

The Early 1990s Cigarette Price Decrease and Trends in Youth Smoking in Ontario

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ABSTRACT

Background: Youth are especially vulnerable to fluctuations in cigarette price, and both the smuggling increase during the early 1990s and the 1994 tax decrease made purchasing easier for youth. The purpose of this study is to examine the relation between these price decreases, and trends in smoking prevalence and amount smoked among Ontario youth.

Methods: Data from the Ontario Student Drug Use Survey were analyzed for trend using: 1) polynomial regression, and 2) discontinuity regression with an "event time" of 1993 to capture effects of both pre-tax cut smuggling and the tax cut.

Results: Overall, smoking prevalence decreased from 1977 to 1993, jumped upward at this time, and decreased after 1993. Among daily smokers, mean number of cigarettes smoked daily showed an increase followed by a decrease over the 24 years, and a negative quadratic trend. Trends for subgroups are also reported.

Conclusions: These findings suggest that the early 1990s cigarette price decrease may have played a role in increasing youth smoking in Ontario.

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

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Tobacco use causes nearly 12,000 deaths in Ontario each year.¹ Nearly all adults who are regular smokers began by the age of 20 (as teenagers), and those who have not begun by then rarely become regular smokers as adults.² Therefore, prevention efforts need to focus on this critical life stage.

Price has been shown to be an effective smoking deterrent among adults,³ and more so among youth since limited disposable income contributes to their greater sensitivity to changes in cigarette prices.^{4,5} When more adolescents can afford to smoke, more of their contemporaries are seen smoking. The increased visibility of smoking and the increased potential for peer pressure to smoke are likely synergistic effects of a price decrease.⁶ Price sensitivity has been shown to differ by sex (both among youth and adults), with males showing a higher price elasticity than females.^{7,8}

In the early 1990s, untaxed (smuggled) cigarettes were estimated to represent about 30% of the total market.^{9,10} In an effort to combat smuggling, the Canadian federal government reduced prices per carton by five dollars in February 1994. A further five dollars was removed if provincial governments agreed to match this reduction. Five provinces (including Ontario) did so, cutting cigarette prices by about half in these provinces.¹¹

The goal of the present study is to examine trends in smoking prevalence and amount smoked over time among youth in Ontario from 1977 to 2001, and, in particular, to explicitly relate these trends to the decrease in cigarette prices in 1993-94. This study extends previous research in several ways: by performing formal trend analyses using data over a wider time frame than previously explored; by addressing sampling variation around estimates of prevalence and amount smoked; and by allowing for different trends before and after the tax decrease.

METHODS

Source of data: The Ontario Student Drug Use Survey

The Centre for Addiction and Mental Health (formerly the Addiction Research Foundation) has conducted the biennial Ontario Student Drug Use Survey (OSDUS) since 1977.¹² Students in grades

7, 9, 11 and 13 (OAC) were sampled, initially using a region-by-grade stratified design with self-weighted estimates, as the students were allocated by grade and region proportionately. The design was changed in 1981 to a stratified single-stage school board cluster model, allowing more schools and boards to be selected. In 1999, schools became the primary sampling unit, and this remained the case for the 2001 OSDUS. The design and methodology of the OSDUS are described elsewhere.¹²

Each year, the self-administered questionnaire has included a question regarding level of tobacco use (see Appendix). If respondents answered that they smoked more than one cigarette in the past 12 months (response categories 3-9), they were considered smokers; otherwise, they were considered nonsmokers.¹² In recent years, the OSDUS has also asked a half sample of students if they smoked more than 100 cigarettes in their lifetime and some in the past month. While the definition used (smoked at least one cigarette in the past year) would categorize more students as smokers than a more strict definition of current smoker, the average correlation between the two definitions is 0.69 over a 10-year period (1991-2001). The present study proceeded to use the historical OSDUS definition of current smoker (smoked more than one cigarette in the past 12 months) because it was available since 1977 and provided data for the full sample.

A measure of mean number of cigarettes smoked per day was computed for current daily smokers, using the midpoints of the daily smoker categories (1.5, 4, 8, 13, and 18, respectively), and a conservative value of 20 for more than 20 cigarettes per day.

Data analysis

Trend analyses over the period 1977-2001 were conducted for all respondents and separately by sex and grade, using two methodological approaches: 1) polynomial regression, and 2) discontinuity regression.¹³ For this study, the unit of analysis was the survey ($n = 13$) rather than the individual.

For the polynomial regression, the primary independent variable (year) was centered by subtracting the mean year of 1989 from each survey year. Quadratic and cubic components were included to allow for the possibility of non-linear trends.

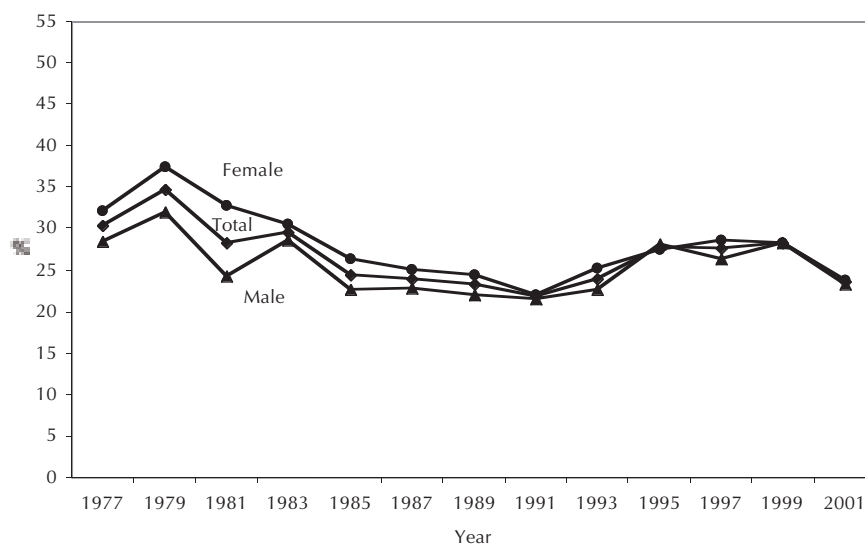


Figure 1. Smoking Prevalence Among Youth, by Sex, Ontario 1977-2001
The sample size for 1999 and 2001 is approximately half that of the other years because grades 7-13 inclusive were sampled in the 1999 and 2001 OSDUS, and prior years only sampled grades 7, 9, 11, and 13. To maintain continuity, only data from grades 7, 9, 11, and 13 in 1999 and 2001 were used in this study. Therefore, precision of the 1999 and 2001 estimates was less than the precision of estimates for previous years.

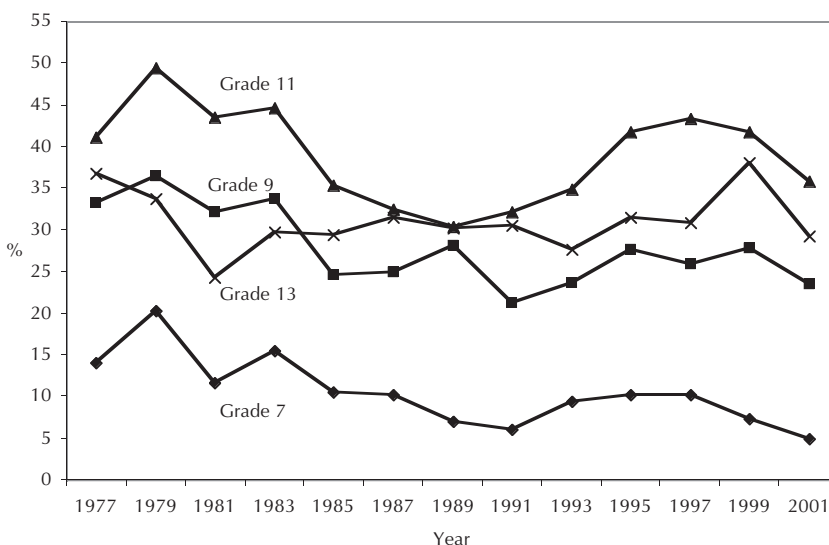


Figure 2. Smoking Prevalence Among Youth, by Grade, Ontario 1977-2001
The sample size for 1999 and 2001 is approximately half that of the other years because grades 7-13 inclusive were sampled in the 1999 and 2001 OSDUS, and prior years only sampled grades 7, 9, 11, and 13. To maintain continuity, only data from grades 7, 9, 11, and 13 in 1999 and 2001 were used in this study. Therefore, precision of the 1999 and 2001 estimates was less than the precision of estimates for previous years.

Discontinuity regression allows one to estimate different trends and different intercepts before and after a specified event. A discontinuity point of 1993 was chosen because although the tax cut occurred in early 1994, cheaper smuggled cigarettes were widely available before then. Further, the next earliest cutpoint would have to be 1991, as there was no 1992 OSDUS survey. To model the event

discontinuity, the following regression models were fitted: 1) equal trends on either side of the discontinuity point (1977 to 1991 vs. 1993-2001) with a change in intercept at the event time; 2) different trends before and after the discontinuity point, with a change in intercept at the event time; and 3) different trends before and after the discontinuity point, with no change in intercept at the event time.

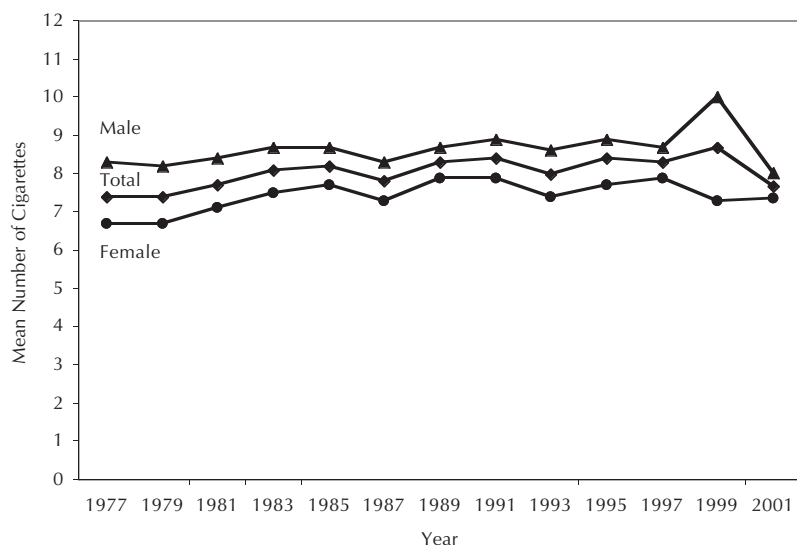


Figure 3. Mean Number of Cigarettes Smoked Daily Among Youth, Daily Smokers, by Sex, 1977-2001

The sample size for 1999 and 2001 is approximately half that of the other years because grades 7-13 inclusive were sampled in the 1999 and 2001 OSDUS, and prior years only sampled grades 7,9,11, and 13. To maintain continuity, only data from grades 7, 9, 11, and 13 in 1999 and 2001 were used in this study. Therefore, precision of the 1999 and 2001 estimates was less than the precision of estimates for previous years.
For the polynomial and discontinuity regressions, the male student subgroup was transformed to $1/x^2$ to produce a normal distribution of the data.

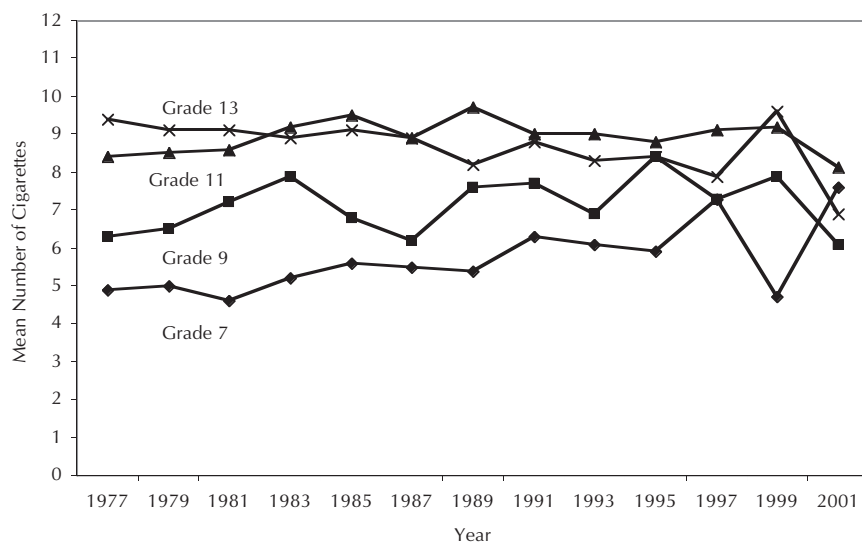


Figure 4. Mean Number of Cigarettes Smoked Daily Among Youth, Daily Smokers, by Grade, 1977-2001

The sample size for 1999 and 2001 is approximately half that of the other years because grades 7-13 inclusive were sampled in the 1999 and 2001 OSDUS, and prior years only sampled grades 7,9,11, and 13. To maintain continuity, only data from grades 7, 9, 11, and 13 in 1999 and 2001 were used in this study. Therefore, precision of the 1999 and 2001 estimates was less than the precision of estimates for previous years.

To assess which regression model produced the best fit, a combination of adjusted R^2 values (higher indicates more variance explained by the model) and significance of t-tests for coefficients was used.

Mean number of cigarettes smoked per day for male students was not normally

distributed. A reciprocal square transformation ($1/x^2$) was used for this subgroup, as it showed the most normal distribution. This transformation was chosen with the aid of a statistical function that allows graphing and chi-square tests of nine possible transformations, for the purpose of

choosing the transformation which best approximates a normal distribution when applied to the data.¹⁴

A weight was used to account for the fact that smoking prevalence and mean number of cigarettes smoked per day are estimates with varying precision that depend on the survey design and a sample of finite size. Smoking prevalence (p) was analyzed using the logit transformation, with $\log(p/[1-p])$ as the dependent variable. The weight used for prevalence was the inverse of the variance of the logit of smoking prevalence, where the variance of the logit is $[\text{var}(p)]/[p(1-p)]^2$. The weight used for mean number of cigarettes smoked per day was the inverse of its associated variance (the square of the standard error). Standard error estimates were obtained using Taylor series methods for complex survey analysis.¹⁴ Differences between subgroups were tested using interaction terms. Because of the time-series nature of the data, a Durbin-Watson test statistic was calculated to check for residual autocorrelation. No evidence of this was found. All analyses were conducted using Stata software.¹⁴

RESULTS

Smoking prevalence

For the sample as a whole, smoking prevalence showed a significant discontinuity effect, with a negative slope until 1993, an upward jump at the discontinuity point, and a leveling off after 1993 (Figure 1); the adjusted R^2 was 0.61. A significant positive quadratic trend was also seen (a U-shaped curve; adjusted $R^2 = 0.42$) over the 24 years (Figure 1). The female subgroup showed similar results, as well as a significant negative linear trend (Figure 1; adjusted R^2 values for linear, quadratic and discontinuity models being 0.33, 0.53 and 0.71, respectively). Males and grade 11 students showed only the discontinuity effect (decrease, jump, leveling off, Figures 1 and 2; adjusted R^2 values of 0.39 and 0.48, respectively). Grade 7 students showed a significant discontinuity effect with equal negative slopes before and after a positive jump at the discontinuity point (adjusted $R^2 = 0.74$), and Grade 9 students showed a decrease with a leveling off after the cut point (adjusted $R^2 = 0.61$, Figure 3). These two groups also exhibited a sig-

nificant negative linear trend (adjusted $R^2 = 0.55$ and 0.42 , respectively). Grade 13 students did not show any significant trends with the models used.

Mean number of cigarettes smoked per day among daily smokers

For all daily smoking students as a whole, the mean number of cigarettes smoked per day showed a significant discontinuity effect, with an increase followed by a shallow decrease (adjusted $R^2 = 0.45$), as well as a significant negative quadratic trend (an inverted U-shaped curve; adjusted $R^2 = 0.52$, Figure 3). Among female daily smokers, a significant negative quadratic trend (adjusted $R^2 = 0.69$) was observed over the 24 years, and females also showed a discontinuity effect (increase, drop, shallow decrease, adjusted $R^2 = 0.64$, Figure 3). A positive linear trend was seen for the grade 7 subgroup, with an adjusted R^2 of 0.39 (Figure 4). Grade 11 students showed a significant negative quadratic trend (adjusted $R^2 = 0.45$), and Grade 13 students showed evidence of a negative linear trend (adjusted $R^2 = 0.33$, Figure 4). The male and Grade 9 subgroups did not show any significant trends with the models used.

DISCUSSION

Although a number of factors would be related to changes in adolescent smoking, it is likely that the tax decrease of 1994 and the effective reduction in price prior to that did facilitate use of tobacco by youth. Over the 24 years from 1977 to 2001, the most common pattern in youth smoking prevalence was a decrease until 1993, an upward jump at 1993, and then a shallow but negative trend after 1993. This supports earlier descriptive analyses which reported a decrease in the 1980s and an increase through the early to mid 1990s.^{15,16} Fewer consistent patterns were found for trends in mean number of cigarettes smoked per day. For all students combined, mean number of cigarettes smoked per day showed an overall increase over the time period, indicating that those youth who smoked daily consumed more cigarettes each day. It should be noted that increases in adolescent use of substances other than tobacco have also been seen since the early 1990s,¹² and thus determi-

Appendix A

The OSDUS Core Tobacco Use Question

How often did you use tobacco/smoke cigarettes in the last 12 months?

- 1) I did not use tobacco/smoke in the last 12 months;
- 2) I tried a cigarette in the last 12 months;
- 3) I had less than 1 cigarette a day (in the last 12 months);
- 4) I had 1-2 cigarettes a day (in the last 12 months);
- 5) I had 3-5 cigarettes a day (in the last 12 months);
- 6) I had 6-10 cigarettes a day (in the last 12 months);
- 7) I had 11-15 cigarettes a day (in the last 12 months);
- 8) I had 16-20 cigarettes a day (in the last 12 months);
- 9) I had more than 20 cigarettes a day (in the last 12 months).

nants in addition to price need to be considered, including various socio-cultural influences and their changes over time. Although trends in cigarette use are similar to those seen in other drug use, there are a few important differences shown by the OSDUS: 1) there were significantly fewer new tobacco users in 2001 than were reported in 1997, and similar decreases were not found for either alcohol or cannabis; 2) early onset (by grade 4) of tobacco use among 7th graders was reported by fewer students in 2001 compared with 1981, vs. no change in early alcohol use and little change in early cannabis use; and 3) a continuing decline in cigarette use prevalence among 7th graders since 1997, not seen for drugs such as cannabis.¹²

Limitations of this study include the small number of observations ($n = 13$ surveys). As with the OSDUS itself, the present study may not be generalizable to students not attending public or Catholic schools in Ontario. As well, the OSDUS is a cross-sectional study, which does not allow us to draw conclusions about causal effects. Of the 13 observations available for this study, only 5 occurred at or after the 1993 discontinuity point, a small number with which to assess a trend. Further, a precise effect of the price decrease cannot be linked to one particular year, as cigarette smuggling began to increase in 1991, and indeed showed an exponential rise up to the time of the tax decrease.^{9,15}

Despite these limitations, an extensive body of research has already demonstrated an association between cigarette price and smoking, including at least seven Canadian studies.¹⁷⁻²³ These studies have taken various approaches to examine the effect of cigarette price on smoking behaviours, with analyses at both aggregate and individual levels. Generally, youth have been found to be more sensitive to changes in cigarette prices than adults.^{17,24} Although the study reported here cannot provide

causal evidence regarding the relationship between the increase in smoking behaviours and the decrease in cigarette prices in 1993-94, the analyses do build on previous reports of trends in youth smoking by refining the modelling of these trends. Future research could extend these findings by examining additional years post-tax cut once data become available, estimating alternate regression models, and replicating the trend analysis in other provinces with and without the tax cut.

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RÉSUMÉ

Contexte : Les jeunes sont particulièrement vulnérables aux fluctuations du prix des cigarettes; or, l'augmentation de la contrebande au début des années 1990 et la réduction des taxes décriée en 1994 ont facilité l'achat des cigarettes par les jeunes. On examine ici le lien entre ces baisses de prix et les tendances de la prévalence du tabagisme et du nombre de cigarettes fumées par les jeunes en Ontario.

Méthode : On a analysé les données du Sondage sur la consommation de drogues parmi les élèves de l'Ontario pour y déceler des tendances. On a procédé 1) par régression polynomiale et 2) par analyse de discontinuité de la régression pour l'année 1993 afin d'évaluer les effets de la contrebande avant la réduction de taxes, puis les effets de la réduction.

Résultats : Dans l'ensemble, la prévalence du tabagisme a diminué entre 1977 et 1993, est montée en flèche en 1993 et a baissé après 1993. Chez les fumeurs quotidiens, le nombre moyen de cigarettes fumées quotidiennement a augmenté, puis diminué au cours de la période de 24 ans et présente une tendance quadratique négative. Les tendances par sous-groupe sont également indiquées.

Conclusions : D'après ces constatations, la baisse du prix des cigarettes au début des années 1990 pourrait avoir joué un rôle dans l'augmentation du tabagisme des jeunes en Ontario.

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s'intéresser au contexte social de sa consommation. En resserrant les règles, on ne fait qu'encourager la méfiance au lieu de manifester sa bienveillance et son souci des étudiants. Il faut « ...encourager ce que nous voulons et non ce que nous craignons. »¹¹

Pour revenir à Gliksman et al., leur étude a le mérite de braquer les projecteurs sur l'important problème de la consommation abusive d'alcool chez les étudiants de premier cycle des universités canadiennes. La difficulté, pour les universités, sera de maintenir l'excellence de l'instruction et de procurer aux étudiants un milieu sûr et propice à l'apprentissage tout en respectant leur autonomie et en leur offrant la liberté de devenir des adultes responsables et compétents.

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