings for more than one medical service by the same or a different type of medical specialist (other than gynecologists) on the same day was considered

one medical visit. So as not to include medical visits that occurred as part of the work-up leading to CCa diagnosis, the observation period was limited to each case's specific pre-diagnostic period, which was also applied to the matched woman in the control group. The windows of observation were therefore the same length for each case and matched control (control group 2). Medical services that occurred on the date of the trigger Pap were not considered. If the date of the trigger Pap was not found, the medical visit to either a family physician or a gynecologist that occurred 1 day before the date of diagnosis was used as a proxy for the trigger Pap date. Similarly, if there was a sequence of visits to family physicians or gynecologists on consecutive days leading up to the diagnosis date, then the earliest date within that sequence was used as the proxy for the trigger Pap date. The trigger Pap date or its proxy for each woman in the case group was then applied to the matched woman in the control group, and the medical visits that each of those women made before that date, but within the 5 years preceding the date of diagnosis for the woman in the case group, were summed and categorized as 0, 1–2, 3–4, or more than 4. Models were mutually adjusted for number of visits to other types of physicians.

Statistical analyses were performed using Stata 10 (StataCorp LP, College Station, TX, U.S.A.).

3. RESULTS

We identified 605 eligible women with CCa who might or might not have resided in Montreal or Laval for at least 5 years before diagnosis, but who met all other eligibility criteria. We contacted 559 of them for interviews. We were not permitted by either physicians or hospital ethics boards to interview the other 46 women. The questionnaire response rate was 65% (n = 362). Reasons for nonparticipation were refusal (30%), inability to trace (31%), death with no proxy available (30%), language barrier (7%), and lack of information on the part of the proxy to respond to the questionnaire (3%). For each woman in the case group, the interview or medical chart informed us of place and duration of residence before diagnosis. In the end, 568 women with CCa, interviewed or not, met all eligibility criteria.

Table II gives select characteristics obtained from hospital medical charts for the women in the case group. The women ranged in age from 22 to 94 years, with a median age of 52 years. Most of the women had symptoms of CCa (70.2%). The most common symptoms were vaginal bleeding and pain at various locations. The most frequent diagnosis was stage IB cancer (30.5%); squamous cell carcinoma was the most common histologic type (72.2%).

Table III presents associations between demographic characteristics and CCa risk. Compared with Canadian-born women, those not born in Canada

TABLE II Select characteristics of the case group participating in the Invasive Cervical Cancer Study, Montreal, Quebec, 1998–2004

Variable	*Value*[a]
Age group at diagnosis [*n* (%)]	
20–29 Years	23 (4.0)
30–39 Years	91 (16.0)
40–49 Years	137 (24.1)
50–59 Years	103 (18.1)
60–69 Years	76 (13.4)
70–79 Years	86 (15.1)
≥80 Years	52 (9.2)
Age at diagnosis (years)	
Median	52
Mean	55
Range	22–94
Presence of symptoms[b] [*n* (%)]	
Yes	399 (70.2)
No	51 (9.0)
Unknown[c]	118 (20.8)
Symptom type, when present[d]	
Vaginal discharge	69 (17.3)
Bleeding	
Vaginal, intermenstrual	101 (25.3)
Vaginal, postmenopausal	200 (50.1)
Vaginal, postcoital	68 (17.0)
Menstrual, heavy or prolonged	12 (3.0)
Abnormal, type unspecified	5 (1.3)
Loss of appetite	15 (3.8)
Weight loss	64 (16.0)
Fatigue	18 (4.5)
Pain[e]	95 (23.8)
Other symptoms	45 (11.3)
Disease stage [*n* (%)]	
IA1	89 (15.7)
IA2	31 (5.5)
IB	173 (30.5)
II	113 (19.9)
III	105 (18.5)
IV	42 (7.4)
Unknown	15 (2.6)
Tumour histology [*n* (%)]	
Squamous cell	410 (72.2)
Adenocarcinoma	123 (21.7)
Adenosquamous	16 (2.8)
Other less common types	14 (2.5)
Unknown	5 (0.9)

[a] Percentages may not add up to 100 because of rounding.
[b] Including abnormal vaginal discharge, intermenstrual vaginal bleeding, postmenopausal vaginal bleeding, heavy or prolonged menses, postcoital vaginal bleeding, loss of appetite, weight loss, fatigue, pain (pelvic, abdominal, back, or leg), and other less common symptoms. The "other" category includes anemia, dyspareunia, dysuria, hematuria, rectal bleeding, urinary or renal tract problems, ascites, and vesicovaginal fistula.
[c] Data indicating the presence or absence of a particular characteristic were not found in the medical chart.
[d] Subject could have experienced more than 1 symptom (n=399).
[e] Pelvic, abdominal, back, leg, or unspecified location.

TABLE III Associations between demographic characteristics of the study subjects and cervical cancer in the Invasive Cervical Cancer Study, Montreal, Quebec, 1998–2004

Characteristic	*Study group [*n *(%)]*		*OR*	*95% CI*[c]
	Cases[a]	*Controls*[b]		
Place of birth				
Canada	256 (71.1)	1442 (77.4)	Reference	
Other	104 (28.9)	421 (22.6)	1.4	1.1 to 1.8
If not Canadian-born, time in Canada				
0–9 Years	22 (23.9)	109 (26.4)	1.5	0.8 to 2.9
≥10 Years	70 (76.1)	304 (73.6)	Reference	
Marital status				
Married	126 (34.9)	662 (33.5)	Reference	
Common-law	61 (16.9)	215 (10.9)	1.6	1.1 to 2.3
Widowed, separated or divorced	107 (29.6)	587 (29.7)	1.1	0.8 to 1.4
Single	67 (18.6)	513 (25.9)	0.9	0.6 to 1.2
Language of conversation				
English and French[d]	136 (37.8)	1034 (55.4)	Reference	
English, not French[d]	37 (10.3)	153 (8.2)	2.0	1.4 to 3.1
French, not English[d]	173 (48.1)	653 (35.0)	2.1	1.6 to 2.7
Neither English nor French	14 (3.9)	28 (1.5)	4.5	2.3 to 9.1
Employment status				
Employed	206 (57.5)	940 (58.1)	Reference	
Unemployed, homemaker	67 (18.7)	284 (17.5)	1.0	0.7 to 1.4
Student	8 (2.2)	41 (2.5)	1.7	0.8 to 4.0
Retired	77 (21.5)	354 (21.9)	0.4	0.3 to 0.7
Highest level of education				
Less than secondary graduation	107 (30.9)	498 (25.5)	Reference	
Secondary graduation	72 (20.8)	251 (12.9)	0.9	0.6 to 1.3
Some postsecondary education	68 (19.4)	105 (5.4)	2.4	1.6 to 3.6
Postsecondary degree or diploma	99 (28.6)	1096 (56.2)	0.3	0.2 to 0.4
Smoking status				
Never-smoker	131(40.1)	676 (34.2)	Reference	
Current smoker	123 (37.6)	537 (27.2)	1.1	0.8 to 1.5
Former smoker	73 (22.3)	763 (38.6)	0.4	0.3 to 0.6
Childbirth in preceding 5 years				
No	294 (89.4)	887 (82.7)	Reference	
Yes	35 (10.6)	186 (17.3)	1.3	0.9 to 2.1
Had a regular doctor				
No	95 (29.7)	408 (20.6)	1.9	1.4 to 2.5
Yes	225 (70.3)	1574 (79.4)	Reference	
Chronic condition				
No	246 (75.5)	448 (22.6)	13.4	10.0 to 18.0
Yes	80 (24.5)	1534 (77.4)	Reference	

[a] Women with invasive cervical cancer for whom data from the subject interview were available. These women might or might not have lived in Montreal or Laval for at least 5 years (n=362). For some questions, numbers might not total to 362 because of nonresponses. The smoking status, childbirth, regular doctor, and chronic condition analyses include only women who resided in Montreal or Laval for a minimum of 5 years before diagnosis because only those women completed the long version of the questionnaire (n=330).

[b] Women living in Montreal or Laval who responded to Statistics Canada's 2003 Canadian Community Health Survey.

[c] Models were adjusted for age (20–24, 25–29, 30–34, ..., ≥80 years) at diagnosis (cervical cancer patients) or at time of Canadian Community Health Survey completion (controls).

[d] Might also speak another language.

OR = odds ratio; CI = confidence interval.

had a statistically significantly greater risk of CCa. This increased CCa risk was present up to 9 years after immigration to Canada. Speaking neither English nor French, having some postsecondary education, not having a regular doctor, and not having a chronic condition were all associated with a statistically significant greater risk of CCa. There was also a statistically nonsignificant indication that the risk of advanced CCa was greater in more recent immigrants and in those without a regular doctor (data not shown).

For the study group, Table IV shows Pap screening histories and their associations with CCa risk. Most women in the case group had been screened at least once in their lifetime, with the frequency varying from 84.8% to 90.4% depending on the analysis. An estimated 30.9%–56.8% had been screened within 3 years of diagnosis. When all sources of data were used to determine screening histories of the women in the case group, a statistically significant increased CCa risk was associated with being ever-screened compared with being never-screened. When the case group was restricted to women whose screening categorization was classified as "definite," the point estimate was lower and no longer statistically significant, but it remained above 1. When screening histories in the case group were limited to data obtained solely from the ICCAS questionnaire, being ever-screened appeared to be associated with a lower CCa risk, although the result just bordered on significance. Moreover, the longer the time interval since the last Pap test, the greater

TABLE IV Associations between screening history (Pap tests) and cervical cancer in the Invasive Cervical Cancer Study, Montreal, Quebec, 1998–2004

Screening variable	*Pap screening history*								
	Based on all sources of data				*Based on all sources of data and screening history reliability deemed "definite"*			*Based on subject self-reported or proxy-reported results*		
	Cases[a] *[n (%)]*	*Controls*[b] *[n (%)]*	*Adjusted*[c]		*Cases*[a] *[n (%)]*	*Adjusted*[c]		*Cases*[a] *[n (%)]*	*Adjusted*[c]	
			OR	95% CI		*OR*	*95% CI*		*OR*	*95% CI*
Screening classification										
Never	39 (9.6)	319 (16.7)	Reference		32 (12.1)	Reference		43 (15.3)	Reference	
Ever	368 (90.4)	1593 (83.3)	1.6	1.1 to 2.3	232 (87.9)	1.2	0.8 to 1.8	239 (84.8)	0.7	0.5 to 1.0
Not classified[d]	161	NA	NA		NA	NA		NA	NA	
Time since last screen for the ever-screened[e]										
<3 Years	146 (40.3)	1252 (79.0)	Reference		71 (30.9)	Reference		113 (56.8)	Reference	
3 to <5 Years	60 (16.6)	68 (4.3)	8.2	5.4 to 12.3	28 (12.2)	7.9	4.7 to 13.3	20 (10.1)	3.3	1.9 to 5.7
≥5 Years	156 (43.1)	264 (16.7)	7.3	5.3 to 9.8	131 (57.0)	14.4	9.9 to 20.9	66 (33.2)	4.8	3.2 to 7.0
Not able to be classified	6	NA	NA		NA	NA		NA	NA	
Overall screening history adequacy[f]										
Inadequate	416 (74.0)	651 (34.2)	6.4	5.1 to 8.0	191 (72.9)	7.8	5.7 to 10.6	129 (53.3)	3.7	2.8 to 4.8
Adequate	146 (26.0)	1252 (65.8)	Reference		71 (27.1)	Reference		113 (46.7)	Reference	

[a] Includes only patients who lived in Montreal or Laval for a minimum 5 years before their diagnosis of invasive cervical cancer (n=568).

[b] Includes women living in Montreal or Laval who responded to Statistics Canada's 2003 Canadian Community Health Survey (n=1912). Nine respondents who characterized themselves as being ever screened did not know the time since their last screening test.

[c] Adjusted for age at diagnosis (cases) and at survey administration (controls). Age was categorized in 5-year intervals (20–24, 25–29, 30–34, ..., ≥80 years).

[d] Based on available data, the screening histories of 161 women could not be classified as "ever" or "never" screened. However, it was determined that they had not been screened within the 5 years preceding their diagnosis with cervical cancer.

[e] Refers to women who were "ever" screened in the past.

[f] "Inadequate" includes women in the case group who were never screened, who were screened within 5 years of diagnosis (but not within 3 years), who were screened more than 5 years before diagnosis, and for whom ever or never screening could not be determined, but for whom no screening in the 5 years preceding diagnosis could be determined. Subjects categorized as "ever screened," but whose time since the last normal screen could not be defined were omitted (n=6). For Canadian Community Health Survey respondents (control group 1), "inadequate" refers to women never screened and to those whose last screen occurred between 3 and 5 years or 5 or more years in the past. "Adequate" refers to patients screened within 3 years of their diagnosis. Adequacy was defined based on prevailing clinical practice guidelines.

OR = odds ratio; CI = confidence interval; NA = not applicable.

the risk of CCa, a finding that was especially evident when the case group was limited to women whose screening categorization was deemed "definite." All three analyses found that an inadequate screening history was associated with a statistically significantly greater risk of CCa. Similarly, never being screened or the passage of 5 or more years since last screening were associated with an increased risk of being diagnosed with regional or distant CCa rather than localized cancer (data not shown).

As Table V shows, having received care from a gynecologist was associated with a lower risk of developing CCa, even after controlling for visits to other physicians. In contrast, a greater risk of CCa was observed if care was received from other medical specialists or from family physicians.

4. DISCUSSION

Our study underscores the importance of regular screening for the prevention and early diagnosis of CCa. Most women in the case group had undergone a Pap test at least once in their lifetime (85%–90%). However, depending on the sources of data used for determining screening, 43%–69% of those women were not screened within 3 years of diagnosis, and overall, an estimated 53%–74% had an inadequate screening history. Those findings emphasize the failings of opportunistic Pap screening and highlight the need for screening within the context of an organized program that has the means to invite women population-wide to screening and to recall women for screening at appropriate intervals.

Compared with Canadian-born women, immigrants have a higher CCa risk, which might be attributed to poorer use of screening[9–14]. Cultural values, beliefs about sexual behaviour, language barriers, fatalism, acculturation, and lack of knowledge about CCa influence the use of Pap screening by immigrants[15–18]. The CCa risk among immigrants appears to be lower with length of time lived in Canada, which might be attributable to a greater likelihood of screening use in long-term immigrants than in recent immigrants[9,19,20]. Language barriers[10] and lower education level[10,12,21] are associated with greater risk of CCa, likely because of poor use of Pap screening[9,10,20,22,23]. The study results also echo earlier findings[9,10,20] in highlighting the importance to appropriate screening of having a regular doctor.

Receipt of care from a gynecologist, independent of other physicians, was associated with a lower risk of CCa. Compared with family physicians, gynecologists are more likely to perform Pap tests[24,25], and women who wish to have Pap tests preferentially go to gynecologists instead of family physicians to be screened[24,26]. We speculate that, because slightly less contact with gynecologists was seen in women in the case group than in the control group, the women in the case group were less likely to be screened and were, as a result, at greater risk of CCa.

TABLE V Associations between physician visits and cervical cancer in the Invasive Cervical Cancer Study, Montreal, Quebec, 1998–2004

Practitioner type	*Study group*		*OR*	*95% CI*	*Adjusted*[b]	
	Cases[a] *[n (%)]*	*Controls [n (%)]*			*OR*	*95% CI*
Family physician						
0 Visits	54 (9.6)	146 (26.0)	Reference		Reference	
1 to 2 Visits	65 (11.6)	53 (9.4)	4.8	2.7 to 8.4	3.6	2.0 to 6.6
3 to 4 Visits	55 (9.8)	49 (8.7)	4.4	2.4 to 7.9	3.4	1.8 to 6.6
>4 Visits	388 (69.0)	314 (55.9)	5.2	3.3 to 8.2	4.3	2.4 to 7.6
Gynecologist						
0 Visits	355 (63.2)	345 (61.4)	Reference		Reference	
1 to 2 Visits	110 (19.6)	75 (13.4)	1.4	1.0 to 1.9	0.9	0.6 to 1.3
3 to 4 Visits	38 (6.8)	58 (10.3)	0.6	0.4 to 0.9	0.4	0.2 to 0.7
>4 Visits	59 (10.5)	84 (15.0)	0.7	0.5 to 1.0	0.5	0.3 to 0.7
Medical specialist other than gynecologist						
0 Visits	86 (15.3)	172 (30.6)	Reference		Reference	
1 to 2 Visits	110 (19.6)	67 (11.9)	4.1	2.6 to 6.4	2.4	1.4 to 4.0
3 to 4 Visits	65 (11.6)	47 (8.4)	3.6	2.2 to 5.9	2.0	1.1 to 3.5
>4 Visits	301 (53.6)	276 (49.1)	2.8	1.9 to 4.0	1.7	1.0 to 2.8

[a] Of 568 patients who met the study inclusion criteria, 6 did not have a RAMQ number. Matched controls were not obtained for the latter 6 patients, thus leaving 562 cases and 562 controls for analysis.

[b] Each model was adjusted for the number of visits to other physician types, using the 0, 1–2, 3–4, >4 categories.

OR = odds ratio; CI = confidence interval.

Having had specialist visits was associated with an increased risk of CCa. Compared with women not having chronic conditions, women with such conditions undergo any type of screening less often, especially if physicians believe that those women have a shortened lifespan[27,28]. Therefore, if, before diagnosis, chronic morbidities that required care by specialists were more prevalent in the case group than in the control group, it is plausible to assume that women in the case group would be less likely to receive Pap screening because of the emphasis the specialist might have placed on properly investigating and treating the chronic condition. A lower opportunity to screen could consequently have contributed to an increased risk of being diagnosed with CCa. Although this explanation is plausible, it might not actually be applicable to our cohort, because our study found that women in the case group reported chronic diseases less frequently than did women in the control group. However, that finding was based on a subgroup of the case group who responded to the ICCAS questionnaire. Those women tended to be younger and were perhaps less likely than the women who did not participate in the survey to have a chronic disease.

5. STUDY LIMITATIONS AND STRENGTHS

Lack of data prevented a determination of the lifetime screening histories of 161 women in the case group, which could ultimately have resulted in overestimation of the proportion of cases considered "ever screened." Women in the case group with an unclassified history were demographically similar to women who tended to have a poor Pap screening history (data not shown); hence, we believe that the women with an unclassified history were most likely to have been never-screened. Further, to be classified as never-screened, women in the case group or their proxies must have responded to the ICCAS questionnaire by saying that they had never been screened. Women in the case group with unclassified screening histories were less likely than those whose screening histories were classified to have participated in the interview (21.7% and 72.5% respectively). Hence, although we did not find any evidence of Pap screening before diagnosis, the 161 women in the case group could not have been classified as never-screened if no interview took place.

Because multiple data sources were used for the case histories, differential misclassification of screening histories might have affected the Pap screening–CCa associations. When data from all sources were used to classify use of screening by women in the case group, the tendency to categorize those women as ever-screened appeared to be a greater than it was for women in the control group, which resulted in the odds ratio being greater than 1. That observation might be attributable to the more exhaustive search for data and the various contexts in which data collection occurred for the case group. In contrast, screening histories in the control group were based solely on responses to the CCHS question "Have you ever had a Pap test?" The odds ratio declined slightly in the analyses when the screening histories used for the case group were those deemed to be "definite," which is probably reflective of the greater objectivity of laboratory reports compared with other data sources. Likewise, the association between time since the last Pap test and CCa, when based on all sources of data, might also have been affected by differential misclassification because of the multiple sources of data for the case group.

Social desirability bias and telescoping could have led subjects to report their last Pap test as occurring more recently than it actually had, resulting in an underestimation of time since the last Pap test[29–31]. Such biases would have most affected the analyses based on the ICCAS questionnaire and the CCHS.

The ICCAS questionnaire response rate (64.8%) might be a limitation. However, that rate is higher than the rates in many similar studies that included CCa cases[32–35], and although some women in the case group did not respond to the ICCAS questionnaire, screening histories could still be obtained from other data sources. Other limitations included the routine discarding by physicians of medical files after 5 years of dormancy and the poor organization, missing laboratory reports, and illegible handwriting that often characterized hospital medical charts. Also, some laboratories refused to provide reports to our study, and of those that did, many did not have computerized systems and had missing records.

Study strengths include a large study population with complete case ascertainment, an extensive audit process for data retrieval (multiple sources of data accessed), and attention to data quality through staff training and continuous monitoring of data collection. Although technologies for CCa prevention might change in future, the implications of our study would still be applicable.

6. CONCLUSIONS

A greater CCa risk was associated with a period of 3 or more years since the last Pap test (compared with screening in the preceding 3 years). Immigrant women, less educated women, and women with language barriers were at greatest risk of CCa, as were women who received care from medical specialists other than gynecologists and from family physicians in the 5 years preceding diagnosis (case group) or CCHS interview (control group 1). Our findings underscore the importance of provider education to prevent missed opportunities for CCa screening when at-risk women seek medical attention and provide further evidence of the need for an organized population-based screening program.

The prevention of invasive CCa requires not only adoption of the Pap test, but also appropriate referral and treatment of cervical intraepithelial lesions before they progress to invasion. An audit of the appropriateness of such downstream processes of care is warranted in the future, particularly as new screening technologies—for example, testing for human papillomavirus—become part of the standard of care.

7. ACKNOWLEDGMENTS

The authors acknowledge and thank the following people for their invaluable contributions to the successful execution and completion of the ICCAS study: Dr. Alex Ferenczy, Dr. Martin Dawes, Dr. Gerald Stanimir, Dr. Parviz Ghadirian, Dr. Francois Lehmann, Dr. Flavia Da Silva, Ms. Claude Richard, and the many pathologists and medical records technicians at the Greater Montreal and Laval hospitals. A most heartfelt thank-you is also extended to the study subjects and their next of kin who participated in our study.

This study was supported financially through grants from the Canadian Institutes of Health Research (IHS-61108, MOP-64454, and CRN83320).

8. CONFLICT OF INTEREST DISCLOSURES

ELF has no conflicts of interest with respect to the content and message of the present work, but he reports having served as occasional paid consultant to companies involved with HPV vaccination (Merck, GlaxoSmithKline) and cervical cancer screening (Roche, BD, Qiagen, Gen-Probe). His institution has received three grants from Merck in partial support of research that he initiated. AA declares no conflicts of interest with respect to the content and message of the present work, but his institution has received a grant from GlaxoSmithKline in support of other unrelated research. No other authors had financial conflicts of interest to declare.

9. REFERENCES

1. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin* 2011;61:69–90.
2. Canadian Cancer Society's Advisory Committee on Cancer Statistics. *Canadian Cancer Statistics 2014.* Toronto, ON: Canadian Cancer Society; 2014.
3. Health Canada. *Cervical Cancer Screening in Canada: 1998 Surveillance Report.* Ottawa, ON: Public Works and Government Services Canada; 2002.
4. 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.
5. Miller AB, Anderson G, Brisson J, *et al.* Report of a national workshop on screening for cancer of the cervix. *CMAJ* 1991;145:1301–25.
6. Morrison BJ. *Screening for Cervical Cancer.* Ottawa, ON: Health Canada; 1994.
7. Statistics Canada. Canadian Community Health Survey. Ottawa, ON: Statistics Canada; 2003. [Available online at: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SurvId=3226&SurvVer=0&InstaId=15282&InstaVer=2&SDDS=3226&lang=en&db=imdb&adm=8&dis=2; cited March 14, 2014]
8. Young J, Roffers SD, Ries LAG, Fritz AG, Hurlbut AA, eds. *SEER Summary Staging Manual–2000: Codes and Coding Instructions.* Bethesda, MD: National Cancer Institute; 2001.
9. Woltman KJ, Newbold KB. Immigrant women and cervical cancer screening uptake: a multilevel analysis. *Can J Public Health* 2007;98:470–5.
10. 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;92:127–33.
11. Goel V. Factors associated with cervical cancer screening: results from the Ontario Health Survey. *Can J Public Health* 1994;85:125–7.
12. Lee J, Parsons GF, Gentleman JF. Falling short of Pap test guidelines. *Health Rep* 1998;10:9–19[English];9–21[French].
13. Matuk LC. Pap smear screening practices in newcomer women. *Womens Health Issues* 1996;6:82–8.
14. Lofters AK, Moineddin R, Hwang SW, Glazier RH. Low rates of cervical cancer screening among urban immigrants: a population-based study in Ontario, Canada. *Med Care* 2010;48:611–18.
15. Chen WT. Chinese female immigrants English-speaking ability and breast and cervical cancer early detection practices in the New York metropolitan area. *Asian Pac J Cancer Prev* 2013;14:733–8.
16. Johnson CE, Mues KE, Mayne SL, Kiblawi AN. Cervical cancer screening among immigrants and ethnic minorities: a systematic review using the Health Belief Model. *J Low Genit Tract Dis* 2008;12:232–41.
17. Gupta A, Kumar A, Stewart DE. Cervical cancer screening among South Asian women in Canada: the role of education and acculturation. *Health Care Women Int* 2002;23:123–34.
18. Hyman I, Guruge S. A review of theory and health promotion strategies for new immigrant women. *Can J Public Health* 2002;93:183–7.
19. Khadilkar A, Chen Y. Rate of cervical cancer screening associated with immigration status and number of years since immigration in Ontario, Canada. *J Immigr Minor Health* 2013;15:244–8.
20. Schoueri–Mychasiw N, McDonald PW. Factors associated with underscreening for cervical cancer among women in Canada. *Asian Pac J Cancer Prev* 2013;14:6445–50.
21. Ibfelt E, Kjaer SK, Johansen C, *et al.* Socioeconomic position and stage of cervical cancer in Danish women diagnosed 2005 to 2009. *Cancer Epidemiol Biomarkers Prev* 2012;21:835–42.
22. Chen HY, Kessler CL, Mori N, Chauhan SP. Cervical cancer screening in the United States, 1993–2010: characteristics of women who are never screened. *J Womens Health (Larchmt)* 2012;21:1132–8.
23. Stanley SL, Thomas CC, King JB, Richardson LC. Predictors of never being screened for cervical cancer by metropolitan area. *J Community Health* 2014;39:400–8.

24. Lurie N, Margolis K, McGovern PG, Mink P. Physician self-report of comfort and skill in providing preventive care to patients of the opposite sex. *Arch Fam Med* 1998;7:134–7.
25. Camirand J, Potvin L, Beland F. Pap recency: modeling women's characteristics and their patterns of medical care use. *Prev Med* 1995;24:259–69.
26. Pemberton AG, Margolis KL, Mink PJ, McGovern PG, Lurie N. Women's preferences for specialists who provide cancer screening and general medical care. *J Gen Intern Med* 1998;13:624–6.
27. Kiefe CI, Funkhouser E, Fouad MN, May DS. Chronic disease as a barrier to breast and cervical cancer screening. *J Gen Intern Med* 1998;13:357–65.
28. Hsia J, Kemper E, Kiefe C, *et al.* The importance of health insurance as a determinant of cancer screening: evidence from the Women's Health Initiative. *Prev Med* 2000;31:261–70.
29. 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;35:463–73.
30. Johnson TP, O'Rourke DP, Burris JE, Warnecke RB. An investigation of the effects of social desirability on the validity of self-reports of cancer screening behaviors. *Med Care* 2005;43:565–73.
31. Rauscher GH, Johnson TP, Cho YI, Walk JA. Accuracy of self-reported cancer-screening histories: a meta-analysis. *Cancer Epidemiol Biomarkers Prev* 2008;17:748–57.
32. Stuart GC, McGregor SE, Duggan MA, Nation JG. Review of the screening history of Alberta women with invasive cervical cancer. *CMAJ* 1997;157:513–19.
33. Nasca PC, Ellish N, Caputo TA, Saboda K, Metzger B. An epidemiologic study of Pap screening histories in women with invasive carcinomas of the uterine cervix. *N Y State J Med* 1991;91:152–6.
34. Ratima K, Paul C, Skegg DC. Cervical smear histories of Maori women developing invasive cervical cancer. *N Z Med J* 1993;106:519–21.
35. Ciatto S, Grazzini G, Cecchini S, Iossa A. Screening history of incident cases of invasive carcinoma of the cervix. Florence district 1988–1989. *Tumori* 1993;79:311–13.

Correspondence to: Andrea Spence, Division of Cancer Epidemiology, 546 Pine Avenue West, Montreal, Quebec H2W 1S6.
E-mail: andrea.spence@mail.mcgill.ca

* Division of Cancer Epidemiology, McGill University, Montreal, QC.
† Department of Obstetrics and Gynecology, King Khaled University Hospital, Riyadh, Saudi Arabia.
‡ Division of Gynecologic Oncology, Centre hospitalier de l'Université de Montréal, Montreal, QC.
§ Institut national de santé publique du Québec, Montreal, QC.
|| Department of Obstetrics and Gynecology, McGill University Health Centre, Montreal, QC.
Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, Montreal, QC.
** Direction de santé publique de l'Agence de la santé et des services sociaux de Montréal, Montreal, QC.