DEPARTMENT OF PRACTICE AND POLICY, SCHOOL OF PHARMACY

Interrupted Time Series (ITS) in Big Data Research

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A brief introduction

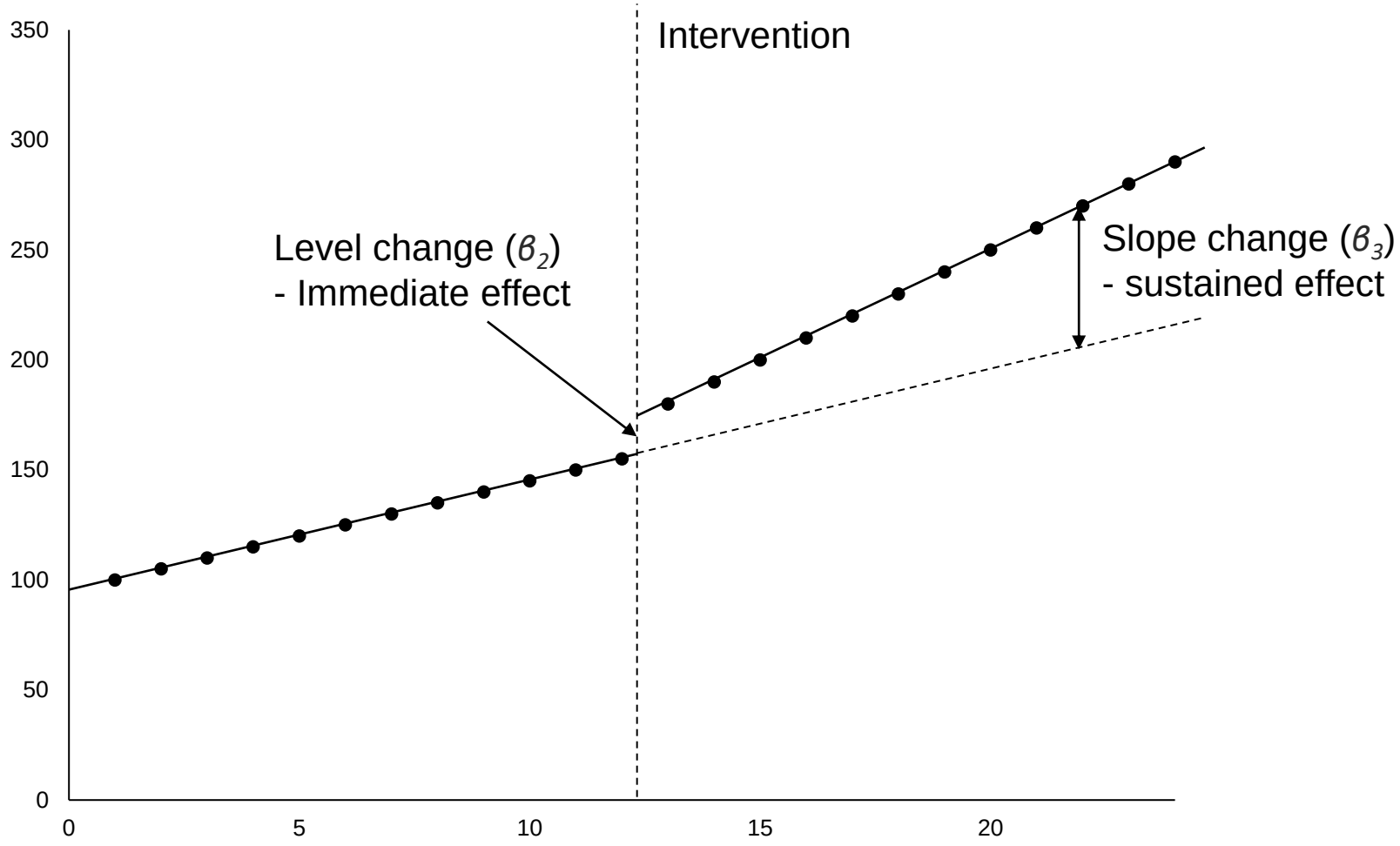
- Useful for evaluation of public health interventions at a population-level
- E.g.

Suicide trends in the early months of the COVID-19 pandemic: an interrupted time-series analysis of preliminary data from 21 countries

- ITS - a time series that is ‘interrupted’ by an intervention
- Compare pre-intervention and post-intervention measurements

- A quasi-experimental design for observational data

ITS Analysis with segmented linear regression



Standard linear regression:

$Y=\beta_0+\beta_1 X$

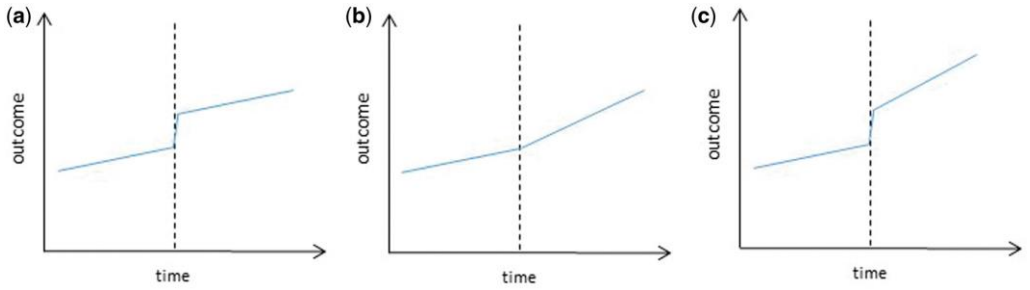
Segmented linear regression:

$Y_t=\beta_0+\beta_1 X+\beta_2 \boldsymbol{T}+\beta_3 T\boldsymbol{X_t}$

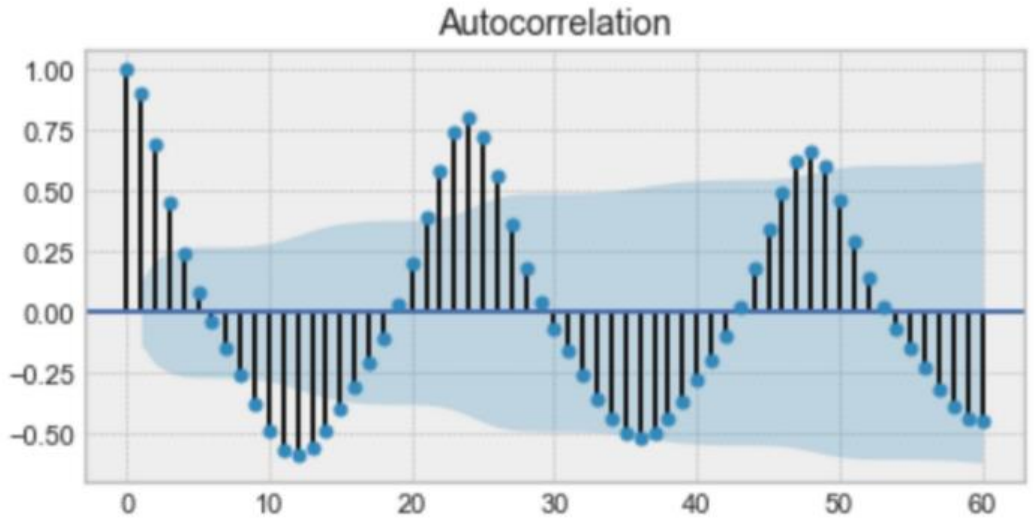
X	Y	T	X_t
1	100	0	0
2	105	0	0
3	110	0	0
4	115	0	0
5	120	0	0
6	125	0	0
7	130	0	0
8	135	0	0
9	140	0	0
10	145	0	0
11	150	0	0
12	155	0	0
13	180	1	1
14	190	1	2
15	200	1	3
16	210	1	4
17	220	1	5
18	230	1	6
…	…	…	…

ITS Analysis – other considerations

- Other impact models



- Autocorrelation and seasonality



- Controls series/ effect modifiers/ sample size?

Example

Open access Original research

BMJ Open

Changes in prescribing rates of sodium-containing medications in the UK from 2009 to 2018: a cross-sectional study with interrupted time series analysis

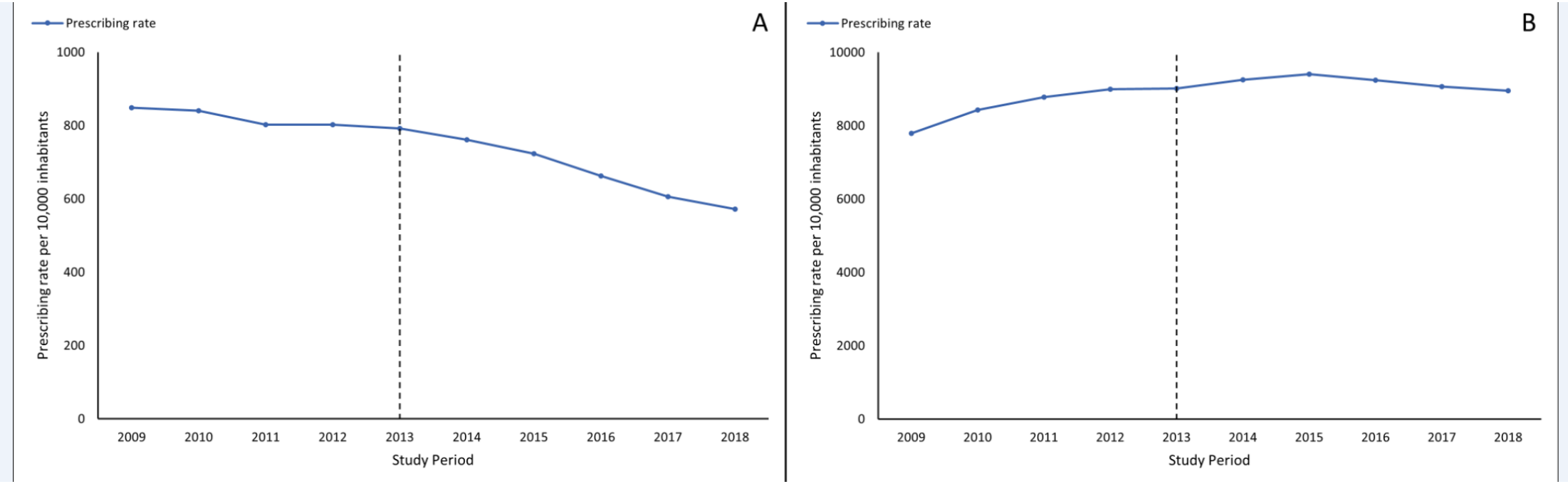
Chengsheng Ju [1], Li Wei [1], Isla S Mackenzie [2], Thomas M MacDonald [2], Jacob George [2]

http://dx.doi.org/10.1136/bmjopen-2020-043566

Example – descriptive

Association between cardiovascular events and sodium-containing effervescent, dispersible, and soluble drugs: nested case-control study

BMJ 2013;347:f6954 doi: 10.1136/bmj.f6954 (Published 26 November 2013)



Example – ITSA with control

	Baseline level (95% CI)	Baseline slope (95% CI)	Change in level (95% CI)	P value	Change in slope (95% CI)	P value
Prescribing rate						
Sodium overall	69.2 (65.9 to 72.5)	0.03 (−0.13 to 0.18)	0.59 (−2.19 to 3.37)	0.678	−0.26 (−0.45 to −0.07)	**0.009**
Non-sodium overall (control)	765.1 (728.8 to 801.3)	1.58 (−0.08 to 3.24)	22.3 (−8.14 to 52.7)	0.151	1.14 (−0.99 to 3.27)	0.294

Change in level (95% CI)	P value
0.59 (−2.19 to 3.37)	0.678
22.3 (−8.14 to 52.7)	0.151

Change in slope (95% CI)	P value
−0.26 (−0.45 to −0.07)	**0.009**
1.14 (−0.99 to 3.27)	0.294

Example – effect modifier

	Baseline level (95% CI)	Baseline slope (95% CI)	Change in level (95% CI)	P value	Change in slope (95% CI)	P value
sex						
Sodium user man	39.10 (37.61 to 40.59)	0.04 (−0.02 to 0.11)	0.36 (−0.94 to 1.65)	0.590	−0.16 (−0.26 to −0.09)	**<0.001**
Sodium user woman	73.38 (70.51 to 76.25)	0.01 (−0.01 to 0.01)	0.77 (−1.64 to 3.18)	0.532	−0.27 (−0.44 to −0.10)	**0.002**
age						
Sodium user age <45 years	12.96 (12.29 to 13.63)	−0.03 (−0.06 to 0.00)	0.23 (−0.35 to 0.81)	0.439	−0.03 (−0.07 to 0.01)	0.113
Sodium user age 45–54 years	43.77 (42.03 to 45.51)	0.04 (−0.04 to 0.11)	−0.17 (−1.71 to 1.38)	0.833	−0.12 (−0.22 to −0.02)	**0.020**
Sodium user age 55–64 years	81.07 (78.21 to 83.92)	−0.07 (−0.19 to 0.06)	−0.41 (−2.95 to 2.14)	0.754	−0.21 (−0.38 to −0.05)	**0.011**
Sodium user age 65–74 years	128.34 (123.23 to 133.46)	0.30 (0.07 to 0.53)	−2.28 (−6.72 to 2.16)	0.314	−0.68 (−0.98 to −0.39)	**<0.001**
Sodium user age 74–84 years	226.90 (219.18 to 234.62)	−0.05 (−0.40 to 0.30)	3.18 (−3.52 to 9.87)	0.352	−0.71 (−1.15 to −0.26)	**0.002**
Sodium user age ≥85 years	304.96 (293.46 to 316.46)	−0.37 (−0.88 to 0.13)	9.45 (−0.78 to 19.69)	0.070	−0.69 (−1.35 to −0.03)	**0.041**

Assumptions and limitations

- Pre-intervention trends are assumed to be linear
- The characteristics of the populations remain unchanged throughout the study period
- No background interventions during the study period