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Is your commute killing you? On the mortality risks of long-distance commuting

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Background

Health Effects of Commuting

- Direct health consequences
  - Stress, higher blood pressure, obesity, fatigue, and certain cancers
- Indirect health consequences
  - sleep reduction, physical activity, food preparation
- Contextual factors
  - e.g. traffic situation, availability of public transportation
- Home, family and commuting balancing
- Genders
  - Women are more negatively affected than men
- Positive aspects of the commute
  - Activities while travelling, e.g. listening to music, mentally shifting between work and home, enjoyment of driving

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Data

Data

- Longitudinal register data on the entire Swedish population

Time

- Year 1985 – 2008

Available Variables

- Yearly detailed individual information on socioeconomic and demographic characteristics
- Locations of residence and work

Distance

- Euclidean distance
- At least 50 km to work ‘one way’ (average of 60 minutes by car)

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Study Design

Participants

- People aged 55 years in 1994 in Sweden, active on the labor market in 1994

Treated	Control
Long-distance commuters (LDC) in 1993 or 1994	Not LDC during 1985 to 2008
Sample size: 2700	Sample Size: 56 800 potential controls
(1961 men and 775 women)	(27 462 men and 29 373 women)

Outcome

- Mortality
- Stratified analysis by sex, income and education

Covariates

- Family situation
- Income
- Employment
- Education level
- Employment status
- Regional Indicators (using the Stockholm metro area as reference))

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Biased Estimates

Unobserved Factors

- Individuals' habits/lifestyles affecting health
  - Some health conditions may be an obstacle to LDC
- Work environments or illness/morbidity
- May be correlated with existing variables

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Methods

1. Estimation for the propensity score
   - Probability of being a long-distance commuter as a function of individual and regional characteristics
   - Nearest Neighbor, 1 to 4 match
2. Comparison of sample means for unmatched and matched samples
3. Estimation of survival rates between matched groups (Kaplan–Meyer)
4. Differences in mortality for matched subsamples by SES

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Estimation for the Propensity Score

Table 1. Logit estimates for the propensity score.

	Men			Women		
	coefficient	standard error	*p*-value	coefficient	standard error	*p*-value
Household characteristics						
Partner	−0.201	0.055	0.000	−0.292	0.079	0.000
Child(ren) aged 0–10 years at home[a]	0.418	0.114	0.000			
Income, SEK[b]	0.739	0.054	0.000	0.028	0.066	0.675
Previous employment situation						
Employed 1990 and 1991, unemployed 1992	0.785	0.148	0.000	0.551	0.237	0.020
Unemployed 1990 and 1991, employed 1992	0.487	0.751	0.517	0.995	0.372	0.007
Income changes (1990–92)[c]	−0.120	0.031	0.000	−0.107	0.059	0.069
Access job openings	0.002	0.000	0.000	0.004	0.001	0.000
Active commuting 1990	−0.850	0.080	0.000	−0.727	0.097	0.000
Education level						
High school education	0.164	0.056	0.003	0.346	0.095	0.000
University education	0.280	0.082	0.001	1.004	0.117	0.000

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Estimation for the Propensity Score (Cont.)

Table 1. Logit estimates for the propensity score.

	Men			Women		
	coefficient	standard	*p*-value	coefficient	standard	*p*-value
Employment sector						
Real estate, renting, and business activities	−0.188	0.086	0.030	0.691	0.127	0.000
Public administration and defence; compulsory social security	0.162	0.088	0.065	0.075	0.143	0.598
Construction	0.376	0.078	0.000	0.736	0.283	0.009
Manufacturing	−0.508	0.065	0.000	0.063	0.133	0.637
Health and social work	−0.416	0.134	0.002	−0.571	0.102	0.000
Residential region						
East middle Sweden	0.630	0.116	0.000	0.411	0.188	0.029
Småland and the islands	0.787	0.110	0.000	0.364	0.191	0.057
Southern Sweden	0.660	0.097	0.000	0.663	0.153	0.000
West Sweden	0.626	0.094	0.000	0.643	0.149	0.000
North middle Sweden	0.972	0.102	0.000	0.608	0.174	0.000
Middle Norrland	1.342	0.122	0.000	1.501	0.188	0.000
Upper Norrland	1.385	0.121	0.000	1.693	0.181	0.000
Constant	−12.535	0.667	0.000	−5.122	0.797	0.000
Pseudo R^2	0.0521			0.0524		

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Comparison of Sample Means

-- Before and After Matching

Table 2. Descriptive statistics of long-distance commuters and comparisons as measured in 1994, unless stated otherwise.

Variable	Men		Before		After	Women		Before		After
	LDC[a]	no LDC	*p*-value[b]	matched comparisons	*p*-value[b]	LDC	no LDC	*p*-value[b]	matched comparisons	*p*-value[b]
N	1961	27462				775	29373			
Household characteristics										
Partner	0.732	0.736	0.683	0.733	0.911	0.647	0.698	0.003	0.656	0.662
Child(ren) aged 0–10 years at home[c]	0.049	0.033	0.000	0.044	0.920					–
Income, SEK[d]	12.332	12.156	0.000	12.296	0.617	11.856	11.801	0.015	11.848	0.914
Previous employment situation										
Employed 1990 and 1991, unemployed 1992	0.031	0.017	0.025	0.727		0.027	0.015	0.011	0.024	0.590
Unemployed 1990 and 1991, employed 1992	0.001	0.001	0.689	0.001	0.651	0.011	0.004	0.011	0.009	0.887
Income changes (1990–92)[d]	−0.010	0.023	0.054	0.001	0.653	0.044	0.087	0.034	0.058	0.761
Access job openings	169.290	164.090	0.009	169.160	0.414	172.780	162.590	0.001	167.820	0.595
Active commuting 1990	0.099	0.199	0.000	0.104	0.707	0.186	0.318	0.000	0.196	0.815
Education level										
High school education	0.486	0.459	0.022	0.49232	0.830	0.492	0.531	0.035	0.507	0.873
University education	0.178	0.128	0.000	0.16301	0.832	0.247	0.129	0.000	0.219	0.885
Employment sector										
Real estate, renting, and business activities	0.096	0.097	0.933	0.099	0.912	0.117	0.059	0.000	0.107	0.522
Public administration and defence; compulsory social security	0.097	0.066	0.000	0.094	0.699	0.084	0.073	0.261	0.081	0.883
Construction	0.131	0.085	0.000	0.122	0.725	0.019	0.010	0.014	0.019	0.681
Manufacturing	0.206	0.310	0.000	0.214	0.555	0.105	0.108	0.754	0.109	0.983
Health and social work	0.036	0.041	0.318	0.036	0.791	0.213	0.345	0.000	0.223	0.848

LDC: long distance commuting

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Comparison of Sample Means (Cont.)

-- Before and After Matching

Table 2 (continued)

Variable	Men		Before		After	Women		Before		After
	LDC [a]	no LDC	*p*-value [b]	matched comparisons	*p*-value [b]	LDC	no LDC	*p*-value [b]	matched comparisons	*p*-value [b]
N	1961	27462				775	29373			
Residential region										
East middle Sweden	0.204	0.174	0.001	0.198	0.405	0.200	0.168	0.024	0.184	0.784
Småland and the islands	0.087	0.093	0.362	0.088	0.758	0.063	0.092	0.006	0.064	0.708
Southern Sweden	0.139	0.144	0.493	0.143	0.766	0.149	0.141	0.491	0.154	0.766
West Sweden	0.198	0.197	0.908	0.203	0.590	0.227	0.197	0.046	0.224	0.898
North middle Sweden	0.107	0.096	0.112	0.109	0.536	0.079	0.097	0.096	0.083	0.942
Middle Norrland	0.066	0.042	0.000	0.056	0.381	0.069	0.046	0.003	0.070	0.917
Upper Norrland	0.076	0.052	0.000	0.025	0.727	0.092	0.057	0.000	0.093	0.908

LDC: long distance commuting

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Survival between Groups

Men

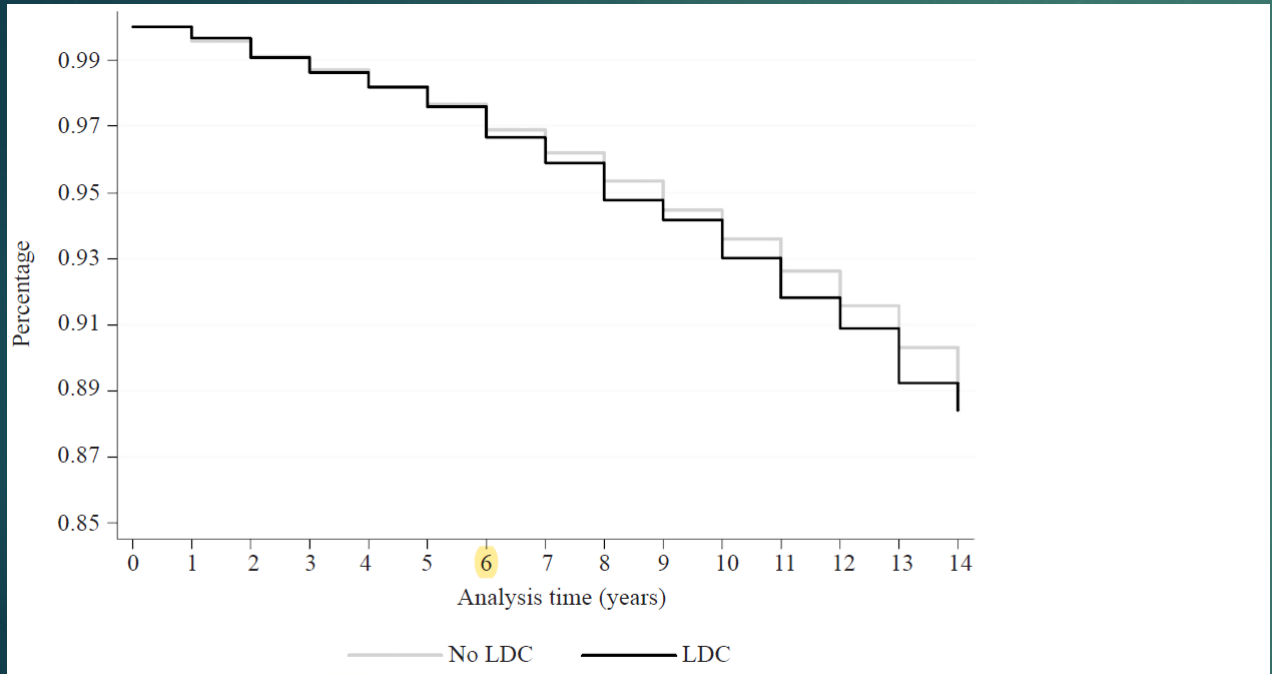

Figure 1. Survival rates, men 1995–2008. Matched samples of long-distance commuting (LDC) men and controls (log–rank test for equality of survivor functions: p-value = 0.3933, $\chi^2 = 0.73$).

log–rank test p-value = 0.3933

Women

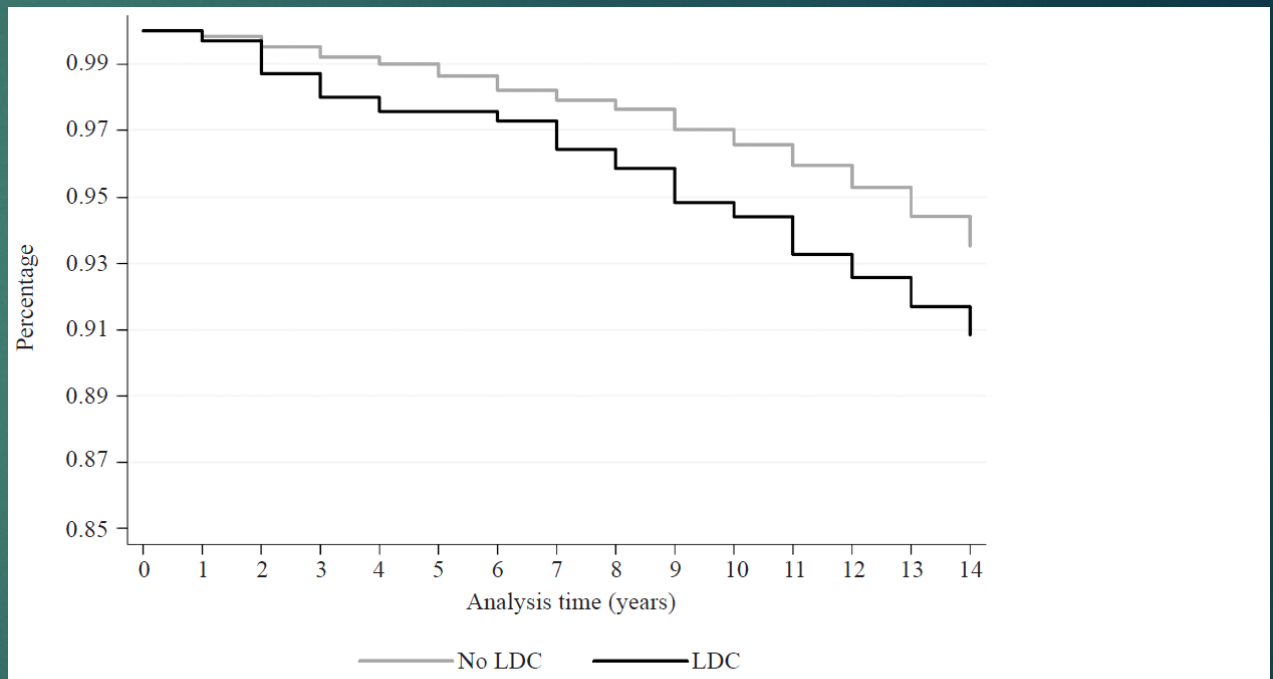

Figure 2. Survival rates, women 1995–2008. Matched samples of long-distance commuting (LDC) women and controls (log–rank test for equality of survivor functions: p-value = 0.0118, $\chi^2 = 6.34$).

log–rank test p-value = 0.0118

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Survival between Groups (Cont.)

Table 3. Hazard ratios of mortality risk between long-distance commuting (LDC) and non-LDC women.

Time (years)	All	Low incomes	Low education
1	1.933	1.222	1.946
2	2.804	4.296	1.419
3	2.577	3.064	1.230
4	2.426	2.942	1.361
5 [a]	na	na	na
6	1.531	1.908	1.210
7	1.716	2.034	1.344
8	1.773	2.071	1.672
9	1.742	1.982	1.742
10	1.636	1.676	1.711
11	1.676	1.801	1.783
12	1.595	1.677	1.728
13	1.508	1.578	1.696
14 [b]	1.436	1.539	1.663

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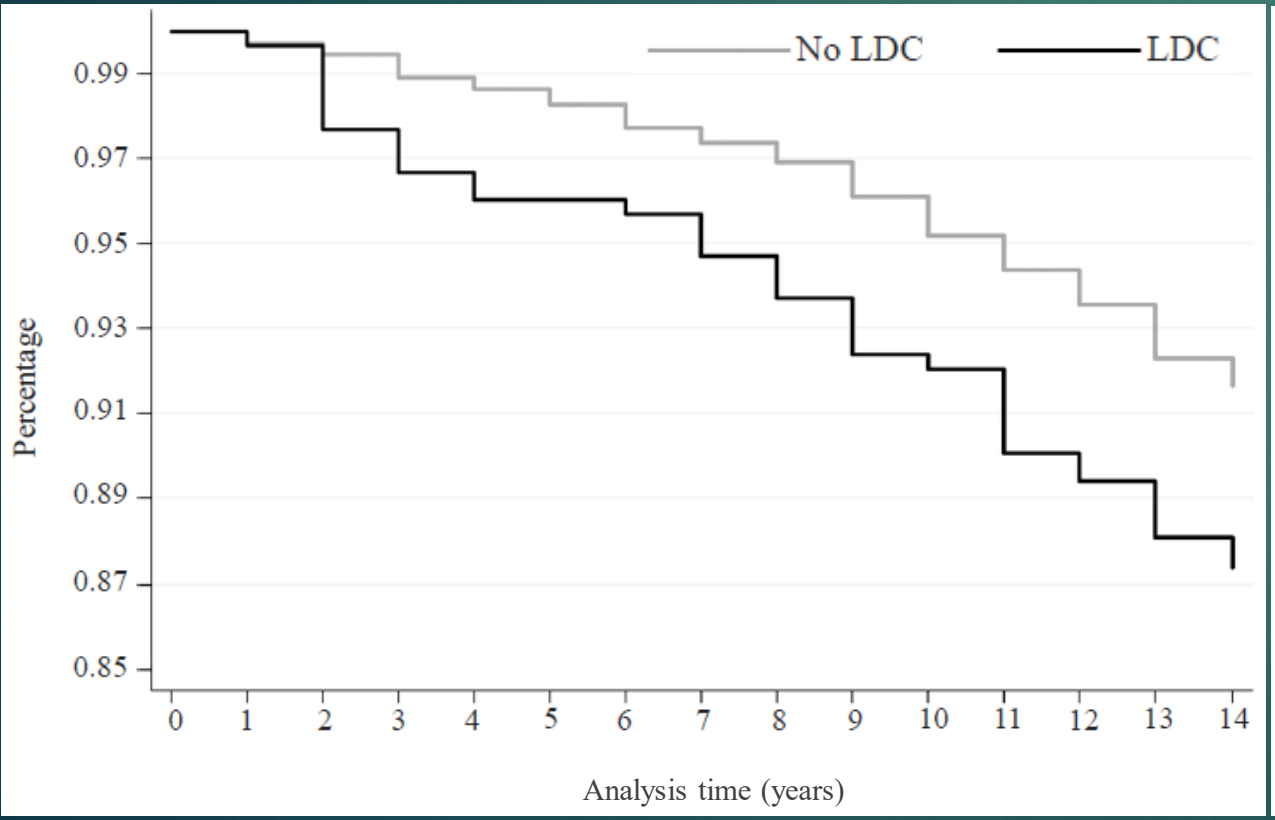
Survival for Women

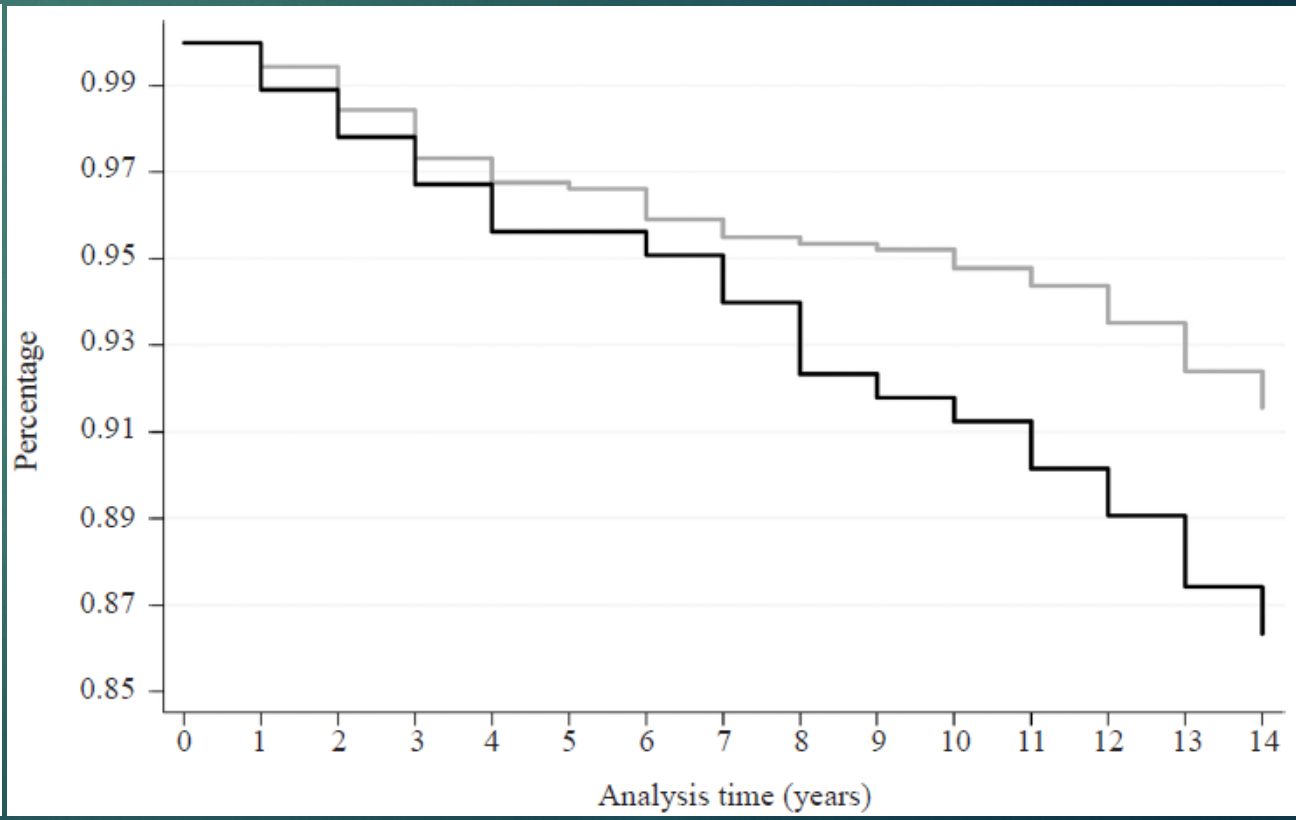
Figure 3&4 Survival rates for **women** with low incomes and low education, 1995–2008.

Low Income (below median)



log–rank test p-value = 0.0203

Low Education (less than high school)



log–rank test p-value = 0.0310

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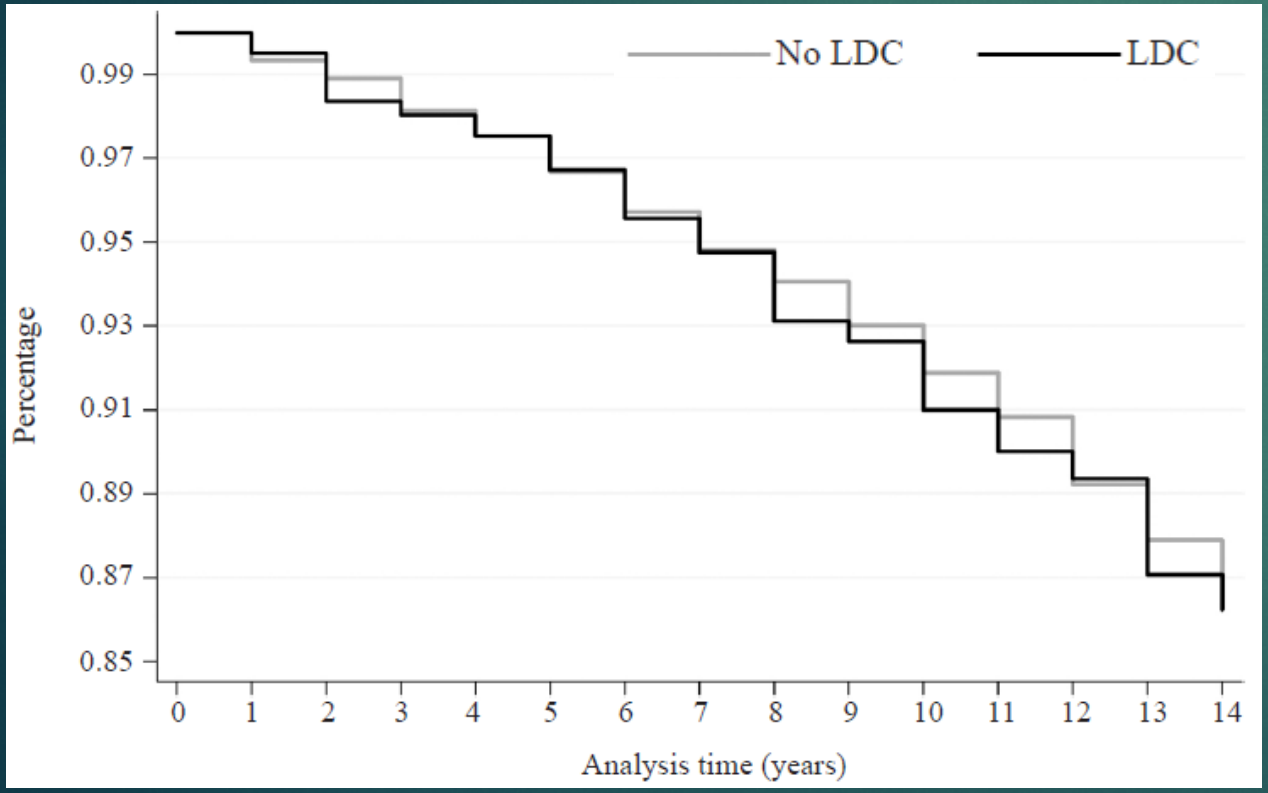
Survival for Men

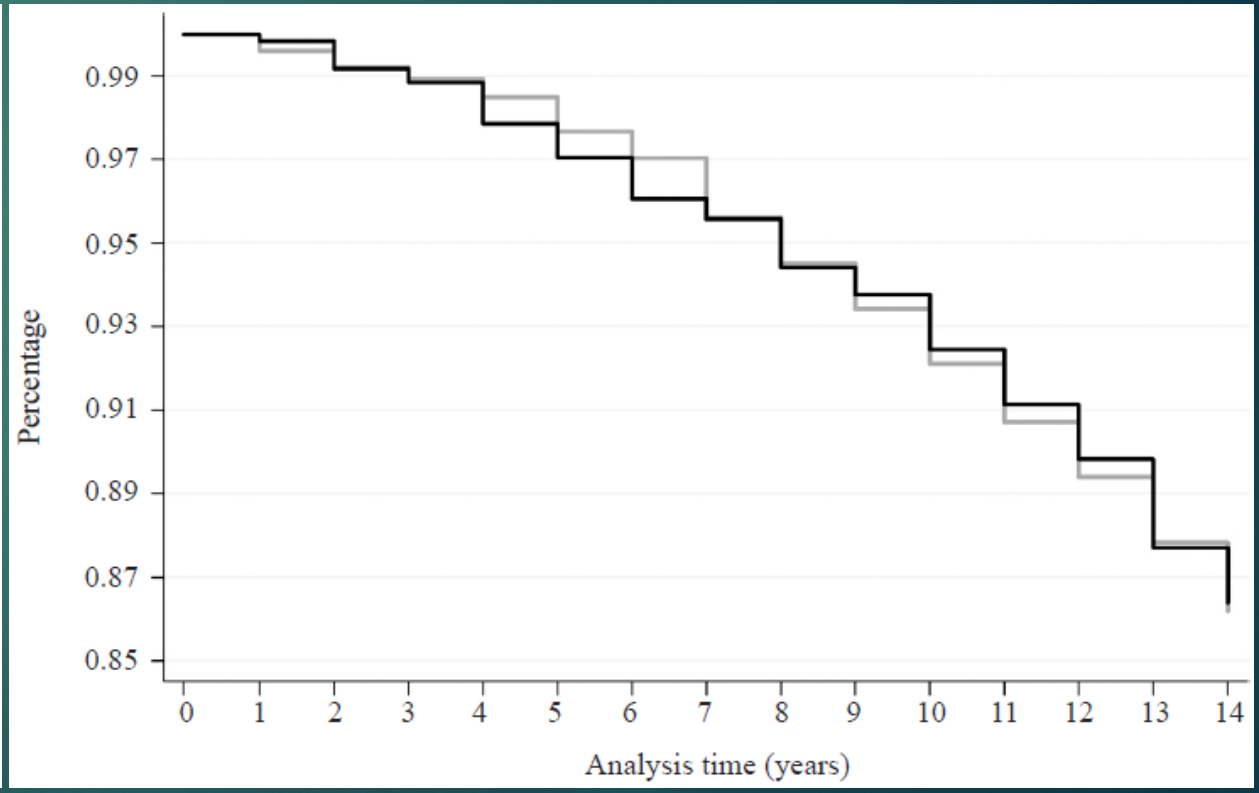
Figure 5&6 Survival rates for **men** with low incomes and low education, 1995–2008.

Low Income (below median)



log–rank test p-value = 0.9823

Low Education (less than high school)



log–rank test p-value = 0.9069

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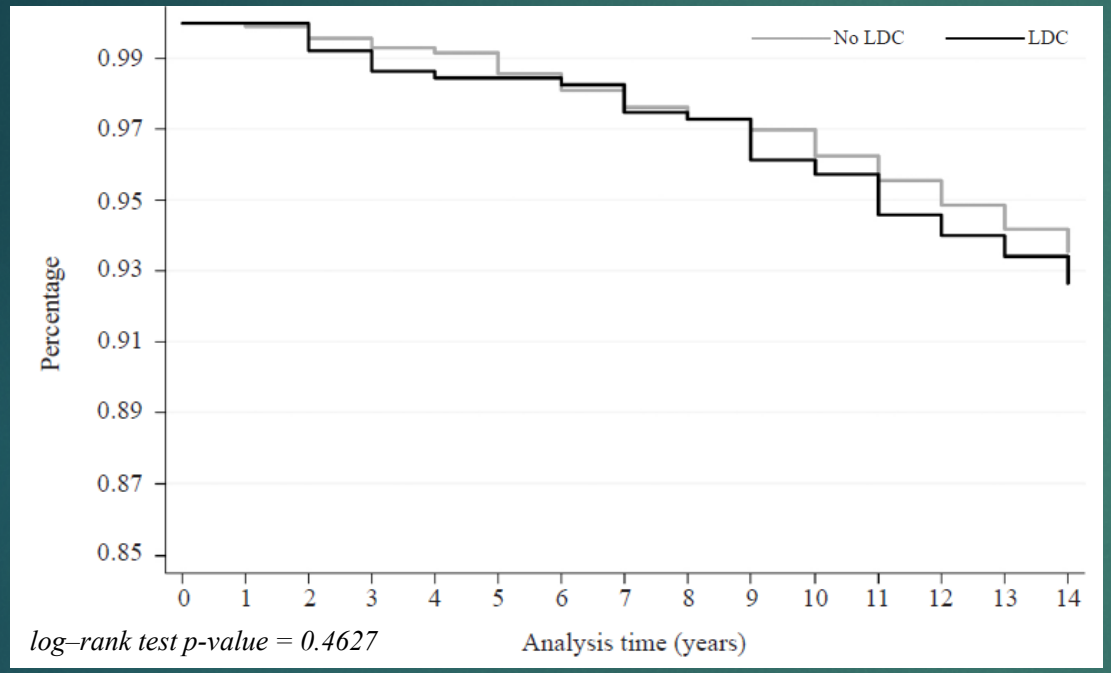
Robustness checks

1. For women with LDC, lower overall survival rates were driven by lower SES.
   Figure 10. Survival rates for women with high education



2. Removing people passing away in the first or second year of follow-up did not affect conclusions

Summary and discussion

- Higher mortality due to long distance commuting appear in women but not in men
- For women with lower educational attainment and low incomes, long-distance commenters had lower survival rates
- Higher mortality among women with lower income or education level may reflect a high gender inequality in housework
  - Existing gender roles -- women facing a double burden
- Should not be given strong interpretations in terms of causal effects, but to inspire further research
  - More information needed: health status, cause of death, mode of transportation

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SECOND READER: Morgan McGrath

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Conclusions

Conclusion #1:

No evidence of differences in survival rates between **males** with LDC and matched controls

Conclusion #2:

Higher mortality among **females** with LDC compared to matched controls

"Risk of dying within 14 years of follow up is 43% higher for long distance commuters."

Conclusion #3:

This estimated association in females is driven by individuals with **lower education** and **lower incomes**

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Strengths

- Longitudinal data source with large n
- Transparency was great:
  - Detailed methods of analysis techniques
    - 1:4 nearest neighbor matching
    - "Average treatment effect on treated"
  - Robustness checks
  - Laid out necessary assumptions!
- Upfront and realistic about limitations of study design
  - "Results should not be given strong causal interpretations…"
  - Never overstated conclusions

Assumptions required for unbiased estimate of a causal effect:

1. An individual's decision to become a LDC does not affect mortality of other individuals
2. Conditional on covariates used to estimate the propensity score, the probability of being a LDC is independent of the outcome
3. Conditional on covariates, the probability of treatment is strictly between 0 and 1
4. Conditional on covariates, the censoring mechanism is independent of the outcome

"If, for some reason, long-distance commuters have shorter longevity than other employees because of unobserved factors, the estimated effect of LDC on mortality will be biased unless the covariates in the propensity score reflect these factors sufficiently."

Weaknesses

- How inclusive was original data set of entire Swedish population? Selection bias?
- Unfortunate lack of data on relevant confounders:
  - Type of commute (car, public transport, etc.)
  - Job environment (used employment sector as proxy)
  - Lifestyle, physical activity (used previous active commute as proxy…bit of a stretch)
  - Health status, comorbidities
  - Cause of death
- Operational definition of treatment: commute > 50km **ONLY** in 1993 or 1994
  - Controls: no LDC during 1985-2008
  - Age 55 in 1994…retirement by 2008?
- Only discussed stress and health outcomes as explanation for the association between LDC and mortality

Claims data analyses unable to properly characterize the value of neurologists in epilepsy care

Hill et al. *Neurology* (2019)

Observational Studies in Action

PQHS 500

2020-03-26

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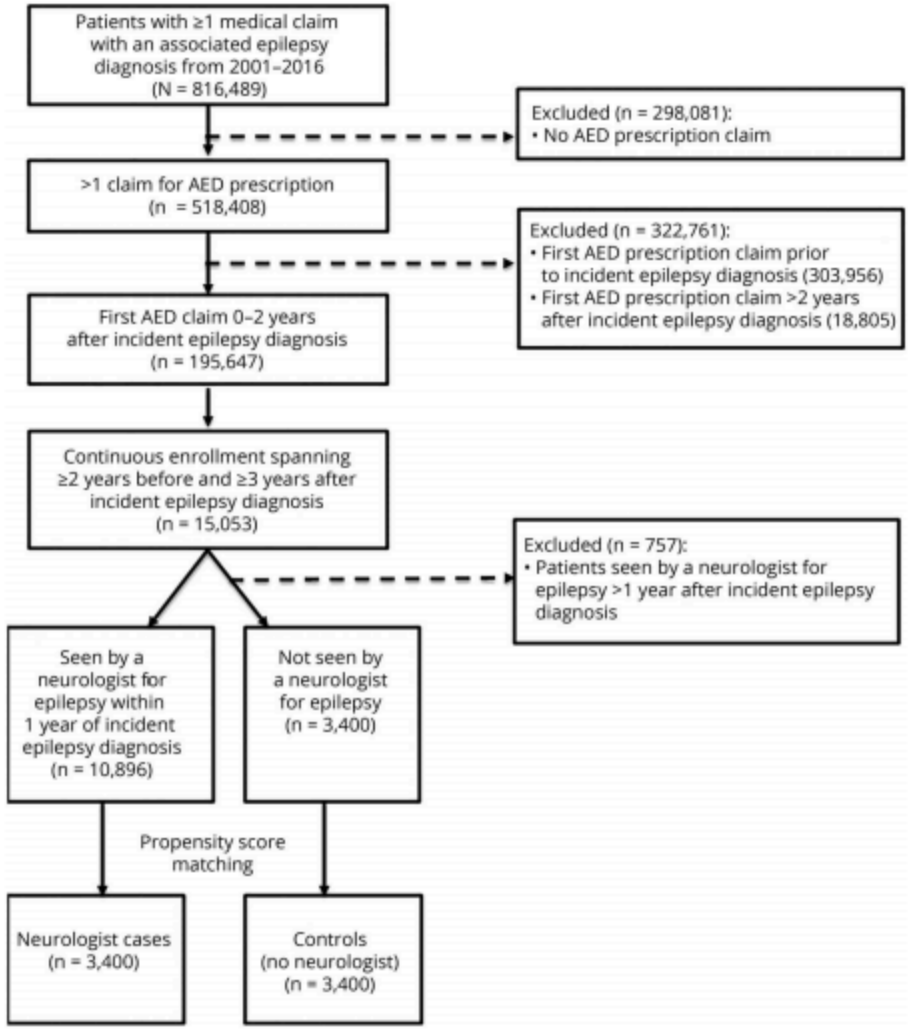
Background

- Epilepsy is a complex neurological disease characterized by unprovoked seizures
- Initially handled by primary care
  - Persistent seizures should be seen by a neurologist
- Evidence of benefit of neurologist care
  - This benefit has ”not been well characterized”
- **Study Objective:**
  - Determine association of a neurologist visit on health care use and cost outcomes for patients with incident epilepsy

Methods

- OptumInsight Clinformatics Data Mart
  - United Healthcare claims 2001 – 2016
- Identified people with epilepsy (PWE) via ICD codes
  - Excluding: < 5 years of continuous coverage incl. 2 years prediagnosis and 3 years follow-up data.
  - Incident cases: no antiepileptic drug (AED) prescription or claims for 2 years
- Exposure: neurologist encounter for epilepsy
- Outcome: ER visits and hospitalizations for epilepsy

Figure 1 Study flow diagram



AED = antiepileptic drug.

PS Matching (1:1 Nearest Neighbor)

- Age
- Sex
- Charlson Comorbidity Index categories
- Preexisting psychiatric comorbid conditions: Anxiety, bipolar disorder, alcohol dependence/abuse
- Preexisting neurological comorbid conditions: Head injury, brain tumor, tuberous sclerosis, migraine, headache, neuropathy, chronic pain
- Total expenditures 2 yrs before diagnosis
- Medical service use (hospitalization, nursing facility, ER, neurologist visit), psychiatric treatment
- Benefit design
- Eligibility time
- Setting of incident epilepsy
- Year of diagnosis
- Region-level defined by hospital service area

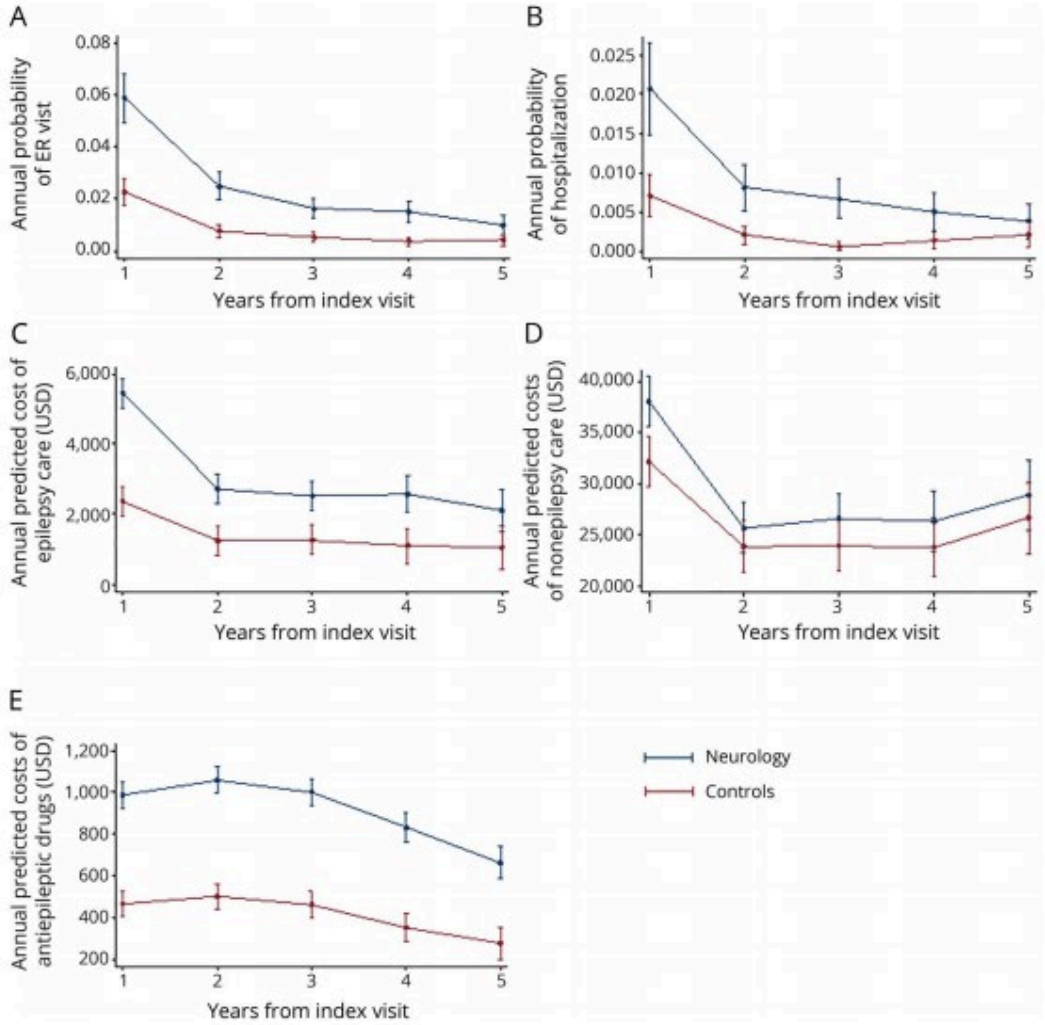
PSM Results

- 10,896 patients
  - Matched 3,400 cases and controls
- After matching: chronic obstructive pulmonary disease, anxiety, chronic pain more likely in cases
  - Cases more frequently diagnosed in clinic, and eligible for insurance coverage for a shorter length of time before incident diagnosis

Results

- ER visits for epilepsy were more likely for cases than controls
  - Magnitude of differences decreased over time
- Similar pattern in number of ER visits and hospitalizations
- Epilepsy-related expenditures were higher in cases than controls
  - As was total cost of non-epilepsy care
- EEG evaluation and surgery was more common for cases than controls

Figure 2 Health care use for epilepsy and costs of care



Predicted (A) epilepsy-related emergency room (ER) visits, (B) epilepsy-related hospitalizations, (C) epilepsy medical costs, (D) nonepilepsy medical costs, and (E) antiepileptic drugs costs each year for cases compared to controls with 95% confidence intervals. USD = US dollars.

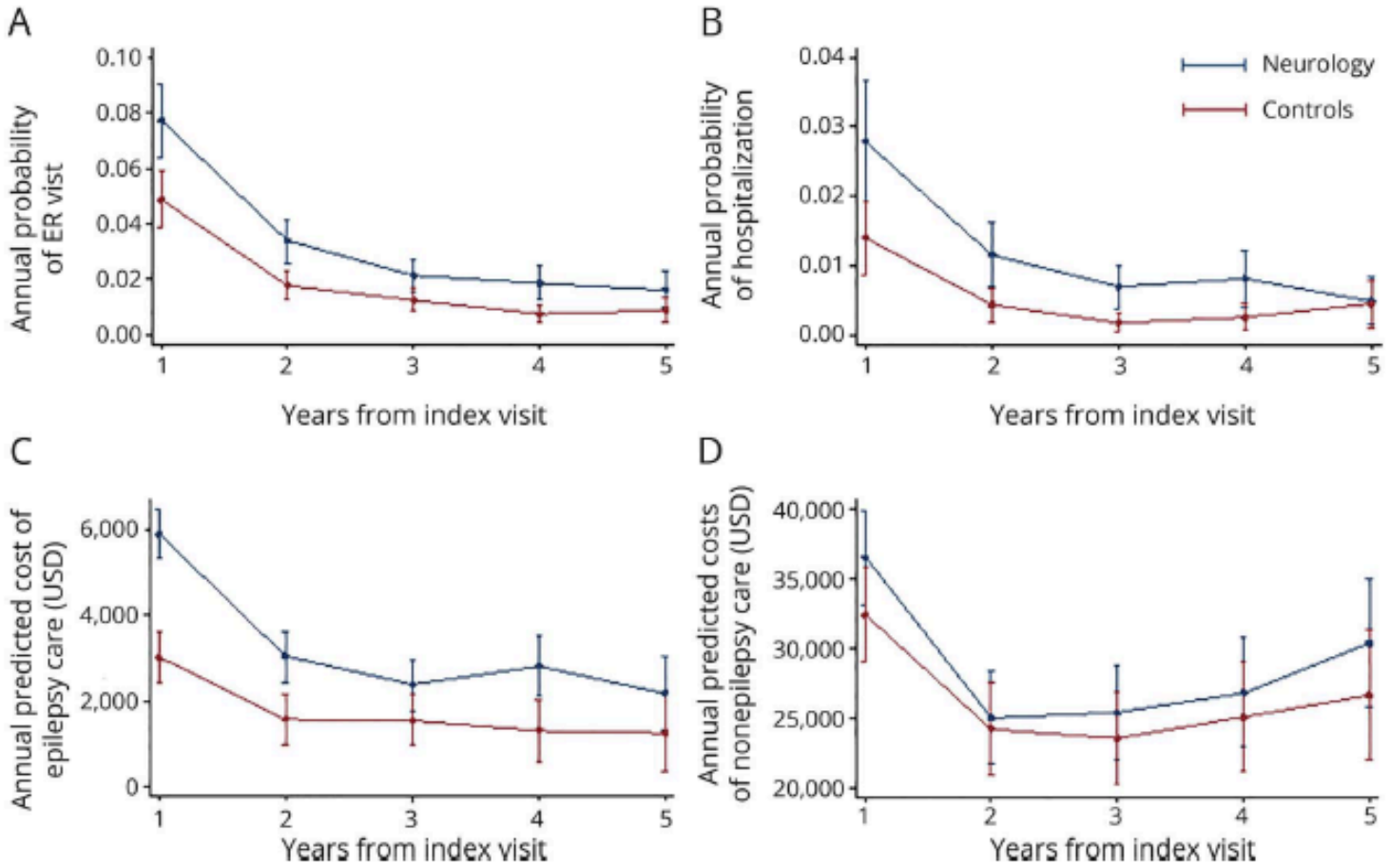
Results

- Cases had higher rate of bone-health evaluation
  - Fracture risk due to epilepsy and AED use
- No difference in antidepressant prescription
  - Yet cases more commonly had psychiatrist visits
- Cases more likely to be continued on antiepileptic medication after initial prescription
- Status epilepticus and intractable epilepsy were more likely for cases than controls

Discussion

- Patients with incident epilepsy who visited a neurologist had higher subsequent epilepsy-related ER visits and hospitalizations
- Neurologist leads to increase in cost/utilization (?)
- **Patients referred to a neurologist have more severe disease**
  - With more stringent case definition, the cost differences nearly disappeared
- "The results of our study suggest that even rigorously adjusted claims data are likely inadequate to assess the value of care in epilepsy."

Figure 3 Health care use for epilepsy and medical costs: sensitivity analysis



For the population defined with the requirement of 2 epilepsy diagnosis codes, predicted (A) epilepsy-related emergency room (ER) visits, (B) epilepsy-related hospitalizations, (C) epilepsy medical costs, and (D) nonepilepsy medical costs each year for cases compared to controls with 95% confidence intervals. USD = US dollars.

Limitations

- Data collected for billing purposes
- Limited clinical information
- Outcome issues: not all hospitalizations for epilepsy are adverse outcomes as some hospitalizations may represent an appropriate care escalation

- **Epilepsy disease severity not full accounted for**
- **Flaws in identifying people with epilepsy in claims data**

Questions?

ARTICLE

Claims data analyses unable to properly characterize the value of neurologists in epilepsy care

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Neurology® 2019;92:e973-e987. doi:10.1212/WNL.0000000000007004

OBSERVATIONAL STUDIES IN ACTION

PQHS 500

2020-03-26

JESUS GUTIERREZ

Study Aim

- "…to determine the association of a neurologist visit on health care use and cost outcomes for patients with incident epilepsy using a large, private insurance claims dataset."

Propensity Score Matching

- 1:1 nearest neighbor match
  - Number of controls stayed the same
  - Reduced extrapolation and higher precision
- Based on 43 matching variables
  - However, some notable absences
- Without replacement
  - Given large number of controls available compared to cases (10,896 vs. 3,400)

"Retrospectively identifying patients with epilepsy is difficult."

- Definition used had a PPV of 84%
- Claims data have limited clinical details to allow determination of correct diagnosis
- Etiology of seizures (other than epilepsy)
- Convulsive episodes due to alternative pathologies

"…it is more likely that patients with complicated illness are directed to neurologists for care."

- Markers of severity of disease
  - Status epilepticus, intractable epilepsy, presentations to ER for trauma, surgical procedures, etc.
- Use of prescription data to determine severity of disease
  - Higher number and types of AEDs

QUESTIONS?