Mass media coverage and vaccination uptake: evidence from the demand for meningococcal vaccines in Hungary

Anikó Bíró[1] Ágnes Szabó-Morvai[1]

[1] Centre for Economic and Regional Studies
Health and Population Research Group

08 Nov, 2019

KRTK KTI

Summary

- Estimate the effect of mass media coverage of the meningococcal disease on the uptake of meningococcal vaccinations in Hungary
- Identification: utilize time and geographical variance in news, vaccination and disease indicators
- Results
  - strong positive effect of mass media coverage
  - not much evidence that disease incidence itself would have a positive impact on vaccination

Relevance of the study

- Vaccination is key to global health
  - Vaccine hesitancy: among 10 most serious threats to global health in 2019 (WHO, 2019)
  - Vaccination prevents 2-3 million deaths annually (WHO, 2018)
  - Important for addressing antibiotic resistance
  - High policy relevance: how to improve vaccination uptake
- Main question: which tools are effective in raising vaccine uptake

Information sources about meningococcus

- Health care providers (GP)
- National Center for Epidemiology information leaflet
  - 8 pages
  - long description about the history of meningococcus, types, vaccines
  - people only find this leaflet if actively search for it in the internet
- Hungarian Epidemiological Centre information webpage
  - a mere blank subpage is available
  - people do not get there by chance
- News of social and mass media
  - readily available
  - anyone has a chance to see the news even if not actively searching for meningococcus-related information
  - effectively transmits the most important information: meningococcus is very dangerous, but preventable

Related literature

- Role of media types on vaccination
  - Social media
    - spread of anti-vaccine sentiments (Brunson 2013, Hoffman et al. 2019, Jamison et al. 2019)
  - Websites (Betsch et al. 2010)
  - Mass media
    - sparse evidence
    - little effect on MMR immunization (Smith et al 2008)
- Role of disease outbreaks
  - whooping cough outbreaks increase vaccination rates (Oster 2018)
- Determinants of elective vaccination in Hungary
  - low awareness of HPV vaccination (Marek et al 2011)

Novelties of our paper

- Meningococcal vaccination – little is known about its determinants
- Estimate both the effect of mass media and actual disease outbreaks

Theoretical foundations of vaccination demand

Why would news increase vaccination uptake at all?

- Decide to vaccinate if

$$B \geq C$$
$$B = \pi \cdot H$$

- C: costs of vaccination (side-effects, time)
- B: benefit of vaccination
  - π: perceived probability of the disease
    - depends on actual probability of IMD
    - the individual perception of the probability
  - H: health costs of the disease

- How news on IMD cases affect B
  - π: through availability heuristic (Tversky and Kahneman, 1973): higher perceived probability of most recent cases which can be recalled from memory
  - H: the details of an IMD case or a death due to IMD might impact the perceived severity of the disease

KRTK KTI

Data

- Disease incidence
  - administrative records of disease incidence (county × month)
  - provider: National Center for Epidemiology (Országos Epidemiológiai Központ)
- Vaccinations
  - administrative data on vaccine purchases (county × month)
  - January 2009 - December 2018
  - provider: National Institute of Health Insurance Fund Management (Nemzeti Egészségbiztosítási Alapkezelő, NEAK)
- News
  - self-collected data (webscraping; keyword: meningitis in Hungarian)
  - indicators of media coverage of the meningococcal disease
  - 24.hu, blikk.hu, index.hu and origo.hu
  - county-specific vs. not; topic: related to death case vs. not
- County specific browsing history (from Google trends)
- Further statistics
  - population size, unemployment rate
  - provider: Hungarian Central Statistical Office (T-STAR)

KRTK KTI

Invasive meningococcal disease (IMD)

- Rare disease
  - with a rapid progression
  - very high case-fatality ratio (up to 15%)
  - occurrence of IMD somewhere has no effect on the probability of re-occurrence elsewhere (Elias et al. (2006) and Hoebe et al. (2004))

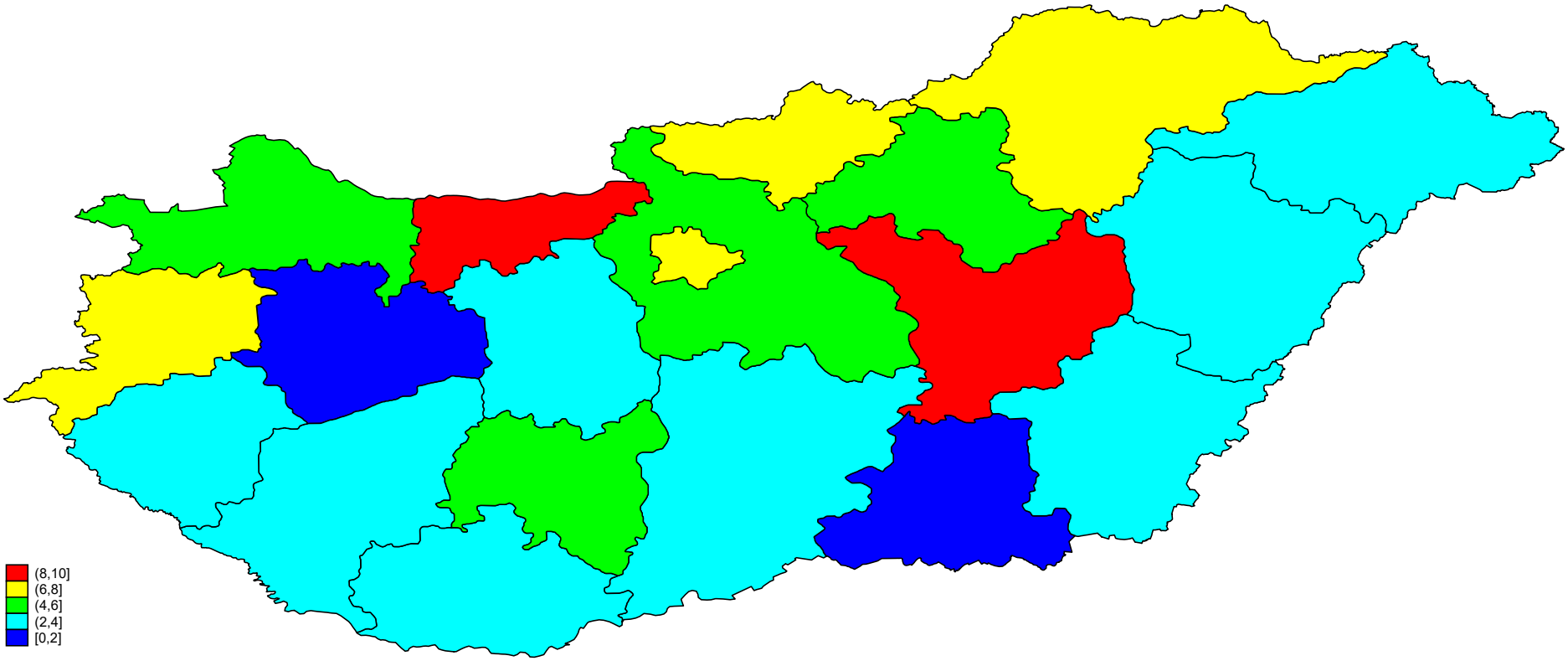
Number of IMD cases and deaths per year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
IMD cases	34	39	41	70	56	54	33	36	49	41
IMD deaths	7	5	4	12	6	9	3	9	9	6

- Vaccines
  - Elective
  - 3 types of vaccines of very different out-of-pocket prices (needed for full immunization)
    - Men C: 300 HUF (8,000 HUF before 2017)
    - Men ACWY: 15,000 HUF
    - Men B: 90,000 HUF

KRTK KTI

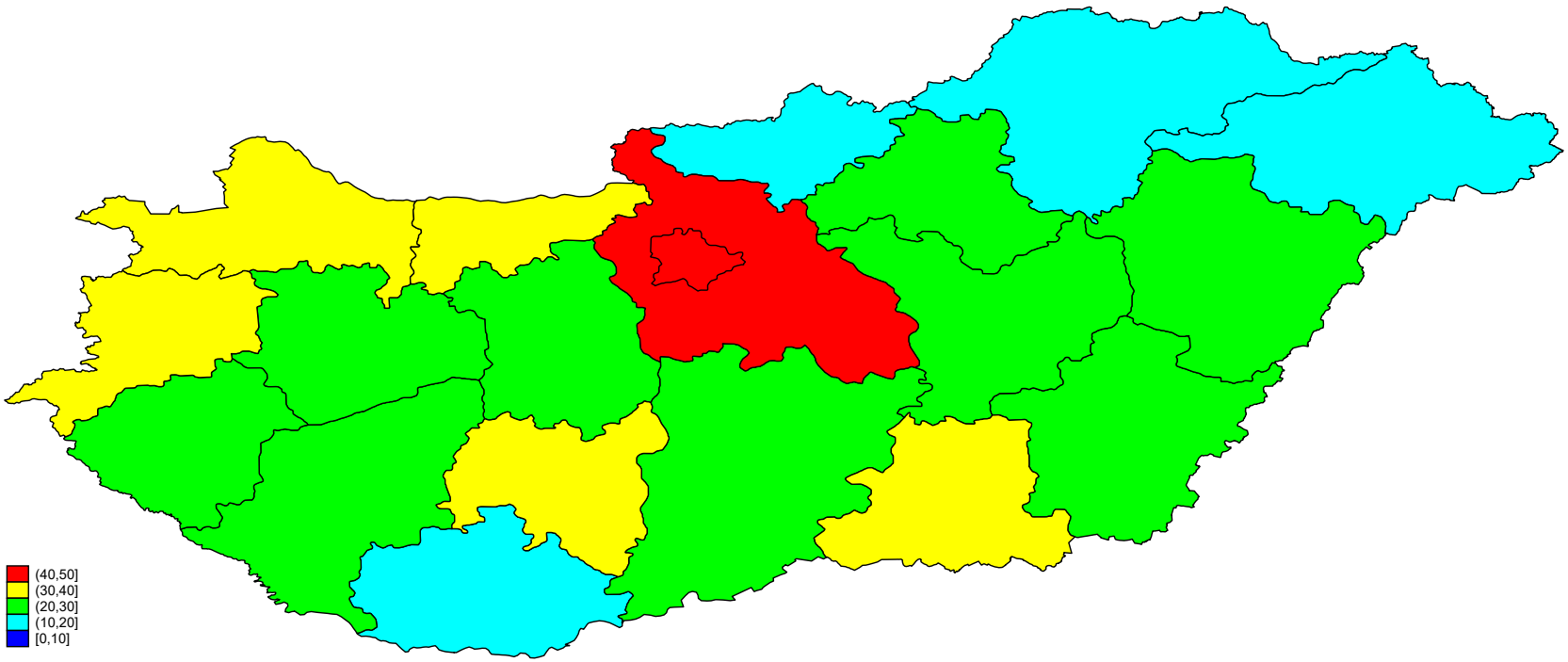
IMD cases per 1 million inhabitants



KRTK KTI

Annual meningitis shots per 1,000 population aged 0-17

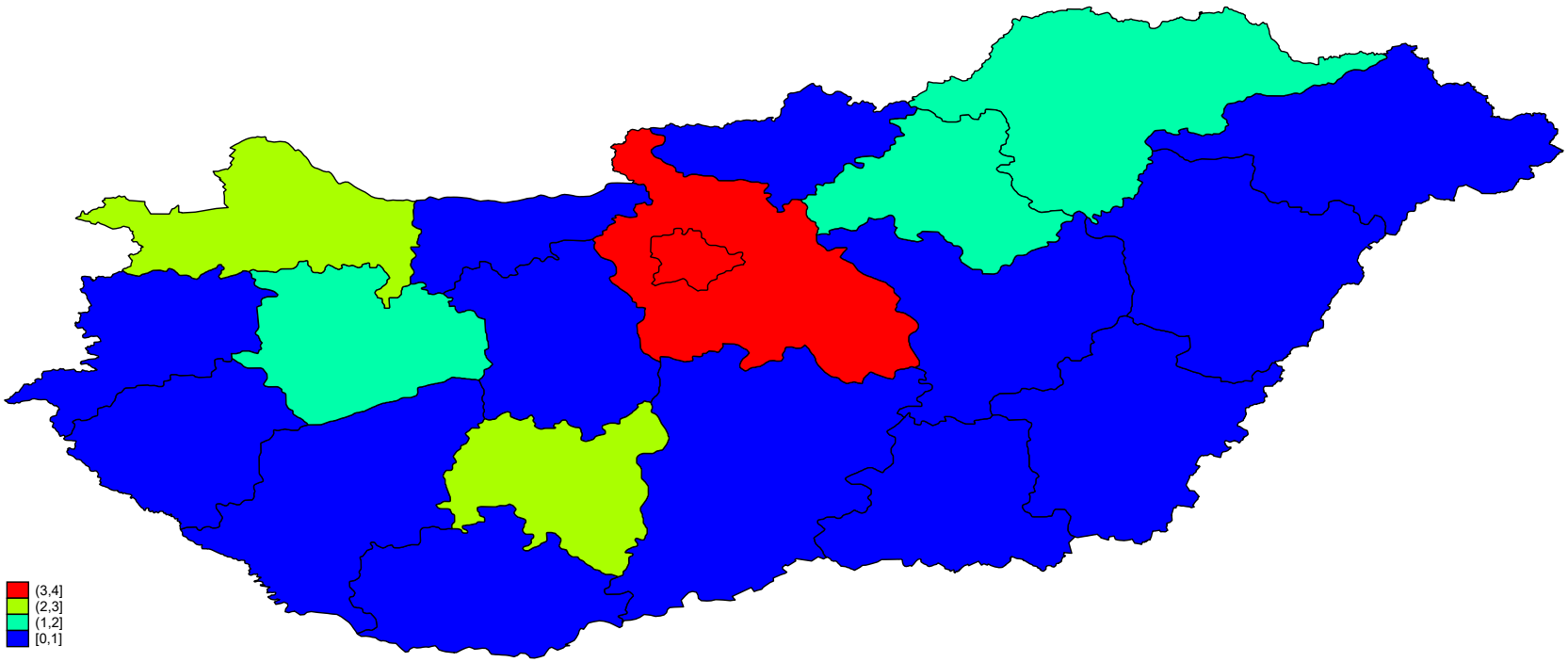
Men C



KRTK KTI

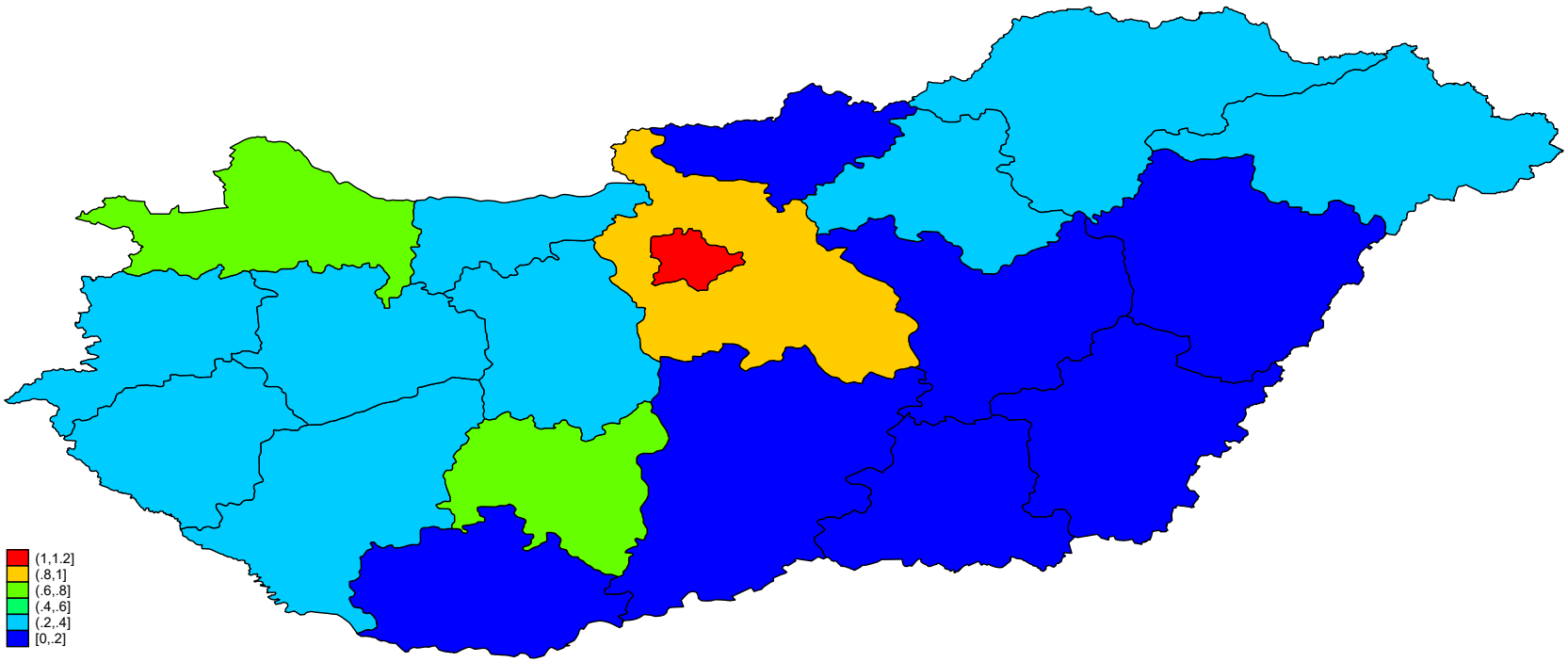
Annual meningitis shots per 1,000 population aged 0-17

Men B



Annual meningitis shots per 1,000 population aged 0-17

Men ACWY



Empirical design

$$v_{mct} = \beta_0 + \sum \beta_1^k article_{c,t-k} + \sum \beta_2^k IMD_{c,t-k} + D_t\beta_d + D_c\beta_c + \nu_{mct}$$

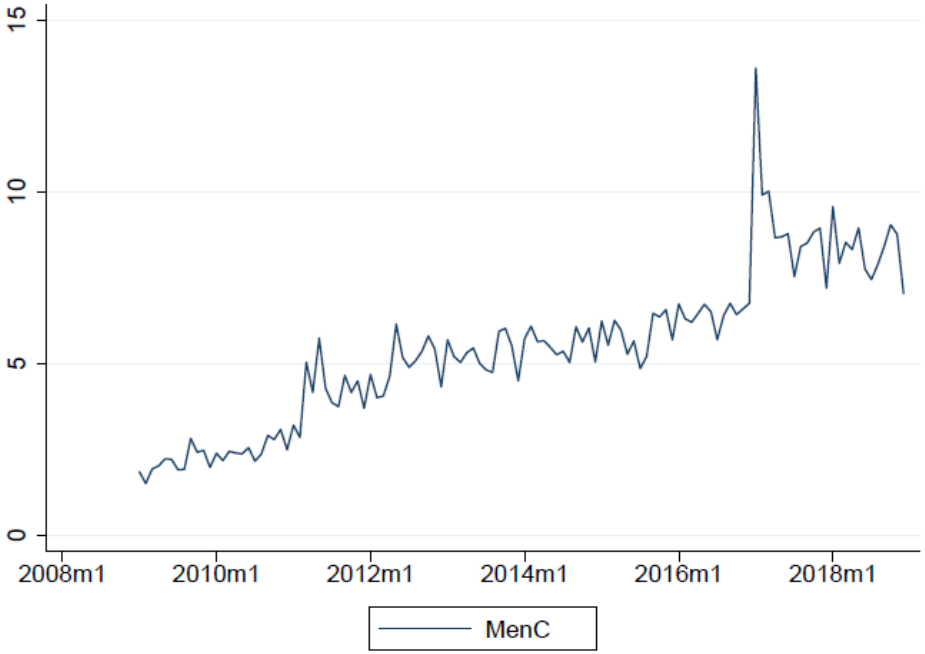
- v:
  - Baseline: per capita IMD vaccination of type m in county c at month t;
  - Channel: Google search activity
  - Placebo: tick-borne encephalitis
- *article*: number of related articles (any or reporting death);
  - related to own county
  - related to all other counties
- *IMD*: per capita number of IMD cases;
- D_t, D_c time and county fixed effects.

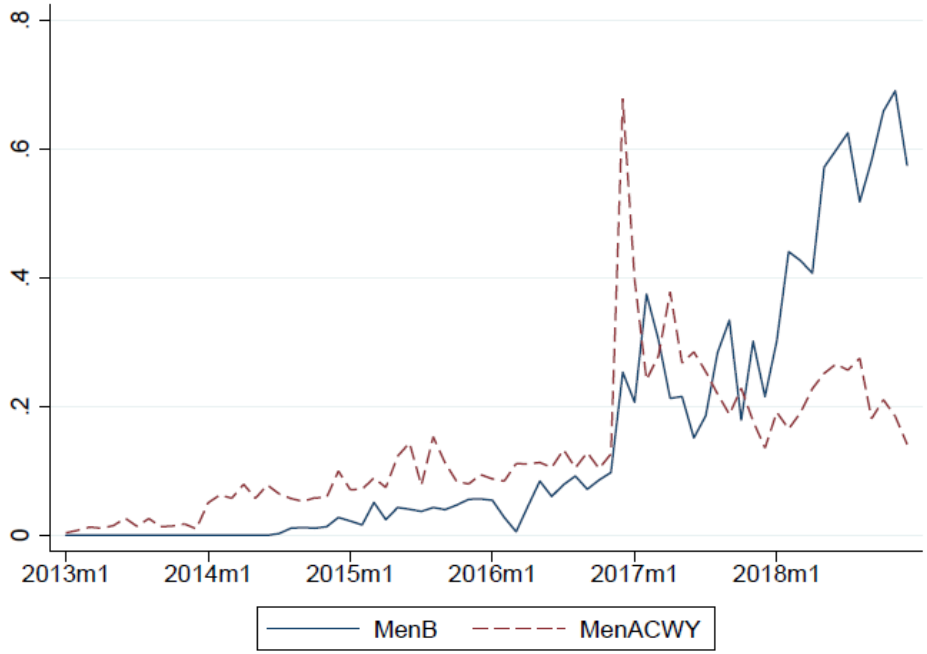
Alternative specification: country-level regression

KRTK KTI

Monthly number of meningococcal vaccines purchased

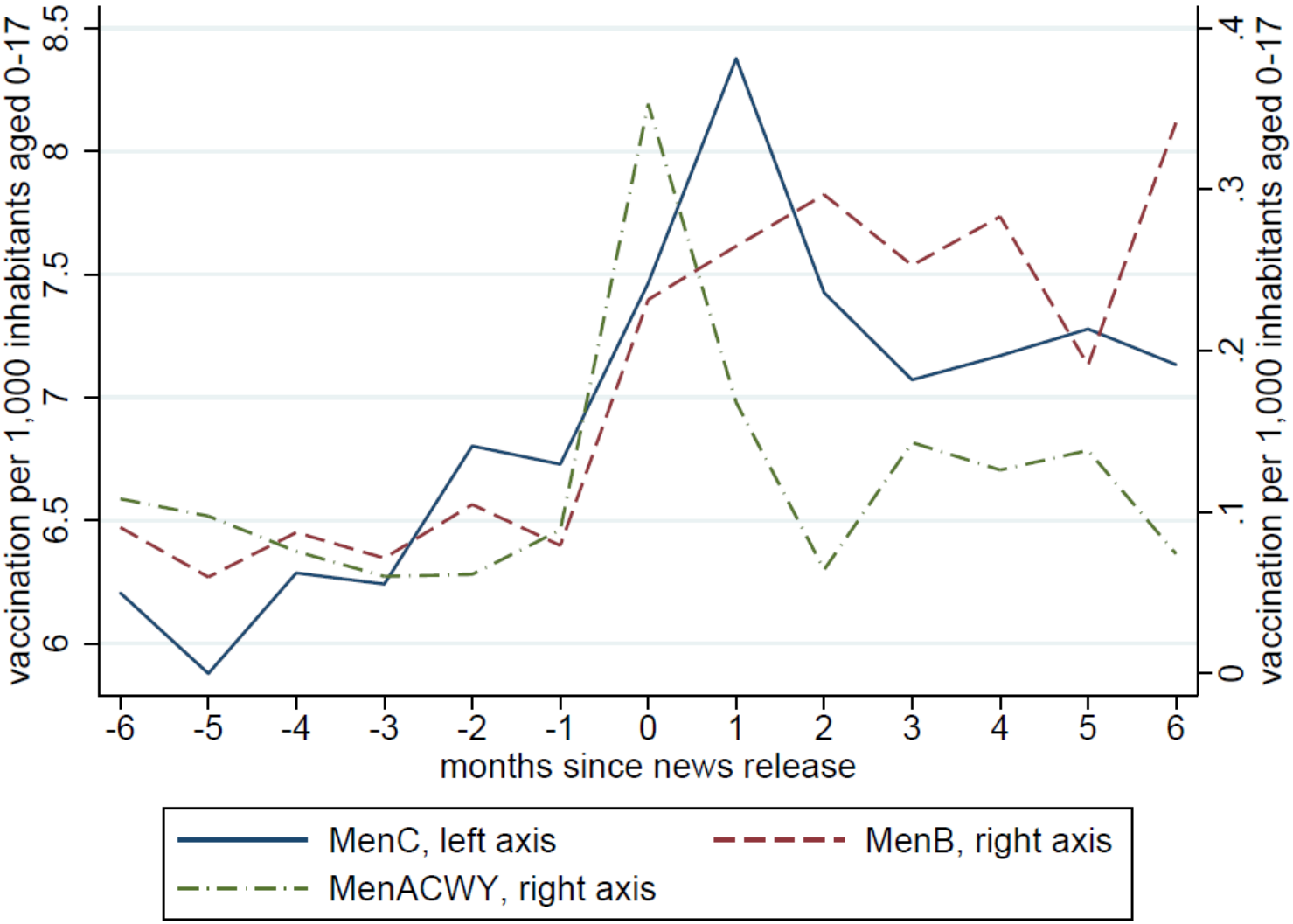
(per 1,000 population aged 0-17)





KRTK KTI

Related news increase vaccination rate



Effect of county specific news on Menningococcus vaccination

	all articles			death related articles		
	(1)	(2)	(3)	(4)	(5)	(6)
	Men C	Men B	Men ACWY	Men C	Men B	Men ACWY
monthly nr of articles referring to own county						
current	69.88**	2.931	77.01***	94.44***	3.523	79.84***
	[28.44]	[6.260]	[25.49]	[22.11]	[5.516]	[27.01]
1 month lag	26.37	0.149	10.84	23.97	-1.120	14.68
	[25.88]	[9.819]	[7.232]	[21.61]	[5.980]	[8.587]
2 months lag	-42.06	-6.970	-10.89**	-42.07	-10.12	-11.03**
	[31.27]	[10.13]	[5.103]	[30.67]	[9.822]	[5.181]
3 months lag	-42.57**	-4.182	5.756	-41.78***	-2.660	3.452
	[15.00]	[7.672]	[3.751]	[13.70]	[6.092]	[3.150]
4 months lag	-13.97	2.730	7.612	-29.11	-1.865	8.472
	[23.12]	[12.22]	[6.241]	[23.11]	[6.514]	[6.748]
IMD cases per million inhabitants aged 0-17 in the county						
current	2.855	-0.905	0.203	2.892	-0.914	0.275
	[4.158]	[0.762]	[0.597]	[4.142]	[0.759]	[0.632]
1 month lag	9.979	-1.156	-0.0171	9.979	-1.142	0.0907
	[6.282]	[0.913]	[0.438]	[6.329]	[0.879]	[0.436]
2 months lag	8.859	-1.519	0.687	8.922	-1.476	0.780
	[9.125]	[0.883]	[0.684]	[9.191]	[0.894]	[0.655]
3 months lag	9.612	3.846*	-0.517	9.560	3.819*	-0.549
	[6.064]	[2.195]	[0.500]	[6.011]	[2.145]	[0.495]
4 months lag	3.676	-0.0214	0.114	3.670	-0.0155	0.0990
	[2.813]	[0.924]	[0.363]	[2.731]	[0.916]	[0.356]
county effects	yes	yes	yes	yes	yes	yes
monthly date effects	yes	yes	yes	yes	yes	yes
mean of outcome	5,151	179.2	108.4	5,151	179.2	108.4

KRTK KTI

Effect of county specific news on web search

Google trends, county specific search intensity

	all articles (7) search	death related articles (8) search
monthly nr of articles referring to own county		
current	1.860***	1.653***
	[0.505]	[0.447]
1 month lag	0.426	0.176
	[0.286]	[0.365]
2 months lag	0.0567	-0.0511
	[0.165]	[0.158]
3 months lag	0.184	0.0587
	[0.244]	[0.238]
4 months lag	-0.338	-0.426
	[0.242]	[0.249]
IMD cases per million inhabitants aged 0-17 in the county		
current	0.0842	0.0882
	[0.0746]	[0.0747]
1 month lag	-0.0473	-0.0442
	[0.0426]	[0.0428]
2 months lag	0.0288	0.0320
	[0.0414]	[0.0423]
3 months lag	-0.0391	-0.0369
	[0.0797]	[0.0798]
4 months lag	0.0504	0.0514
	[0.0694]	[0.0690]
county effects	yes	yes
monthly date effects	yes	yes
mean of outcome	13.866	13.866

Effect of news on uptake of vaccination against tick-borne encephalitis

	coeff	S.E.
monthly number of meningitis related articles referring to own county		
current	-93.72	[54.51]
1 month lag	-99.48	[75.16]
2 months lag	-170.7	[121.3]
3 months lag	-68.98	[86.74]
4 months lag	-39.62	[69.08]
IMD cases per million inhabitants aged 0-17 in the county		
current	0.552	[10.17]
1 month lag	-2.076	[18.29]
2 months lag	9.698	[27.14]
3 months lag	13.23	[25.05]
4 months lag	18.00	[18.03]
county effects	yes	
monthly date effects	yes	
mean of outcome	4312.9	

Robust standard errors in brackets, *** p<0.01, ** p<0.05, * p<0.1. All meningitis related articles are considered. The outcome is the monthly vaccination rate per 1 million inhabitants aged 0-17.

KRTK KTI

Discussion

- Strong impact of mass media coverage of a disease on the uptake of vaccinations
  - Timing effect on Men C (1.3%)
  - Timing and quantity effect on Men ACWY (83%)
- Lack of perfect information about the prevalence of a disease
- Vaccination decisions are not fully rational

- Responsibility of mass media in influencing health related decisions
  - Importance of regulation – fake news
  - Importance of objective information provision by experts

Further plans for analysis

- individual administrative vaccination data
- linked to CSO Birth Registry data
- Analysis: demographic composition, age of vaccine recipients