Comparison of Papanicolaou (Pap) Test Rates Across Ontario and Factors Associated with Cervical Screening

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ABSTRACT

Background: Cervical cancer remains a significant yet preventable disease despite the widespread availability of Pap test screening, which detects cervical cancer and its precursor lesions. The aims of this study were to: i) estimate and compare age- and hysterectomy-adjusted Pap test rates across the 37 Ontario public health units (PHUs), and ii) explore the association between several factors and Pap test rates (at the ecological level).

Methods: Cytobase, an Ontario Pap test registry, captures more than 80% of all Pap tests in Ontario. Cytobase was used to determine Pap test rates adjusted for age, hysterectomy and Cytobase coverage for the year 2001. Multiple linear regression analyses were used to evaluate the relationship between Pap test rates and various factors at an ecological level.

Results: Age-, hysterectomy- and Cytobase-adjusted one-year Pap rates ranged from 11.6% to 73.9% among PHUs. The overall rate for Ontario was 40.7%. Multivariate analyses indicated that the presence of a teaching hospital was associated with higher Pap test rates.

Conclusion: One-year Pap test rates varied greatly across the 37 public health units in Ontario. Pap test rates determined using Cytobase were lower than self-reported rates obtained from the Canadian Community Health Survey, possibly due to "over-reporting". In general, women were not screened as frequently as recommended by the Ontario Cervical Screening Program. A positive association was observed between Pap test rates and the presence of a teaching hospital. Data quality issues limit the ability to monitor cervical screening. A provincial registry would address these issues.

MeSH terms: Mass screening; cervix neoplasms; vaginal smears

La traduction du résumé se trouve à la fin de l'article.

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Despite the dramatic decline in cervical cancer incidence and mortality rates over the last few decades, cancer of the cervix is still a significant, yet largely preventable, health concern among women. In 2001, 501 Ontario women were diagnosed with cervical cancer and 163 women died from this disease. Cervical cancer is the fourth most common cancer diagnosed among Ontario women aged 20-49.[1] The decrease in incidence and mortality has been attributed to Pap test screening.[2]

The Papanicolaou (Pap) test can detect both precursor lesions and cervical cancers. Treatment of precursor lesions essentially prevents development of cervical cancer. Current Ontario guidelines recommend a Pap test every two years after the first three annual normal Pap tests, until age 70.[3] Screening is sub-optimal given that the majority of women diagnosed with cervical cancer have a history of inadequate or no screening.[4-6] Regular screening is important in preventing this disease.

Incidence and mortality rates of cervical cancer vary across the province,[7] likely explained, in part, by geographic variation of Pap test rates. Further, variation in Pap test utilization in Ontario is reported to be related to a number of factors. Studies have reported positive associations with having a sexual partner in the last year, being single and without children, having a regular physician and more professional health contacts, higher levels of education and income, living in an urban area and not being disabled.[8,9]

Two data sources are readily available to examine geographic variation in recent Pap test rates in Ontario. The 2001 Canadian Community Health Survey (CCHS)[10] collected data on self-reported Pap test utilization by public health unit (PHU). However, studies have consistently shown that self-reported Pap tests overestimate screening participation rates.[11-17] The second source is Cytobase, a database operated and maintained by INSCYTE (a non-profit corporation) in partnership with Cancer Care Ontario. Participation is voluntary; currently four large private laboratories contribute approximately 80% of Pap tests.[18] Cervical cytology from smaller private and hospital laboratories is absent, and no pathology data are included.[18]

The study's main purpose was to estimate and compare age- and hysterectomy-

adjusted Pap test rates across 37 provincial PHUs, using data from Cytobase. An additional aim was to explore whether the observed variation in Pap test rates across PHUs could be explained as part of an ecological analysis.

METHODS

The number of women aged 20-69 with Pap tests in 2001 was determined for each PHU using Cytobase data. Among women with multiple Pap tests, the first Pap test was abstracted. Patient address is incomplete in Cytobase; therefore, physician addresses were used as a proxy to assign records to PHUs. Physician postal code was present on 99.5% of Cytobase records. The Postal Code Conversion Program 2001[19] was used to convert postal codes to census divisions, which were then assigned to a PHU. Census divisions were combined and totals added to produce counts for some PHUs.

Pap tests from hospital laboratories are absent from Cytobase. "Cytobase coverage" varies by PHU, so it is important to adjust Pap test rates, as some regions rely more heavily on hospital, rather than private, laboratories for cervical cytology. Cytobase coverage for Ontario, and for each PHU, was estimated by dividing Pap tests in Cytobase by the combined total of Cytobase Pap tests plus hospital laboratory Pap tests reported to the Ontario Ministry of Health and Long-Term Care (MOHLTC).[20] This result was used to adjust for Cytobase coverage when calculating one-year Pap test rates.

Statistics Canada 2001 population data[21] by 10-year age group and census division were used to construct PHU populations (the denominator for rate calculations). Within each PHU, population data were adjusted to account for women with a hysterectomy (as reported in the CCHS[10]). All Pap rate estimates were directly standardized by age to the Ontario 2001 female population[21] and 95% confidence intervals were calculated.[22]

Univariate analyses (linear regression and t-tests) and multiple linear regression were used to evaluate the association between age-, hysterectomy- and Cytobase coverage-adjusted Pap test rates and several ecological measures (at the PHU level) including: current smoking rates among those 12 years and older; percentage of population aged 20-74 having contact with a physician in the last year; percentage of women aged 50-69 who had a routine screening mammogram in the last two years (2001 CCHS);[10] percentage of population over 25

TABLE I

One-year Age-, Hysterectomy- and Cytobase Coverage-adjusted Pap Test Rates with 95% Confidence Intervals, by Ontario Public Health Units in 2001

Public Health Unit	Population*	Age-,† Hysterectomy- and Cytobase Coverage-adjusted Pap Test Rate (%)	95% Confidence Interval‡
Timiskaming	8,520	11.6	(10.6, 12.7)
Northwestern	21,926	25.6	(22.7, 28.5)
Halton	111,061	27.2	(26.9, 27.6)
Muskoka-Parry Sound	25,267	28.2	(13.7, 42.7)
Haliburton-Kawartha-Pine Ridge	43,725	29.5	(29.0, 30.1)
Huron	14,774	32.1	(31.1, 33.1)
Bruce-Grey-Owen Sound	40,639	32.7	(32.2, 33.3)
Eastern Ontario	48,406	33.2	(32.5, 34.0)
Kent-Chatham	26,594	33.7	(32.7, 34.7)
Elgin-St. Thomas	20,702	34.2	(30.2, 38.2)
York	236,332	35.0	(34.8, 35.2)
Peel	326,902	35.7	(35.5, 36.0)
Haldimand-Norfolk	27,419	35.7	(35.0, 36.5)
Oxford	24,587	36.0	(35.2, 36.9)
Durham	146,908	36.1	(35.8, 36.4)
Niagara	114,598	36.4	(36.0, 36.7)
Porcupine	22,018	36.4	(35.5, 37.3)
Simcoe	105,905	37.9	(37.5, 38.3)
Leeds-Grenville-Lanark	42,507	38.3	(37.7, 38.9)
Sudbury	52,882	38.9	(38.2, 39.6)
Hamilton-Wentworth	137,261	40.0	(39.5, 40.5)
Renfrew	25,023	40.1	(38.1, 42.0)
North Bay and District	22,262	43.8	(39.6, 48.1)
Hastings-Prince Edward	40,467	44.0	(43.4, 44.6)
Waterloo	132,204	44.1	(43.7, 44.5)
Windsor-Essex	101,014	44.5	(44.0, 44.9)
Wellington-Dufferin-Guelph	66,433	45.6	(44.9, 46.3)
Brant	36,696	45.6	(43.4, 47.9)
Algoma	30,012	46.3	(45.4, 47.2)
Thunder Bay	40,494	46.9	(46.2, 47.6)
Toronto	812,961	48.7	(48.5, 48.8)
Lambton	32,864	49.7	(45.7, 53.7)
Middlesex-London	116,469	57.3	(56.6, 57.9)
Peterborough	35,150	57.4	(55.8, 58.9)
Ottawa-Carleton	229,482	59.6	(59.3, 59.9)
Perth	19,147	63.2	(62.0, 64.4)
Kingston-Frontenac-Lennox-Addington	51,466	73.9	(72.7, 75.2)
Ontario (age 20-69)	**3,391,077**	**40.7**	**–**
Ontario (age 20-49)	**2,557,146**	**40.8**	**–**
Ontario (age 50-69)	**833,931**	**40.3**	**–**

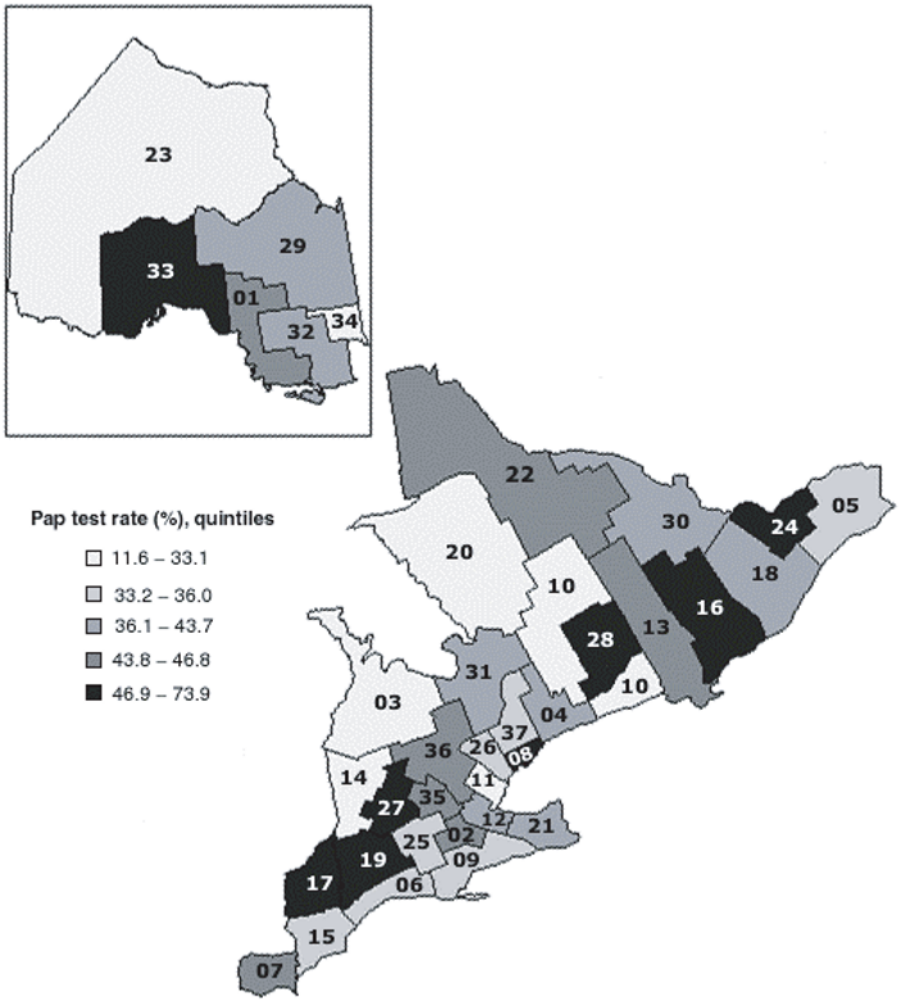
* Population size corrected for hysterectomy
† Age was adjusted to the 2001 Ontario female population[23]
‡ Calculated according to Carriere and Roos, 1994[22]

TABLE II

Association Between Several Ecological Level Variables and Age-, Hysterectomy- and Cytobase Coverage-adjusted Pap Test Rates for 2001

	Model A – Univariate Analysis			Model B – Multivariate Model*		
Variable	Parameter Estimate	SE†	P-value	Parameter Estimate	SE	P-value
% current smokers 12 years and over	-1.05	0.45	0.02	-0.43	0.47	0.37
Presence of teaching hospital (vs. absence)	17.58	4.80	0.001	12.74	5.75	0.03
% living in urban area	0.20	0.10	0.05	0.03	0.12	0.82
% over age 25 with high school education	1.06	0.37	0.01	0.34	0.51	0.51
% of population with physician contact in last 12 months	0.93	0.72	0.21	–	–	–
% of women aged 50-69 with routine screening mammogram in past 12 months	-0.22	0.27	0.41	–	–	–

* Including all variables where $p \leq 0.05$ in Model A
† SE=standard error



1	Algoma	11	Halton	21	Niagara	31	Simcoe
2	Brant	12	Hamilton	22	North Bay	32	Sudbury
3	Bruce	13	Hastings	23	Northwestern	33	Thunder Bay
4	Durham	14	Huron	24	Ottawa	34	Timiskaming
5	Eastern Ontario	15	Kent	25	Oxford	35	Waterloo
6	Elgin-St. Thomas	16	Kingston	26	Peel	36	Wellington
7	Windsor-Essex	17	Lambton	27	Perth	37	York
8	Toronto	18	Leeds	28	Peterborough		
9	Haldimand-Norfolk	19	Middlesex	29	Porcupine		
10	Haliburton	20	Muskoka	30	Renfrew		

Figure 1. Age-, hysterectomy- and Cytobase coverage-adjusted Pap test rates in Ontario, by Public Health Unit, 2001

with a high school diploma; percentage of population living in rural areas (Statistics Canada 1996 census results);[23] and presence of a teaching hospital.[24] Only the variable "contact with a physician in the last year" could be age-adjusted to the Ontario 2001 female population.[25] Variables found to be significant in univariate analyses ($p \leq 0.05$) were examined simultaneously in the multivariate regression analysis. All analyses were performed using SAS (version 8.02, Cary, NC).

Ethics approval was received from the Research Ethics Board at the University of Toronto.

RESULTS

Cytobase coverage by PHUs ranged from 13% to 100%. Pap test rates adjusted for age, hysterectomy and Cytobase coverage varied greatly by PHU, with rates ranging from 11.6% to 73.9% (Table I).

Geographic variation in age-, hysterectomy- and Cytobase coverage-adjusted Pap test rates is presented in Figure 1. This figure indicates great geographical variation in one-year Pap test rates, with no apparent identifiable pattern. Public health units with high Pap test rates are scattered across the province (e.g., Kingston-Frontenac, Perth, Ottawa-Carleton, Peterborough, Middlesex-London, Lambton, Toronto, Thunder Bay), as are those with low rates (e.g., Timiskaming, Northwestern, Halton, Muskoka-Parry Sound, Haliburton-Kawartha-Pine Ridge, Huron, Bruce-Grey-Owen Sound).

Presence of a teaching hospital (p=0.002), percentage of population with a high-school education (p=0.01), and percentage of population living in an urban area (p=0.03) were positively associated with age-, hysterectomy- and Cytobase coverage-adjusted Pap test rates in univariate analyses. Percentage of current smokers was negatively associated with age-, hysterectomy- and Cytobase coverage-adjusted Pap test rate (p=0.01) (Table II). In the multivariate analysis, a significant positive association was observed between presence of a teaching hospital and age-, hysterectomy- and Cytobase coverage-adjusted Pap test rate. Significant associations were not observed for other variables (Table II).

DISCUSSION

Ontario guidelines recommend Pap tests every two years after three annual normal Pap tests.[3] Our study found that approximately 41% of Ontario women had a Pap test during 2001. If most women were optimally screened once every two years, an adequate one-year screening rate would be approximately 50%, assuming that the number of women who have more than one screen in a two-year period is negligible. Only five PHUs achieved this standard, while fewer than 40% of women in most PHUs were screened in 2001. This suggests that screening participation was inconsistent with provincial guidelines. Furthermore, our estimate of an adequate one-year screening rate of 50% is likely low as many clinical associations still recommend annual screening.[26]

The Canadian Community Health Survey found self-reported one-year crude Pap test rates in Ontario similar to those in other provinces, with rates ranging from 50% to 60%.[10] While US one-year rates are not readily available, their 1998 National Health Interview Survey[27] indicated a three-year self-reported Pap rate of 83% for women aged 40-64. Studies that have examined the accuracy of self-reported rates consistently demonstrate that self-

reports overestimate screening participation.[11-17] Similarly, our analysis of Cytobase indicates that CCHS self-reported data likely overestimate Ontario rates by 16% (53% vs. 37%, data not shown), based on comparison of estimates unadjusted for age and hysterectomy (i.e., crude rates: the CCHS does not provide rates adjusted for age or hysterectomy). Furthermore, in half of the PHUs, crude Pap test rates (using Cytobase) are at least 20% lower than self-reported rates (data not shown). Although Cytobase estimates are likely more accurate than self-reported rates, caution should be employed when interpreting extreme findings, such as the unusually high Pap test rate for Kingston-Frontenac (74%) and the low rate for Timiskaming (12%).

There are several limitations to our study that should be addressed. Cytobase coverage adjustment in our analysis assumes that MOHLTC data accurately reflect Pap test utilization in each PHU. Some hospitals might under-report Pap tests to the MOHLTC, leading to overestimated Cytobase coverage and underestimated Pap test rates. Furthermore, some public and private laboratories may process Pap tests from adjacent PHUs. This would lead to errors in estimates of Cytobase coverage for some PHUs due to residence misclassification, and either over- or underestimation of Pap test rates.

Caution should be employed when attempting to interpret our Pap test rates with respect to screening participation. Cytobase data largely reflect screening participation, but hospital reports, which are not present in Cytobase, may include many diagnostic Pap tests. Consequently, our coverage adjustment may result in an overestimation of screening participation. More problematic is the interpretation of Pap test rates by PHU. We do not know the extent to which the proportion of screening versus diagnostic tests reported by the MOHLTC varies by PHU. Large variation would significantly reduce the degree to which our PHU rankings accurately reflect screening participation.

Geocoding accuracy is another possible limitation. Health care provider postal code was used as a proxy for patient address, to determine the associated geocode and PHU. More than 99% of physician postal codes were resolved to a census division. Still, some residence misclassification may occur because a small number of women may visit a physician outside of their PHU, although the effect on Pap test rates should be minimal.

Pap test rates varied considerably among PHUs. Our multivariate model indicated that presence of a teaching hospital was associated with higher Pap test rates among PHUs. It is not clear why presence of a teaching hospital in a PHU would positively influence Pap test uptake. There could be direct benefits (e.g., greater knowledge transfer about screening among physicians) or presence of teaching hospital may be an indicator of other factors that increase Pap uptake.

Unlike some studies at the individual level, Pap test rates in multivariate models were not found to be positively associated with physician contact or education, or negatively associated with living in a rural area and smoking.[8,9,27,28] These differences are likely, in large part, a consequence of well-known limitations of ecological studies.[29]

In conclusion, results of this study suggest that Pap test rates in many public health units are below recommended levels. This study establishes a baseline against which future screening participation can be monitored. Our results reinforce the need to improve screening participation in many regions. Furthermore, these data quality issues reinforce the need for complete data access and linkages at all levels of health care, from screening to diagnosis and treatment.

Our ability to determine Pap test uptake is limited by regulatory barriers. Mandatory reporting to Cytobase would ensure collection of reports from all laboratories. Similarly, availability of pathology and follow-up diagnostic procedures, outcome results and population data would allow a more thorough review of participation rates, quality assurance, routine recall, assessment procedures following an abnormal Pap test, and outcomes. Such comprehensive analysis could be used to develop and evaluate strategies to improve screening participation rates.[18] A provincial cervical screening registry is the instrument that would enable all these essential components.[18] The Pan-Canadian Forum on Cervical Screening in November 2003 reconfirmed the necessity of provincial registries with key data elements to enable systematic reporting, recruitment, recall and follow-up.[30]

Both Manitoba[31] and Alberta[32] implemented legislative amendments to allow better data access and linkages. Similar legislative changes in Ontario would allow the establishment of an Ontario cervical screening registry, facilitating our ability to accurately measure the impact of cervical screening and to inform public health units regarding screening participation in each region.

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Received: December 17, 2003
Accepted: October 6, 2004

RÉSUMÉ

Contexte : Le cancer du col utérin est une maladie évitable encore très répandue malgré la grande disponibilité du test de Papanicolaou, qui permet de dépister ce type de cancer et ses lésions précurseurs. Notre étude visait : i) à estimer et à comparer les taux de dépistage par le test de Papanicolaou, ajustés selon l'âge et la présence d'une hystérectomie, dans les 37 bureaux de santé publique de l'Ontario, et ii) à analyser l'association entre divers facteurs et les taux de dépistage par le test de Papanicolaou (au palier écologique).

Méthode : Les résultats de plus de 80 % des tests de Papanicolaou en Ontario sont entrés dans le registre ontarien Cytobase. Nous avons utilisé ce registre pour déterminer les taux de dépistage par le test de Papanicolaou, ajustés selon l'âge, l'hystérectomie et la couverture de Cytobase pour l'année 2001. Au moyen d'analyses de régression linéaire multiple, nous avons évalué la relation entre ces taux de dépistage et divers facteurs au palier écologique.

Résultats : Les taux de dépistage par le test de Papanicolaou ajustés selon l'âge, l'hystérectomie et la couverture de Cytobase sur un an variaient de 11,6 % à 73,9 % d'un bureau de santé publique à l'autre. Le taux pour l'ensemble de l'Ontario était de 40,7 %. Selon nos analyses multivariables, la présence d'un hôpital d'enseignement était associée à des taux de dépistage supérieurs.

Conclusion : Les taux de dépistage par le test de Papanicolaou sur un an variaient considérablement dans les 37 bureaux de santé publique de l'Ontario. Les taux apparaissant dans le répertoire Cytobase étaient plus faibles que les taux déclarés par les intéressées dans l'Enquête sur la santé dans les collectivités canadiennes (il y a peut-être eu surdéclaration dans l'Enquête). Dans l'ensemble, les femmes n'étaient pas testées aussi souvent que le recommande le Programme ontarien de dépistage du cancer du col de l'utérus. Nous avons observé une association positive entre les taux de dépistage par le test de Papanicolaou et la présence d'un hôpital d'enseignement. Des problèmes de qualité des données limitent notre capacité de surveiller le dépistage du cancer du col utérin. Un registre provincial serait une solution.