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Direct Healthcare Cost by Smoking Status Among Ontario Adults

Background

Cigarette smoking causes a wide variety of preventable diseases as it causes damage to almost all human organs.^{1,2} The health burden and cost of cigarette smoking is enormous.^{3,4} Prior research has mainly used aggregate population-level data to estimate the direct healthcare cost for cigarette smoking. This study used individual-level health survey data linked with health administrative data to estimate the direct healthcare cost by smoking status for Ontario adults.

Key Message

After age 70, current smokers cost the healthcare system much more than never and former smokers. It's never too late to quit smoking.

Methods

This analysis used baseline cross-sectional data from the Ontario Tobacco Survey (OTS), a population-based random telephone survey of Ontario adults (aged 18+), recruited between 2005 and 2008. The OTS baseline cross-sectional data consisted of 7,505 Ontario adults. Sociodemographic and smoking data were from the OTS survey. Participants were categorized into three groups:

1. Current smokers (who had smoked at least 100 cigarettes/lifetime and smoked in the past 30 days)
2. Former smokers (who had smoked at least 100 cigarettes/lifetime but did not smoke in the past 30 days)
3. Never smokers (who had never smoked 100 cigarettes/lifetime) at the time of the baseline interview

The OTS data were linked to health data administered by the Institute for Clinical Evaluative Sciences (ICES). Overall, 5,250 (70%) out of 7,505 OTS participants were successfully linked to

the ICES health data. The average annual total cost over the five years after the baseline survey was calculated.ⁱ For those who died during the 5-year follow-up period, the follow-up time between their baseline interview and death was calculated and the annual direct health care cost was estimated accordingly. A total of 1217 never smokers, 942 former smokers and 3086 current smokers were included in this analysis.ⁱⁱ

Results

Among the OTS-ICES linked data, 59% were current smokers, 18% former smokers and 23% never smokers at the baseline survey. The average age of these participants was 46 years old. Current smokers were younger than never and former smokers, and never smokers were younger than former smokers (average ages: current smokers 43.9 years, former smokers 51.9 years, never smokers 45.7 years). Over half of the participants (55%) were female. The average annual direct healthcare cost was \$2,902 in the overall sample, while 4% of the participants did not accrue any healthcare costs and another 4% of the participants died during the 5-year follow-up period.

Table 1 and Figure 1 show the direct healthcare cost estimated by the finite mixture modeling (FMM) model. Before age 30, the direct healthcare cost was greater among former smokers than current and never smokers, while the direct healthcare cost was greater among current smokers than never smokers. After age 30, the direct healthcare cost was highest among current smokers compared to the other two smoking groups, while former smokers continued to have higher direct healthcare cost than never smokers. The difference in direct healthcare cost between the three smoking groups was smaller before age 60. However, after age 60, the difference in direct

ⁱ Healthcare costs were calculated from a number of ICES data holdings, including: the cost of fee for service (FFS) visits, physician capitation cost, complex continuing care (CCC) cost, long-term care (LTC) cost using continuing care reporting system (CCRS), inpatient cost, Ontario Health Insurance Plan (OHIP) lab cost, LTC cost, national ambulatory care reporting system (NACRS) cancer cost and dialysis cost, OHIP non-physician cost, rehab national rehabilitation reporting system (NRS) cost, Ontario drug benefit (ODB) drug cost, inpatient mental health (MH) cost, LTC cost using OHIP/ODB, cost of emergency department alternative funding agreements (ED-AFA) non-FFS visits, cost of non-FFS general practitioner/family physician (GP/FP), cost of non-FFS medical oncologists, cost of other non-FFS visits, cost of non-FFS radiation oncologists, same day surgery cost, and cost of total visits.

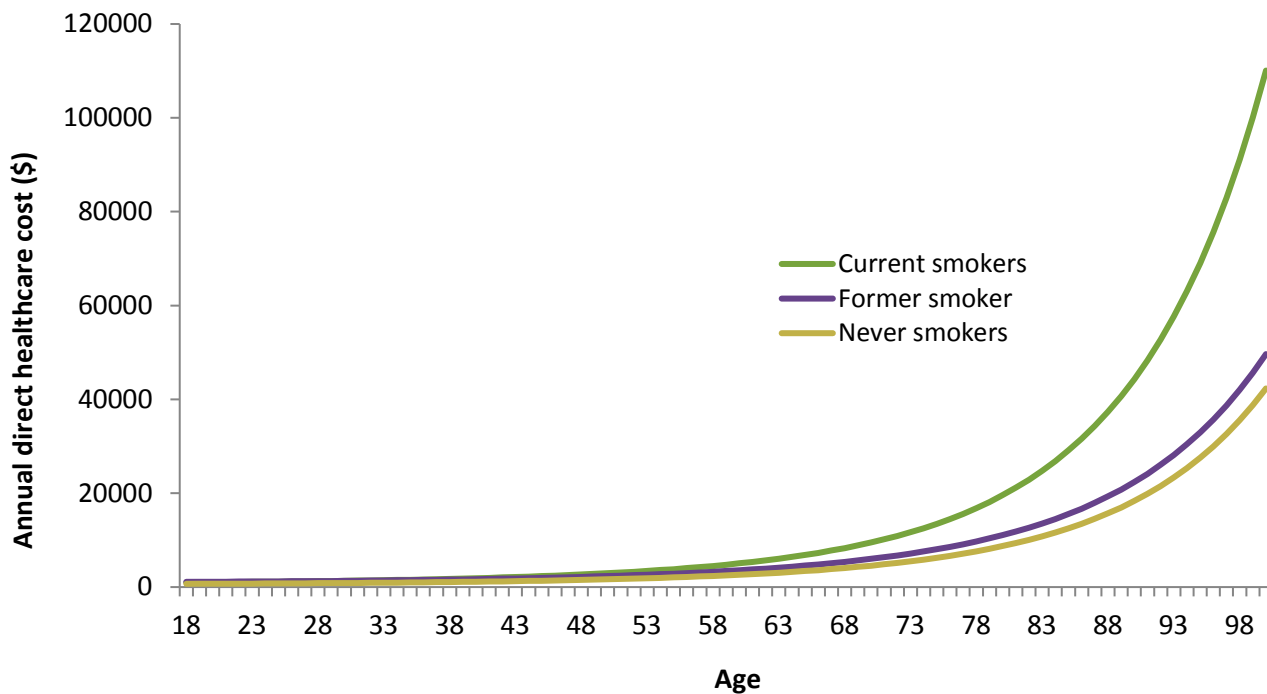
ⁱⁱ Because the direct healthcare cost data in this analysis were heavily right skewed and had lots of zero values, finite mixture modeling (FMM) was used to estimate the direct healthcare cost by smoking status. FMM has been used to estimate healthcare cost data in different populations.^{5,6,7} In the FMM model, age, gender, smoking status, as well as interaction terms for age and gender, and smoking status with age and gender were examined. Insignificant interaction terms were removed in the final parsimonious model.

healthcare cost was much larger between current smokers than the other two smoking groups, especially after age 70.

Table 1: Model Estimated Annual Direct Health Care Cost by Age and Smoking Status, OTS-ICES Linked Data, Ontario Adults Aged 18+, 2005-2013

Age	Never Smokers	Former Smokers	Current Smokers
18	\$695	\$1119	\$982
20	\$713	\$1139	\$1023
30	\$859	\$1320	\$1326
40	\$1135	\$1678	\$1888
50	\$1645	\$2340	\$2947
60	\$2616	\$3580	\$5050
70	\$4564	\$6011	\$9494
80	\$8740	\$11074	\$19583
90	\$18362	\$22385	\$44324
100	\$42330	\$49649	\$110078

Figure 1: Model Estimated Annual Direct Healthcare Cost (\$) by Age and Smoking Status



Note: Full data table for this graph provided in the Appendix (Table A-1).

Discussion

Consistent with other studies, we found that the direct healthcare cost increased with age and that smokers accrued more healthcare costs than never smokers. A unique finding of this study was the significant interaction effect between age and smoking status. Current smokers cost the healthcare system much more than never smokers and former smokers, especially after age 70.

A limitation to this study's findings is the inclusion of the ODB drug benefit costs for those over the age of 65 years in the estimated direct healthcare costs. Similar drug benefit data for those under the age of 65 years was not included in the analyses (unless participants were receiving ODB benefits through social services). Therefore, the inclusion of the ODB drug benefit costs in the FMM model may have influenced the estimated direct healthcare costs among those over 65 years. Further analyses will be conducted in the near future to address this limitation by excluding the ODB drug benefit data for those over 65 years.

Findings of this study suggest that smoking cessation is important, even at advanced ages. Quitting smoking even at age 60, 70 and 80 will help reduce direct healthcare cost. Research indicates that older smokers are less interested in quitting and less likely to be offered cessation support. Future research is needed to encourage older smokers to get cessation support and quit smoking.

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Appendix

Table A1: Model Estimated Annual Direct Healthcare Cost (\$) by Age and Smoking Status

Age	Cost for Never Smokers	Cost for Former Smokers	Cost for Current Smokers
18	\$695.10	\$1,118.87	\$981.68
19	\$703.86	\$1,128.61	\$1,001.49
20	\$713.40	\$1,139.50	\$1,022.64
21	\$723.74	\$1,151.55	\$1,045.21
22	\$734.90	\$1,164.82	\$1,069.27
23	\$746.93	\$1,179.33	\$1,094.89
24	\$759.87	\$1,195.12	\$1,122.18
25	\$773.74	\$1,212.26	\$1,151.21
26	\$788.61	\$1,230.78	\$1,182.09
27	\$804.50	\$1,250.75	\$1,214.92
28	\$821.47	\$1,272.22	\$1,249.82
29	\$839.58	\$1,295.26	\$1,286.93
30	\$858.89	\$1,319.94	\$1,326.36
31	\$879.46	\$1,346.34	\$1,368.27
32	\$901.35	\$1,374.54	\$1,412.81
33	\$924.65	\$1,404.64	\$1,460.16
34	\$949.43	\$1,436.73	\$1,510.50
35	\$975.78	\$1,470.92	\$1,564.02
36	\$1,003.80	\$1,507.32	\$1,620.95
37	\$1,033.57	\$1,546.05	\$1,681.50
38	\$1,065.22	\$1,587.25	\$1,745.94
39	\$1,098.86	\$1,631.06	\$1,814.53
40	\$1,134.61	\$1,677.64	\$1,887.56
41	\$1,172.61	\$1,727.15	\$1,965.36
42	\$1,213.01	\$1,779.77	\$2,048.26
43	\$1,255.96	\$1,835.69	\$2,136.65
44	\$1,301.65	\$1,895.14	\$2,230.91
45	\$1,350.25	\$1,958.32	\$2,331.50
46	\$1,401.96	\$2,025.49	\$2,438.88
47	\$1,457.00	\$2,096.91	\$2,553.58
48	\$1,515.62	\$2,172.86	\$2,676.16
49	\$1,578.05	\$2,253.65	\$2,807.22
50	\$1,644.58	\$2,339.62	\$2,947.44

Direct Healthcare Cost by Smoking Status Among Ontario Adults

Age	Cost for Never Smokers	Cost for Former Smokers	Cost for Current Smokers
51	\$1,715.51	\$2,431.12	\$3,097.53
52	\$1,791.16	\$2,528.54	\$3,258.29
53	\$1,871.88	\$2,632.31	\$3,430.57
54	\$1,958.05	\$2,742.89	\$3,615.32
55	\$2,050.10	\$2,860.76	\$3,813.55
56	\$2,148.46	\$2,986.47	\$4,026.39
57	\$2,253.63	\$3,120.59	\$4,255.06
58	\$2,366.15	\$3,263.77	\$4,500.88
59	\$2,486.59	\$3,416.68	\$4,765.32
60	\$2,615.58	\$3,580.09	\$5,049.99
61	\$2,753.82	\$3,754.78	\$5,356.63
62	\$2,902.07	\$3,941.66	\$5,687.17
63	\$3,061.13	\$4,141.69	\$6,043.71
64	\$3,231.90	\$4,355.90	\$6,428.56
65	\$3,415.37	\$4,585.44	\$6,844.27
66	\$3,612.61	\$4,831.57	\$7,293.63
67	\$3,824.79	\$5,095.63	\$7,779.70
68	\$4,053.18	\$5,379.11	\$8,305.87
69	\$4,299.21	\$5,683.63	\$8,875.86
70	\$4,564.40	\$6,010.97	\$9,493.78
71	\$4,850.45	\$6,363.07	\$10,164.14
72	\$5,159.21	\$6,742.04	\$10,891.94
73	\$5,492.72	\$7,150.22	\$11,682.68
74	\$5,853.21	\$7,590.15	\$12,542.47
75	\$6,243.16	\$8,064.62	\$13,478.04
76	\$6,665.27	\$8,576.71	\$14,496.84
77	\$7,122.53	\$9,129.79	\$15,607.13
78	\$7,618.22	\$9,727.56	\$16,818.05
79	\$8,155.97	\$10,374.08	\$18,139.75
80	\$8,739.79	\$11,073.85	\$19,583.49
81	\$9,374.10	\$11,831.80	\$21,161.76
82	\$10,063.78	\$12,653.36	\$22,888.46
83	\$10,814.23	\$13,544.53	\$24,779.03
84	\$11,631.43	\$14,511.92	\$26,850.67
85	\$12,522.00	\$15,562.85	\$29,122.52
86	\$13,493.27	\$16,705.38	\$31,615.92

Direct Healthcare Cost by Smoking Status Among Ontario Adults

Age	Cost for Never Smokers	Cost for Former Smokers	Cost for Current Smokers
87	\$14,553.37	\$17,948.43	\$34,354.66
88	\$15,711.34	\$19,301.88	\$37,365.31
89	\$16,977.19	\$20,776.67	\$40,677.52
90	\$18,362.06	\$22,384.90	\$44,324.46
91	\$19,878.34	\$24,140.01	\$48,343.21
92	\$21,539.81	\$26,056.90	\$52,775.27
93	\$23,361.81	\$28,152.12	\$57,667.15
94	\$25,361.46	\$30,444.05	\$63,070.98
95	\$27,557.83	\$32,953.15	\$69,045.22
96	\$29,972.21	\$35,702.14	\$75,655.54
97	\$32,628.39	\$38,716.38	\$82,975.69
98	\$35,552.94	\$42,024.08	\$91,088.61
99	\$38,775.58	\$45,656.72	\$100,087.59
100	\$42,329.60	\$49,649.42	\$110,077.73

Note: [Data table is for Figure 1.](#)

References

- ¹ Office of the Surgeon General (US), Office on Smoking and Health (US). *The Health Consequences of Smoking: A Report of the Surgeon General*. Atlanta, GA: Centers for Disease Control and Prevention (US); 2004.
- ² U.S. Department of Health and Human Services. *The Health Consequences of Smoking-50 Years of Progress: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2014.
- ³ Ekpu VU, Brown AK. The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence. *Tobacco Use Insights* 2015;8:1-35.
- ⁴ GBD 2015 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. *Lancet* 2016;388:1659-724.
- ⁵ Deb P, Holmes AM. Estimates of use and costs of behavioural health care: a comparison of standard and finite mixture models. *Health Economics* 2000;9:475-89.
- ⁶ Eckardt M, Brettschneider C, van den Bussche H, König HH, MultiCare Study Group. Analysis of Health Care Costs in Elderly Patients with Multiple Chronic Conditions Using a Finite Mixture of Generalized Linear Models. *Health Economics* 2017;26:582-99.
- ⁷ Juneau P. Analyzing pregnancy costs with finite mixture models: an opportunity to more adequately accommodate the presence of patient data heterogeneity. *Gynecology and Obstetrics Research – Open Journal* 2015;2:69-76.
- ⁸ Jordan H, Hidajat M, Payne N, Adams J, White M, Ben-Shlomo Y. What are older smokers' attitudes to quitting and how are they managed in primary care? An analysis of the cross-sectional English Smoking Toolkit Study. *BMJ Open* 2017;7:e018150.