Supplement to 'Cannabis-Related Emergency Department Visits by Ontario Youths and their Outcomes: Repeated Cross-Sectional Study'

Objective

This supplement presents a Poisson regression analysis of the trends in the rates of youths with cannabis-related ED visits, and how those trends vary by age and sex.

Statistical Methods

We defined several variables for time and for sex and age differences. We let $c(t) = t - 2009.5$ for year t. $c(t)$ centered time at the midpoint of the year 2009, halfway between the beginning of 2003 and the end of 2017. $c(t)^2$ and $c(t)^3$ are the square and the cube of centered time. $M = 1$ if the youth was male and 0 if the youth was female. Two variables were created to capture age differences. We defined $A_1 = 1$ if a youth was ≥ 13 years old and $A_1 = -2$ for the youngest youths. $A_2 = 1$ for youths who were 19-24 years old, $A_2 = -1$ for youths who were 13 to 17 years old, and $A_2 = 0$ for 10-13 year-old youths. Thus A_1 contrasts the two older groups with the youngest youths, and A_2 contrasts the oldest youths with the 14-18 year-old youths.

Results

First we determined what order of polynomial best fit the curvature of the time trend seen in Figure 1 Panel A. Let $Y_a(t)$ be the count of all youths with cannabis-related visits in year t. Then our generalized linear model for the trend was

Appendix 1, as supplied by the authors. Appendix to: Bechard M, Cloutier P, Lima I, et al. Cannabis-related emergency department visits by youths and their outcomes in Ontario: a trend analysis. *CMAJ Open* 2022. doi: 10.9778/cmajo.20210142.

$$\mathrm{E}[Y_a(t)] = B_0 + B_1\, c(t) + B_2 c(t)^2 + B_3 c(t)^3.$$

We fit this model using the R function glm. We used the Ontario youth population in the year t as an offset, so that we modelled the annual rate of visits, rather than the counts.

Poisson Regression Model for Rates of All Youths with Cannabis Visits

Table S.1 Poisson Regression Model for Rates of Visits by All Youths

Variable	*B*	*95% CI*
Intercept	-7.31836	-7.33649 to -7.30022
c(t)	0.10830	0.10130 to 0.11530
$c(t)^2$	0.00567	0.00497 to 0.00637
$c(t)^3$	0.00009	-0.00010 to 0.00028

Note. *c(t)* is centered time, that is, *c(t)* = *Year* – 2009.5. $c(t)^2$ and $c(t)^3$ are the square and the cube of centered time.

In Table S.1, the 95% confidence interval for the coefficient for $c(t)^3$ included zero, so we concluded that the curvature of the trend was adequately captured by a model with linear and quadratic terms. The Durbin-Watson statistic for the residuals of this model was 1.48 ($p = 0.29$), indicating that there was no substantial serial correlation in the residuals.

Poisson Regression Model for Age and Sex Differences in Rates of Youths with Cannabis Visits

To model the age and sex differences in trends of rates of youths with cannabis visits, we built a Poisson regression model with linear and quadratic terms for time, as well as terms for age, sex, and all two-way interactions among time, sex, and age terms. We did not include possible three-way interactions because such terms are difficult to interpret. The resulting regression model was as follows. Let $Y_{as}(t)$ be the count of cannabis visits in year t for youths in age group a and sex s. Then

$$\begin{aligned}\mathrm{E}[Y_{as}(t)] = \quad & B_0 + B_1 c(t) + B_2 c(t)^2 + B_m M + B_{A_1} A_1 + B_{A_2} A_2 + B_{M\times A_1} M A_1 + \\ & B_{M\times A_2} M A_2 + B_{c\times M}\, c(t) M + B_{c\times A_1}\, c(t) A_1 + B_{c\times A_2}\, c(t) A_2 + \\ & B_{c^2\times M}\, c(t)^2 M + B_{c^2\times A_1}\, c(t)^2 A_1 + B_{c^2\times A_2}\, c(t)^2 A_2.\end{aligned}$$

We were concerned that a model with fourteen terms might be at risk of overfitting the data, so we used a LASSO procedure (1) to determine whether all terms were necessary. Perhaps because of the large number of observations, the LASSO procedure suggested that all time, age, and sex terms, and their two-way interactions were appropriate to keep in the model. Table S.2 reports the estimated regression coefficients from the above model.

Table S.2 Poisson Regression Model for Rates of Visits by Age and Sex

Variable	*B*	*95% CI*
Intercept	-8.32661	-8.38718 to -8.26603
$c(t)$	0.09325	0.08557 to 0.10094
$c(t)^2$	0.00827	0.00629 to 0.01026
M	0.53720	0.47017 to 0.60424
A_1	0.85677	0.80078 to 0.91275
A_2	-0.19467	-0.21919 to -0.17015
$M \times A_1$	0.15628	0.09766 to 0.21491
$M \times A_2$	0.20642	0.18226 to 0.23058
$c(t) \times M$	-0.02066	-0.02642 to -0.01491
$c(t) \times A_1$	0.02941	0.02275 to 0.03607
$c(t) \times A_2$	0.01894	0.01614 to 0.02173
$c(t)^2 x M$	-0.00515	-0.00663 to -0.00367
$c(t)^2 \times A_1$	0.00088	-0.00084 to 0.00260
$c(t)^2 \times A_2$	0.00074	0.00003 to 0.00146

Note. $c(t)$ is centered time, that is, $c(t) = Year - 2009.5$. $c(t)^2$ and $c(t)^3$ are the square and the cube of centered time. M is a dummy variable for male youths. A_1 is a contrast variable comparing the 19-24 year-old and the 14-18 year-old youths against the 10-13 year olds. A_2 contrasts the 19-24 year-old against the 14-18 year-old youths. The remaining variables code the two-way interactions among these variables. For example, $M x A_1$ picks up sex differences in the contrast between 19-24 year-old and the 14-18 year-old youths versus the 10-13 year olds.

In Table S.2, the estimates for $c(t)$ and $c(t)^2$ are similar to those in Table S.1. $B_m > 0$ reflects the consistently higher rates of cannabis visits among males. $A_1 > 0$ means that expected visit rates were higher for 14-18 year-old and 19-24 year-old youths at the midpoint of the period, compared to the 10-13 year olds. $A_2 < 0$ means that visit rates were higher for 14-18 year-old than 19-24 year-old youths at that time. $B_{M \times A_1} > 0$ and $B_{M \times A_2} > 0$ implies that the age effects for males were greater than for females. $B_{c(t) \times M} < 0$ says that the linear component of the trend was smaller for males, but this was counterbalanced by $B_{c(t)^2 \times M} > 0$, which indicated that the quadratic trend was greater for males than for females. $B_{c(t) \times A_1} > 0$ means that rates of youths with visits increased over time faster among the 14-18 year-old and 19-24 year-old youths compared to the 10-13 year olds, as seen in Figure 1 Panel C. Finally, $B_{c(t) \times A_2} > 0$ and $B_{c(t)^2 \times A_2} > 0$, which means that the rates of youths with cannabis visits increased more quickly among 19-24 year-old compared to 14-18 year-olds. This is consistent with the crossover of the trends for these two groups, visible in Figure 1.

Interpretation

The Poisson regression analysis of the trends data support the conclusions apparent in Figure 1 and Table 2. The most important findings were that rates of youths with visits increased faster than linearly between 2003 and 2017. Rates were higher among males. Rates were higher and increased faster for 14-18 year-old and 19-24 year-old youths compared to the 10-13 year olds.

References

1. Hastie T, Tibshirani R, Friedman J. *The elements of statistical learning: Data mining, inference, and prediction*. New York: Springer; 2001.