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Changes in Smoking During Pregnancy in Ontario, 1995 to 2010: Results From the Canadian Community Health Survey

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Abstract

Objective: The objectives of this study were (1) to examine changes in smoking behaviour across time in pregnant women in Ontario (relative to non-pregnant women and men) and (2) to assess whether, among pregnant women, changes across time vary as a function of sociodemographic characteristics.

Methods: This study used data from the Canadian Community Health Survey. The study sample included 15- to 49-year-old residents of Ontario. Multivariable logistic regression, with interactions between time period and the characteristic of interest, was used to examine whether changes varied across time according to (1) group (pregnant women, non-pregnant women, men; two-year intervals, 2001 to 2010) and (2) pregnant subgroup (maternal age, maternal marital status, maternal education; 1995 to 2000 [n = 3745], 2001 to 2005 [n = 5084], and 2006 to 2010 [n = 2900]).

Results: A decrease in the prevalence of smoking across time was seen in all groups but was smaller in pregnant women than in non-pregnant women (23.5% vs. 30.8%). Among pregnant women, interactions between time period and maternal age, maternal marital status, and maternal education were statistically significant. The prevalence of smoking during pregnancy decreased in older, married, and more highly educated women, but increased in younger women (by 8.2%) and less educated women (by 12.8%). Although the prevalence of smoking during pregnancy decreased in unmarried women, the change was smaller than in married women.

Conclusion: Although the prevalence of smoking in pregnant women is decreasing over time, the decrease is smaller than that in non-pregnant women. Pregnant subgroups particularly resistant to change include younger, unmarried, and less educated mothers. These findings suggest there are subgroups that should be targeted more deliberately by public health interventions.

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Résumé

Objectif : Cette étude avait pour objectif (1) d'examiner les modifications des comportements quant au tabagisme avec le temps chez les femmes enceintes de l'Ontario (par comparaison avec les femmes n'étant pas enceintes et les hommes) et (2) de chercher à déterminer si, chez les femmes enceintes, ces modifications avec le temps variaient en fonction de caractéristiques sociodémographiques.

Méthodes : Dans le cadre de cette étude, nous avons utilisé des données tirées de l'Enquête sur la santé dans les collectivités canadiennes. L'échantillon d'étude englobait les résidentes de l'Ontario dont l'âge se situait entre 15 et 49 ans. Une régression logistique multivariée (tenant compte des interactions entre la période et la caractéristique d'intérêt) a été utilisée pour chercher à déterminer si les modifications variaient avec le temps en fonction (1) du groupe (femmes enceintes, femmes n'étant pas enceintes, hommes; intervalles de deux ans, 2001-2010) et (2) du sous-groupe de grossesse (âge maternel, état matrimonial maternel, niveau de scolarité maternel; 1995-2000 [n = 3 745], 2001-2005 [n = 5 084] et 2006-2010 [n = 2 900]).

Résultats : Bien qu'une baisse de la prévalence du tabagisme avec le temps ait été constatée dans tous les groupes, cette baisse était plus faible chez les femmes enceintes que chez les femmes n'étant pas enceintes (23,5 % vs 30,8 %). Chez les femmes enceintes, les interactions entre la période et l'âge maternel, l'état matrimonial maternel et le niveau de scolarité maternel étaient significatives sur le plan statistique. La prévalence du tabagisme pendant la grossesse connaissait une baisse chez les femmes plus âgées, mariées et disposant d'un niveau de scolarité supérieur, tandis qu'il connaissait une hausse chez les jeunes femmes (de l'ordre de 8,2 %) et chez les femmes disposant d'un niveau de scolarité inférieur (de l'ordre de 12,8 %). Bien que la prévalence du tabagisme pendant la grossesse ait connu une baisse chez les femmes n'étant pas mariées, cette modification a été de plus faible envergure que chez les femmes mariées.

Conclusion : Bien que la prévalence du tabagisme chez les femmes enceintes connaisse une baisse avec le temps, cette baisse est de plus faible envergure que chez les femmes n'étant pas enceintes. Parmi les sous-groupes de femmes enceintes particulièrement résistantes au changement, on trouvait les femmes plus jeunes, non mariées et disposant d'un niveau de scolarité inférieur. Ces résultats semblent indiquer que certains sous-groupes devraient être ciblés de façon plus délibérée par les interventions de santé publique.

INTRODUCTION

Smoking is the leading cause of preventable morbidity and premature mortality worldwide.¹ The risks of smoking are compounded during pregnancy because smoking negatively affects both maternal health and fetal health.²⁻⁴ In order to gauge the success of public health programs aimed at reducing the prevalence of smoking during pregnancy, information is needed on changes in smoking behaviour over time and, in particular, on subgroups of pregnant women who may need more targeted interventions.

Our study had two objectives. Our first objective was to examine changes in smoking behaviour between 2001 and 2010 in pregnant women in Ontario relative to non-pregnant women and men. By making comparisons with non-pregnant women and men, we aimed to assess whether potential changes are specific to pregnant women or are reflective of trends in the general population. Our second objective was to assess whether changes in smoking behaviour among pregnant women between 1995 and 2010 varied as a function of their sociodemographic characteristics. By examining potential sources of heterogeneity among pregnant women, we aimed to understand which subgroups are more resistant to change.

One of the goals of the Ontario Tobacco Strategy of the Ontario Ministry of Health and Long-Term Care is to eliminate smoking during pregnancy. Initiatives implemented towards this end have included developing informational resources and smoking cessation programs for pregnant women (in 2001), increasing the price of tobacco (in 2003), and establishing the Smoke-Free Ontario Act (in 2006).^{5,6}

However, few studies have attempted to track the success of Ontario Tobacco Strategy efforts across time. Data from the Canadian Perinatal Surveillance System reports of 2008⁷ and 2013⁸ suggest that the rate of smoking during pregnancy in Canada has decreased; these findings are consistent with studies from other countries.⁹⁻¹¹ However, it is unclear to what extent these trends reflect changes in pregnant women specifically or changes in all women of child-bearing years or in the general population.^{12,13} Several studies have noted that smoking has declined among non-pregnant women of reproductive age at rates similar to the decline seen in pregnant women.^{11,12} To evaluate the success of the Ontario Tobacco Strategy goal to target pregnant women specifically, information is needed on how trends in smoking behaviour among pregnant women in Ontario compare with those observed among non-pregnant women and men.

Related to this, there is a growing body of evidence that pregnant women of different sociodemographic subgroups differ with respect to changes in smoking behaviour across time.^{11,14} An Australian study found that while the proportion of women who smoked during pregnancy declined overall between 1994 and 2007, it declined more in older mothers than in teenage mothers.¹⁴ Moreover when changes were examined in relation to socioeconomic status, the greatest decline (67.9%) was found in the highest socioeconomic group.¹⁴ These analyses suggest that, among pregnant women, certain sociodemographic subgroups may be more or less amenable to public health efforts to reduce smoking. To help the Ontario Tobacco Strategy and other public health campaigns target their efforts at appropriate subgroups, information is needed on changes in smoking over time in subgroups of pregnant women in Ontario.

METHODS

This was a secondary analysis of the Canadian Community Health Survey (CCHS). Each cycle of the CCHS was a cross-sectional survey that was representative of Canadians 12 years and older living in private dwellings. Access to the Research Data Centres Program was obtained through the Social Sciences and Humanities Research Council. For this study, data were obtained from Cycles 1.1 (2001 to 2002), 2.1 (2003 to 2004), 3.1 (2005 to 2006), and 4.1 (2007 to 2008) and from the 2009 and 2010 annual components of the CCHS.

CCHS methodology has been described in detail elsewhere.¹⁵ Briefly, the CCHS sample was allocated to provinces and territories according to population size and, within provinces, proportionally to the square root of the population size of health regions. Two sampling frames were used. The primary sampling frame was borrowed from the Labour Forces Survey, which employs a multi-stage stratified cluster design to select a representative sample of households. One individual was randomly chosen from 82% of households; two people were randomly chosen from the remainder. The secondary sampling frame employed random digit dialling, with one individual randomly chosen from households.¹⁵ Each questionnaire in the CCHS was divided into a 35-minute common content section and a 10-minute optional content section containing questions requested by the particular health region in which it was implemented. All questions for this study were from the common content section.

The population for the CCHS was individuals residing in Canada at the time of data collection, excluding individuals

living in institutions or on reserves or who were members of the Canadian Armed Forces. For the purposes of this study, a sample of residents of Ontario between the ages of 15 and 49 years was selected. Within this sample, we identified three groups: pregnant women, non-pregnant women, and men. The second and third groups served as a comparison to pregnant women, the primary group of interest. Pregnant women were identified as women who responded “yes” to the question “Have you given birth in the past five years?” Non-pregnant women were defined as women who responded “no” to the question “Have you given birth in the past five years?” The final sample sizes of pregnant women were $n = 3745$ in 1995 to 2000, $n = 5084$ in 2001 to 2005, and $n = 2900$ in 2006 to 2010.

At a given CCHS cycle, pregnant women were asked to provide information on smoking behaviour during pregnancies that occurred over the past five years. Thus, the rate of smoking for this group was not directly comparable to the rate of smoking observed among non-pregnant women and men who were asked to report on current smoking behaviour at the time of the interview. If left unaccounted for, comparisons across the three groups could result in differences in smoking rates that are attributed to differences in the year at which the smoking behaviour occurred (period effects), not to actual differences in smoking behaviour. To address this limitation, an indicator, “year at smoking,” was constructed which identified the year when women smoked during pregnancy, based on their response to the pregnancy follow-up question “In what year [did you give birth]?” This “year at smoking” indicator was used as a proxy of the time at which smoking behaviour occurred in pregnant women. The information on current smoking behaviour for the two comparison groups, non-pregnant women and men, were matched to this indicator. In order to keep ages consistent across groups, women who reported pregnancies that would have occurred before the age of 15 were excluded.

The “year at smoking” indicator allowed us to measure changes in smoking behaviour among pregnant women across three time periods: 1995 to 2000, 2001 to 2005, and 2006 to 2010. These time periods were grouped around major Ontario Tobacco Strategy initiatives which took place in 2001 (information and resources on smoking and pregnancy distributed to health professionals) and 2006 (the Smoke-Free Ontario Act).^{5,6} Because information on smoking behaviour for non-pregnant women and men was not available before 2001, changes across time in the three groups (pregnant women, non-pregnant women, and men) were compared in two-year intervals from 2001 to 2010.

For all three groups, smoking behaviour was measured by a dichotomous variable, “active smoking,” which was coded as active smoker (i.e., daily or occasional smoking) or non-smoker. Among non-pregnant women and men, active smokers were those who reported smoking at the time of the interview. Among pregnant women, active smokers were defined as those who reported smoking during their last pregnancy (i.e., up to five years before the interview).

For comparisons across subgroups of pregnant women defined by their sociodemographic characteristics, the variables of interest were maternal age (< 25 years vs. ≥ 25 years), maternal marital status (unmarried [common-law, widowed, separated, divorced, or single] vs. married), and maternal education (secondary or incomplete post-secondary education vs. completed post-secondary education or more).

We used SAS 9.3 (SAS Institute Inc., Cary NC) for all analyses. Descriptive statistics (i.e., frequencies and percentages) were derived to describe the study sample of pregnant women across the three time periods of interest. Multivariable logistic regression models were used to examine changes across time:

1. among groups (i.e., pregnant women, non-pregnant women, and men; 2001 to 2010) and
2. among subgroups of pregnant women (i.e., defined by maternal age, maternal marital status, and maternal education, 1995 to 2010).

To assess whether changes across time differed across the three groups and across subgroups of pregnant women, interactions between time period and group or subgroup were explored. Odds ratios were converted to probabilities for ease of interpretation. Since the goal of this study was to track absolute rates of smoking (and not to make causal inferences), additional covariates were not controlled for in these analyses.

Each respondent to the CCHS was assigned a weight that represented his or her contribution to the total population. This weight took into account the CCHS multi-stage sampling design and was adjusted to be calibrated with population projections of age and sex strata within each province.¹⁵ Weights were also adjusted for non-response.¹⁵ For the current study, weights were standardized to maintain the original sample size.

Ethics approval was not needed for this study because respondents were not identifiable.

Weighted descriptive statistics for pregnant women, Ontario, 1995 to 2010			
	1995 to 2000 n = 3745 n (%)	2001 to 2005 n = 5084 n (%)	2006 to 2010 n = 2900 n (%)
Maternal age, years			
< 25	664.7 (17.8)	828.3 (16.3)	476.7 (16.4)
≥ 25	3080.2 (82.2)	4254.8 (83.7)	2422.6 (83.6)
Maternal marital status			
Unmarried	781.1 (20.9)	1209.4 (23.8)	751.7 (25.9)
Married	2964.1 (79.1)	3868.5 (76.2)	2148.0 (74.1)
Maternal education			
Secondary or some post-secondary	1443.2 (38.8)	1446.2 (28.9)	710.7 (25.2)
Completed post-secondary	2275.4 (61.2)	3556.7 (71.1)	2106.2 (74.8)

*Discrepancies between the total n and the sums of subgroups for each maternal characteristic are due to missing values for that characteristic.

RESULTS

Descriptive statistics for the sample of pregnant women across the three time periods of interest are included in the Table.

There were differential changes across time in smoking behaviour according to group membership (i.e., pregnant women, non-pregnant women, and men), as reflected in a statistically significant interaction between time period and group ($P < 0.001$) (Figure 1). Although smoking rates were lowest in pregnant women throughout the study period, the greatest decrease in smoking rates across time was among non-pregnant women; between 2001–2002 and 2009–2010, there was a 30.9% decrease (from 26.1% to 18.1%). Among pregnant women, smoking rates decreased by only 23.5% (from 12.0% to 9.2%). The decrease in men was the smallest, at 16.1% (from 31.4% to 26.3 %).

Among pregnant women, there were differential changes across time in smoking behaviour according to maternal age ($P = 0.001$) (Figure 2). Smoking rates actually increased by 8.2% in younger pregnant women (from 23.7% to 25.6%). They decreased in older pregnant women by 35.4% (from 10.6% to 6.9%).

There were also differential changes across time in smoking behaviour according to maternal marital status ($P = 0.04$) (Figure 3). Smoking rates decreased in both unmarried and married pregnant women, but the relative decrease in married pregnant women was greater than that in unmarried pregnant women. In married pregnant women, smoking rates decreased by 42.2% (from 8.3% to 4.8%); in unmarried pregnant women, the decrease was only 19.2% (from 30.5% to 24.7%).

Finally, there were differential changes across time in smoking behaviour according to maternal education ($P = 0.002$) (Figure 4). Smoking rates increased by 12.8% in less educated pregnant women (from 21.9% to 24.7%). They decreased by 34.3% in more highly educated pregnant women (from 7.4% to 4.9%).

DISCUSSION

The prevalence of smoking among pregnant women decreased between 2001–2002 and 2009–2010. This finding is consistent with the 2008 Canadian Perinatal Surveillance System report, which, also using CCHS data, showed a 24.7% decrease in the prevalence of smoking during pregnancy (2000–2001 to 2005).⁷ However, our study adds to the literature by showing that the decrease among pregnant women was smaller than that seen in non-pregnant women in the same time period. Changes in smoking behaviour in pregnant women across time thus seem to reflect changes in women of reproductive age in general; to date, targeted public health interventions do not appear to have had a stronger effect on pregnant women. This is consistent with findings from other geographic areas.^{11,12}

Among pregnant women, those who were younger, were unmarried, and had lower levels of education appeared to be more resistant to change. Younger women and women who had lower levels of education actually showed increases in smoking rates between 1995–2000 and 2006–2010. These results add to the Canadian Perinatal Surveillance System data, which did not examine differential changes across time according to maternal sociodemographic characteristics.^{7,8} Our findings are consistent with previous research from Australia showing greater resistance to change in lower

Figure 1. Changes in smoking behaviour across time in pregnant women, non-pregnant women, and men, Ontario, 2001 to 2010

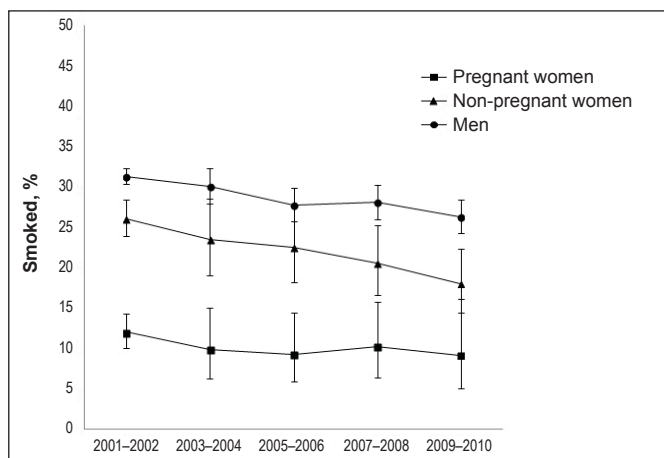


Figure 2. Changes in smoking behaviour across time in pregnant women by maternal age, Ontario, 1995 to 2010

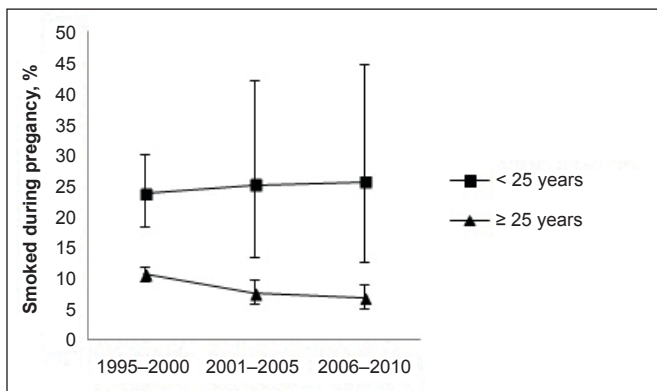


Figure 3. Changes in smoking behaviour across time in pregnant women by maternal marital status, Ontario, 1995 to 2010

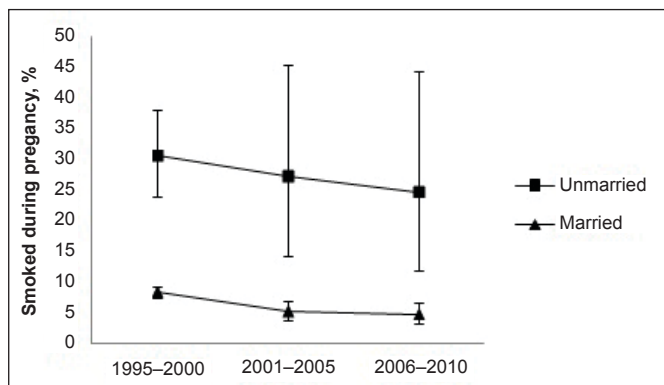
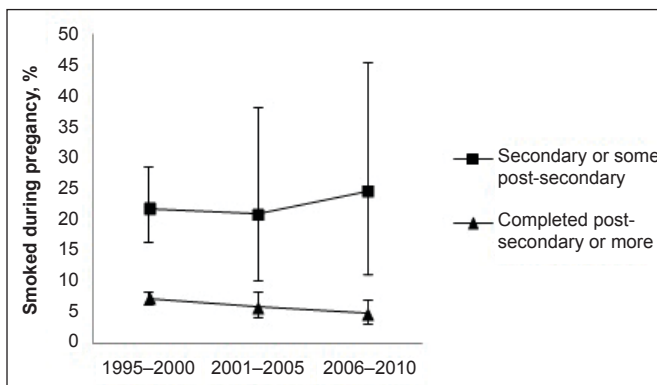


Figure 4. Changes in smoking behaviour across time in pregnant women by maternal education, Ontario, 1995 to 2010



socioeconomic groups¹⁴ and build on this study by providing data which are specific to the Canadian context.

A limitation of this study was that smoking behaviour was by self-report. Research suggests that individuals are prone to under-report smoking because of the associated stigma.^{16,17} Social desirability in reporting is greatest when questions are asked during pregnancy; for example, one study found that when comparing self-reported smoking with a direct measure of cotinine (a metabolite of nicotine) in pregnant women, 23.8% of smokers were missed by self-report alone.¹⁷ Retrospective questioning about pregnancy, as in the CCHS, appears to be less affected by social desirability.^{18,19} Nevertheless, under-reporting of smoking, particularly for pregnant women, remains a possibility in our study. Moreover, social desirability in reporting may vary by sociodemographic characteristics; women with higher socioeconomic status are more likely to under-report smoking during pregnancy.²⁰ It is therefore possible that

differences in smoking rates between sociodemographic subgroups were exaggerated because of differential bias between subgroups. Despite this limitation, it is important to note that for large-scale national surveys such as the CCHS, direct measurement would not be feasible.¹⁶

Aggregation of data across years of data collection may have diluted the magnitude of the change in smoking behaviour across time. However, the large number of time points needed for more sophisticated approaches such as interrupted time series²¹ precluded the use of such analyses. Moreover, particularly for the group of pregnant women, it was necessary to aggregate data to increase the sample size since:

1. the number of women with pregnancies in the CCHS was small and
2. the proportion of smokers within this group was relatively small.

Aggregation of data also made it impossible to examine the impact of specific Ontario Tobacco Strategy efforts (e.g., 2001, 2003, or 2006); conclusions about the success of the Ontario Tobacco Strategy can therefore only be made in a general sense. However, we did choose cut-points for time periods which reflected the major 2001 and 2006 Ontario Tobacco Strategy initiatives, and our examination of changes across time in pregnant subgroups is relevant to the improvement of such initiatives through the use of more targeted interventions.

Wide confidence intervals show a level of uncertainty associated with the smoking rates among subgroups of pregnant women. These reflect smaller sample sizes available after stratification by maternal age, maternal marital status, and maternal education. However, despite this uncertainty, confidence intervals did not overlap for any of the subgroups. Therefore, using even the most conservative potential differences between subgroups of pregnant women, women who were younger, unmarried, and less educated did have higher rates of smoking, which either increased or decreased more slowly across time than their older, married, and more highly educated counterparts.

Smoking during pregnancy is associated with obstetric complications, such as placenta previa, placental abruption, ectopic pregnancy,^{2,4} spontaneous abortion,^{4,22} stillbirth,⁴ and preterm birth.^{2-4,23-26} Adverse fetal outcomes include oral clefts⁴ and fetal growth restriction,^{3,4} and infants are at increased risk for respiratory distress syndrome.⁴ These outcomes are explained by the impact of inhaled carbon monoxide and nicotine on placental blood flow: the reduction in placental blood flow causes low fetal tissue oxygenation.²⁵ Despite these established risks, according to our findings, as of 2009 to 2010, 9.2% of women in Ontario continue to smoke during pregnancy, and rates are higher among younger, unmarried, less educated women.

It is clear from our findings that greater effort needs to be applied to targeting subgroups of pregnant women so that the success of public health interventions aimed at reducing smoking during pregnancy can be improved. Smoking during pregnancy in younger mothers may be explained by greater risk-taking behaviours.²⁷ Unmarried mothers may lack social support in efforts to quit smoking during pregnancy,²⁷ and mothers with lower education levels may have limited access to smoking cessation programs.²⁸⁻³⁰ With these factors in mind, more targeted interventions could help realize the goal of the Ontario Tobacco Strategy to eliminate smoking during pregnancy. While efforts have been made to disseminate information on smoking and pregnancy to physicians, dentists, and pharmacists,⁵ these processes could be improved by providing specific

information on high-risk subgroups or by targeting these subgroups through areas in which they are most likely to come into contact with services (e.g., welfare services, community programs). This may facilitate health care and other professionals' efforts to identify women who may need smoking cessation counselling and who would require greater support in efforts to quit smoking. Furthermore, while it has been argued that general efforts to reduce smoking (e.g., by raising the price of tobacco) will affect behaviours of pregnant women,⁵ it is clear that strategies need to be targeted more deliberately at pregnant women who are younger, unmarried, and less educated to produce a beneficial change in pregnant women overall.

CONCLUSION

We found that although the prevalence of smoking in pregnant women is decreasing over time, this decrease is smaller than that seen in non-pregnant women. Pregnant subgroups particularly resistant to change include younger, unmarried, and less educated mothers. Our findings suggest that these subgroups should be targeted more deliberately by public health interventions in order to meet the goals of the Ontario Tobacco Strategy.

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