Introduction to Biostatistics
STAT 337
Fall 2021 (1219)[*]

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Contents

0 Module 0: Introduction to Biostatistics

Course Goal

Understand common epidemiological study designs and basic biostatistical analysis methods that can be used to answer questions in health research.

Every day we make decisions that affect our health and wellness[1]

- **Exercise lowers risk of depression at all ages, researchers find.**

  - 150 minutes of activity each week is beneficial, but doing less still has positive effects.
    Amina Zafar · CBC News · Posted: 24th April 2018 | Last Updated: 24th April 2018.

- **Fewer hospital stays for asthma reported for Canadian children and teens.**

  - Research says more than half with asthma don't have it under control.
    CBC News · Posted: 26th April 2018 | Last Updated: 26th April 2018.

- **Prescription to slow worsening myopia in Canadian kids? Head outdoors.**

  - Nearly 130% of children 11 to 13 are near-sighted, study finds.
    CBC News · Posted: 21st April 2018 | Last Updated: 23rd April 2018.

- **Opioid-related deaths nearly tripled in Ontario from 2000-2015.**

  - It's time 'to get past the stigma of drug use being among addicts,' scientist says.
    The Canadian Press · Posted: 27th April 2018 | Last Updated: 27th April 2018.

- **EU member states urged to develop co-ordinated vaccine plans for measles, flu, and other diseases.**

  - Several EU nations are facing unprecedented outbreaks of measles — a highly contagious disease that can kill.
    Thomson Reuters · Posted: 26th April 2018 | Last Updated: 26th April 2018.

- **Lung cancer patients live longer with immune therapy, study suggests.**

  - Immune therapy treatments worked for only about half of patients, but that's far better than chemo has done.
    The Associated Press · Posted: 16th April 2018 | Last Updated: 16th April 2018.

Formulating a Research Question[2] [3]

Lung cancer patients live longer with immune therapy, study suggests. Immune therapy treatments worked for only about half of patients, but that's far better than chemo has done.
The Associated Press · Posted: 16th April 2018 | Last Updated: 16th April 2018.

- **Population**: Patients diagnosed with lung cancer (advanced non-small-cell lung cancer with no previous treatment).

- **Exposure**: Treatment with Immune therapy (with chemo vs chemo alone).

- **Outcome**: Overall survival.

- **Timeframe**: One year following diagnosis (study was conducted February 2016 to March 2017).

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[1]Headlines taken from CBC on 30th April 2018.
[2]News Article: https://www.cbc.ca/news/health/keytruda-1.4621895
[3]Original paper: https://www.nejm.org/doi/full/10.1056/NEJMoa1801005

Example: Electronic cigarette use and smoking

Research Question: Is e-cigarette usage in youth associated with the initiation of cigarette smoking?

- Consider the following paper recently published by UW researchers.
- The full text of the paper is available through the course e-reserves.

Electronic cigarette use and smoking initiation among youth: a longitudinal cohort study

David Hammond PhD, Jessica L. Reid MSc, Adam G. Cole MSc, Scott T. Leatherdale PhD

ABSTRACT

BACKGROUND: The influence of e-cigarette use on smoking initiation is a highly controversial issue, with limited longitudinal data available for examining temporal associations. We examined e-cigarette use and its association with cigarette-smoking initiation at 1-year follow-up within a large cohort of Canadian secondary school students.

METHODS: We analyzed data from students in grades 9–12 who participated in 2 waves of COMPASS, a cohort study of purposefully sampled secondary schools in Ontario and Alberta, Canada, at baseline (2013/14) and 1-year follow-up (2014/15). We assessed cigarette smoking and e-cigarette use at baseline and follow-up using self-completed surveys. We used generalized linear mixed-effects models to examine correlates of past 30-day e-cigarette use at baseline and smoking initiation between waves within the longitudinal sample.

RESULTS: Past 30-day e-cigarette use increased from 2013/14 to 2014/15 (7.2% v. 9.7%, $p < 0.001$), whereas past 30-day cigarette smoking decreased slightly (11.4% v. 10.8%, $p = 0.02$). Among the 44 163 students evaluated at baseline, past 30-day e-cigarette use was strongly associated with smoking status and smoking susceptibility. In the longitudinal sample ($n = 19\,130$), past 30-day use of e-cigarettes at baseline was associated with initiation of smoking a whole cigarette (adjusted odds ratio [OR] 2.12, 95% confidence interval [CI] 1.68–2.66) and with initiation of daily smoking (adjusted OR 1.79, 95% CI 1.41–2.28) at follow-up.

INTERPRETATION: E-cigarette use was strongly associated with cigarette smoking behaviour, including smoking initiation at follow-up. The causal nature of this association remains unclear, because common factors underlying the use of both e-cigarettes and conventional cigarettes may also account for the temporal order of initiation.

- **Population**: Canadian secondary school students (age 15-19, grade 9-12 in Alberta and Ontario).
- **Exposure**: E-cigarette usage at baseline (2013/14 school year).
- **Outcome**: Cigarette smoking initiation 1-year later (by 2014/15 school year).
- **Timeframe**: One year of follow-up.

Example Data Analysis (Module 2)

		Smoking Initiation Status		
		$D+$	$D-$	
E-cig Usage	$E+$	136	351	487→27.9 %
	$E-$	1313	15518	1638→7.8 %

Table 3: Between-wave smoking initiation* in the COMPASS follow-up (2014/15) longitudinal sample, Ontario and Alberta, Canada (*n* = 17 318)

Characteristic (at baseline)	No. (%) within category who initiated smoking by follow-up	OR (95% CI)	
		Unadjusted†	Adjusted‡
Age, yr			
≤ 14	436/5936 (7.3)	1.0 (ref)	1.0 (ref)
15	511/5845 (8.7)	1.23 (1.07–1.41)	1.08 (0.94–1.25)
16	397/4464 (8.9)	1.27 (1.10–1.47)	1.04 (0.89–1.21)
≥ 17§	105/1073 (9.8)	1.43 (1.13–1.79)	1.02 (0.80–1.32)
Sex			
Female	683/9289 (7.4)	1.0 (ref)	1.0 (ref)
Male	766/8029 (9.5)	1.37 (1.22–1.52)	1.44 (1.28–1.62)
Past 30-day e-cigarette use			
No	1313/16 831 (7.8)	1.0 (ref)	1.0 (ref)
Yes	136/487 (27.9)	4.81 (3.90–5.94)	2.12 (1.68–2.66)

Note: CI = confidence interval, OR = odds ratio.
*Among those who had never smoked a whole cigarette at baseline, but had smoked a whole cigarette at follow-up; *n* = 1992 had already initiated smoking at baseline and were excluded from this measure.
†From separate generalized linear mixed models for initiating smoking between waves, including only the listed covariable, with school as a random effect (*n* = 17 318 for all models except race/ethnicity; *n* = 17 247 for race/ethnicity model).
‡From a generalized linear mixed model for initiating smoking between waves, including the covariables in the table, with school (*n* = 86) as a random effect (*n* = 17 247).
§Categories for age 17 and age ≥ 18 were combined because of low numbers for the latter category (*n* = 8).
¶Information on race/ethnicity was missing for 71 participants; these were excluded from the multivariable model.

$$\text{Relative Risk} = \frac{136/487}{1313/16831} = 3.58$$

Youth who used e-cigarettes had 3.58 times the rate of smoking initiation one year later versus those who did not use e-cigarettes.