Transportation Noise and Risk of Dementia and Other Diseases in a Nationwide Study (Denmark)

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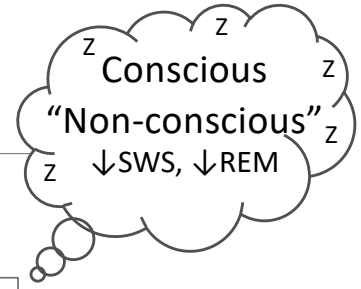
WHY IS NOISE HARMFUL?



Traffic noise

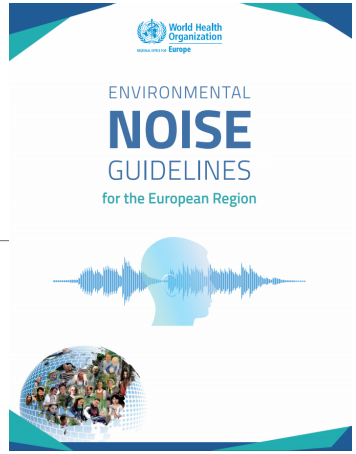
Stress

Sleep disturbance

Biological risk factors

Hypertension Oxidative stress Endothelial dysfunction Inflammation	Decrease in insulin level Increase in blood glucose Increase in leptin (hunger hormone)	Inflammation Oxidative stress ↓SWS (slow wave sleep) ↓REM	Inflammation Oxidative stress Circadian rhythm disruption Change in lifestyle
↓	↓	↓	↓
Cardiovascular disease	Diabetes	Dementia	Cancer

WHO Report 2018



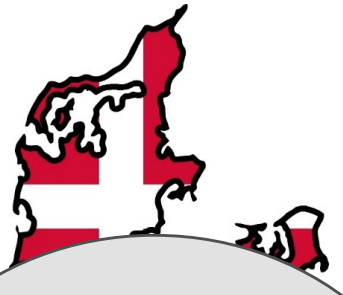
Diseases/outcomes	Evidence
• Ischemic heart disease	++++
• Stroke	+++
• Diabetes	+++
• Dementia	???
• Cancer	???

++++	**High quality** (further research is very unlikely to change confidence in the effect estimate)
+++	**Moderate quality** (further research is likely to have an impact on the effect estimate)
++	**Low quality** (further research is very likely to have an impact on the effect estimate)
+	**Very low quality** (the effect estimate is very uncertain)

Aim

To conduct high quality studies on transportation noise and major diseases on a national scale using the unique Danish administrative and health registries

Study Population



Health and mortality registries
Hospital registry
Prescription registry
Cancer registry

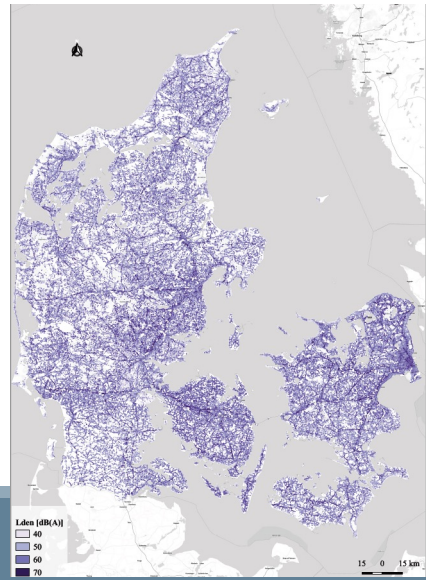
Population
All living in Denmark
> 35 years
2000 – 2017
N = 3.6 million

Statistics Denmark
Socioeconomic status
Income, education, marital status, occupation, ethnicity

Århus University
Estimates yearly air pollution at all addresses

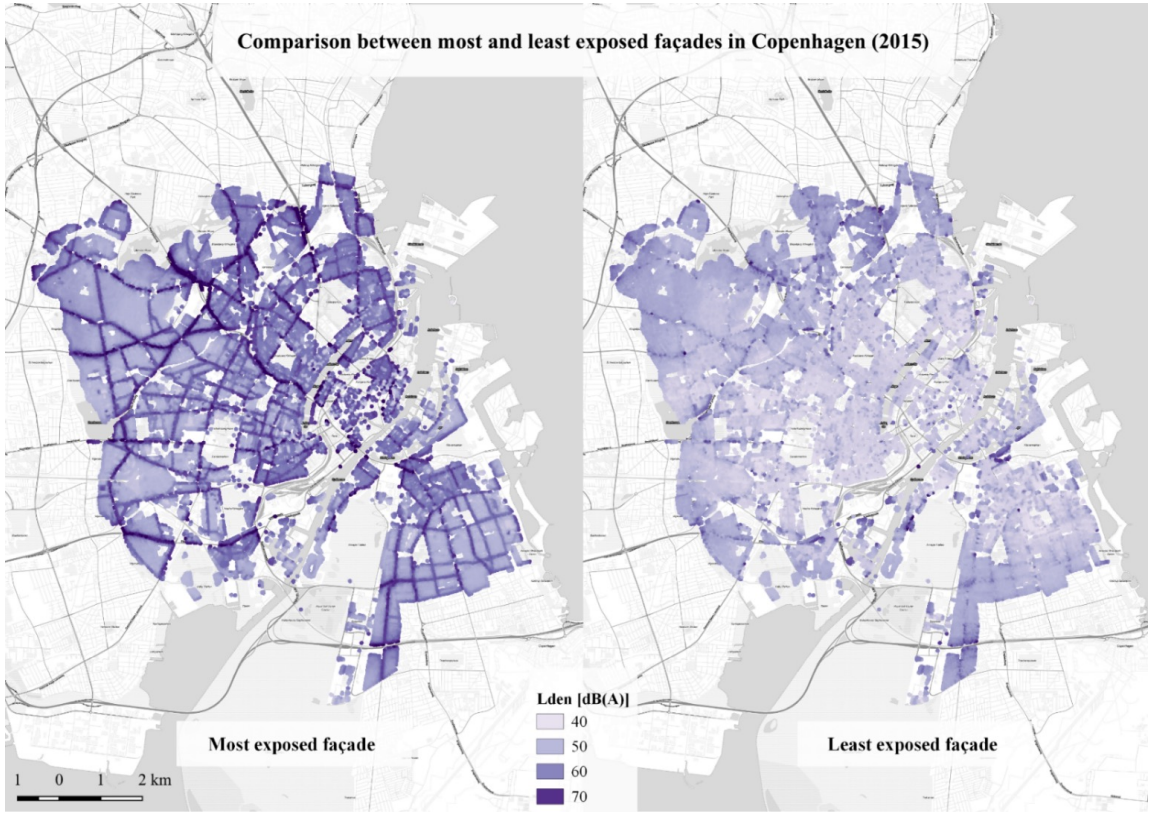
CPR registry
Complete precis address history

Noise consultant
Estimates traffic noise at all addresses (Nordic Prediction Method)



Most and Least Exposed Facade

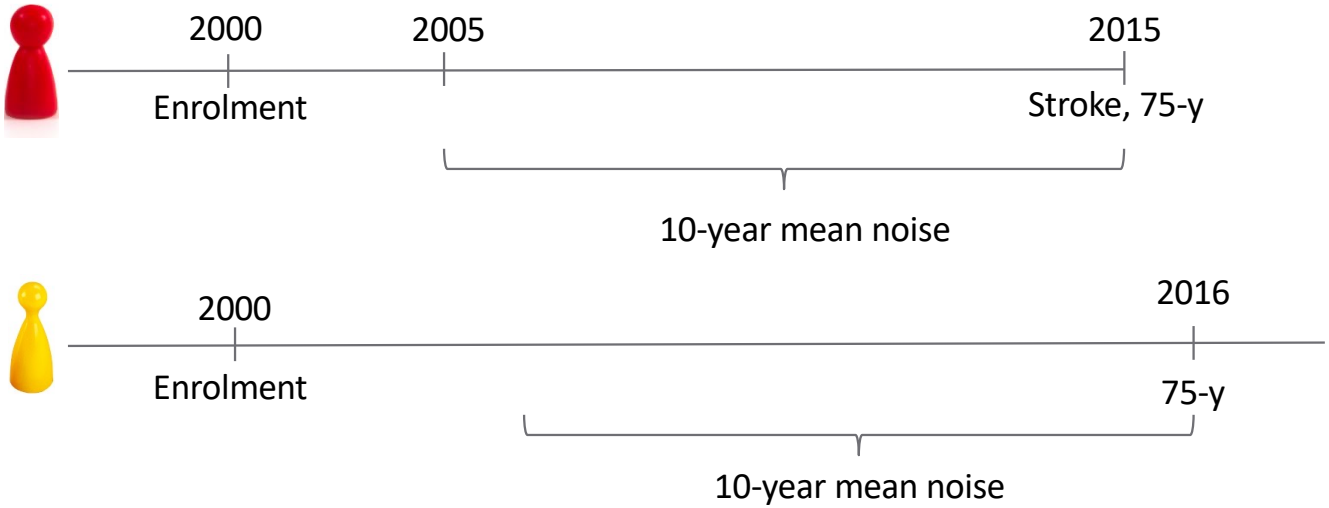
- Estimate exposures at **most** and **least** exposed façades
- People often select a bedroom with a silent façade -> proxy outside noise during sleep



Diseases Investigated

- **Stroke**
  - 185,000 cases (Hospital and Mortality Registries)
- **Type 2 diabetes**
  - 234,000 cases (Hospital and Prescription Registries)
- **Dementia**
  - 103,500 dementia cases (Hospital, Prescription and Psychiatric Registers)
- **Breast Cancer**
  - 66,000 cases (Cancer Registry)

Statistical Analyses



Person 1 (case)

Person 2 ”Healthy”

Adjust for:

- Age, sex
- Socioeconomic status (education, income, occupation etc.)
- Air pollution

STROKE

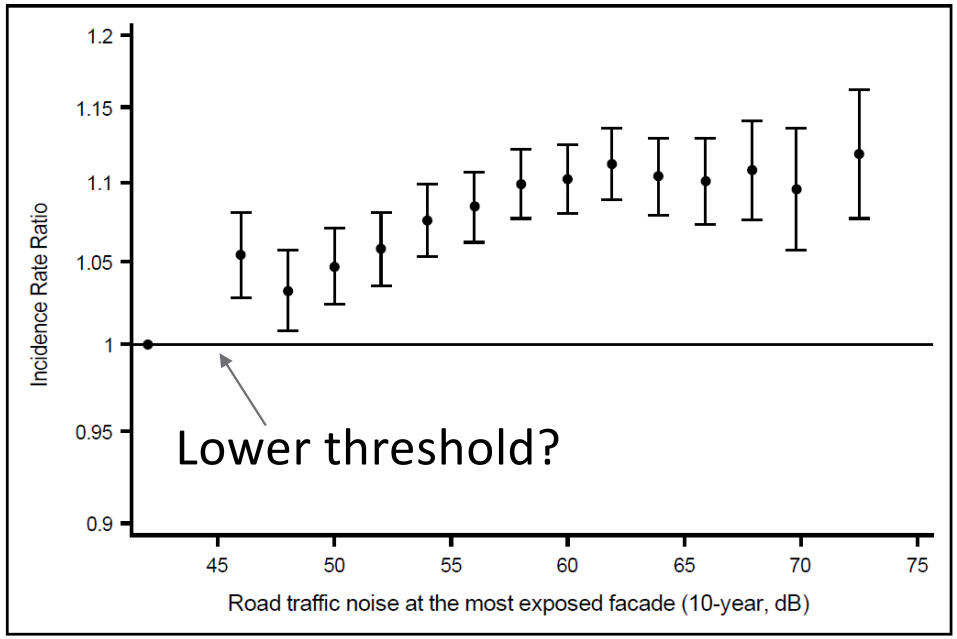
RESULTS - STROKE

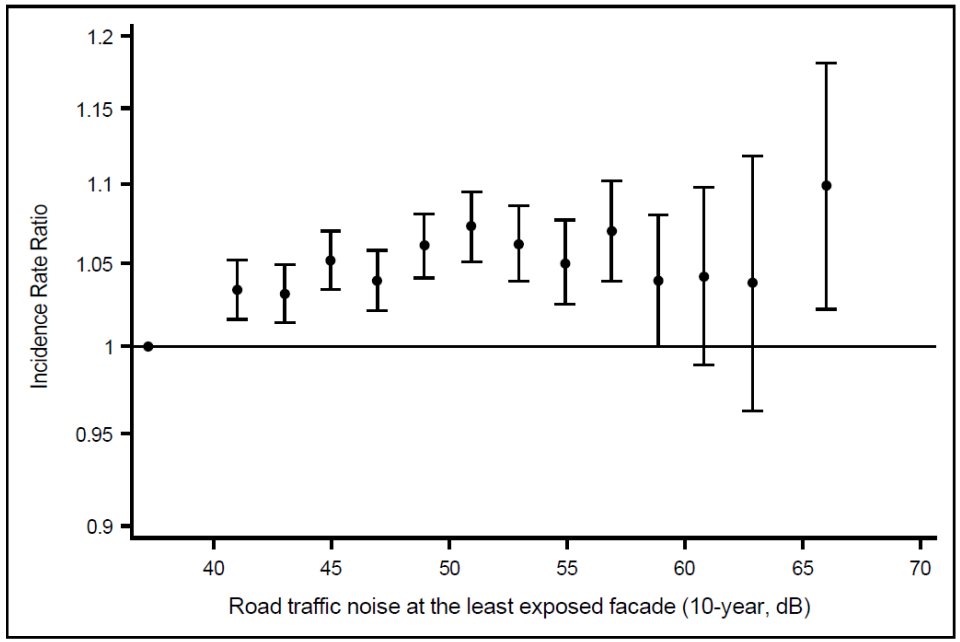
Noise per 10 dB 10-year mean	Crude HR (95% CI)	Adjusted HR (95% CI)	+ $PM_{2.5}$ and NO_2
Road traffic, L_{den} most	1.06 (1.05; 1.06)	1.04 (1.03; 1.05)	1.03 (1.02; 1.04)
Road traffic, L_{den} least	1.05 (1.04; 1.06)	1.03 (1.02; 1.04)	1.02 (1.01; 1.03)

Crude: age, sex and calendar-year
Adjusted: age, sex, calendar-year**, individual-level SES** (civil status, income, region of origin, occupational status), **area-level SES** (area-level information of percent population with low income, basic education, unemployment, manual labour, and single-parent and criminal record) and mutual road/railway noise

Sørensen et al, IJE, 2021

RESULTS - STROKE





No association with railway noise

Sørensen et al, IJE, 2021

Type 2 Diabetes

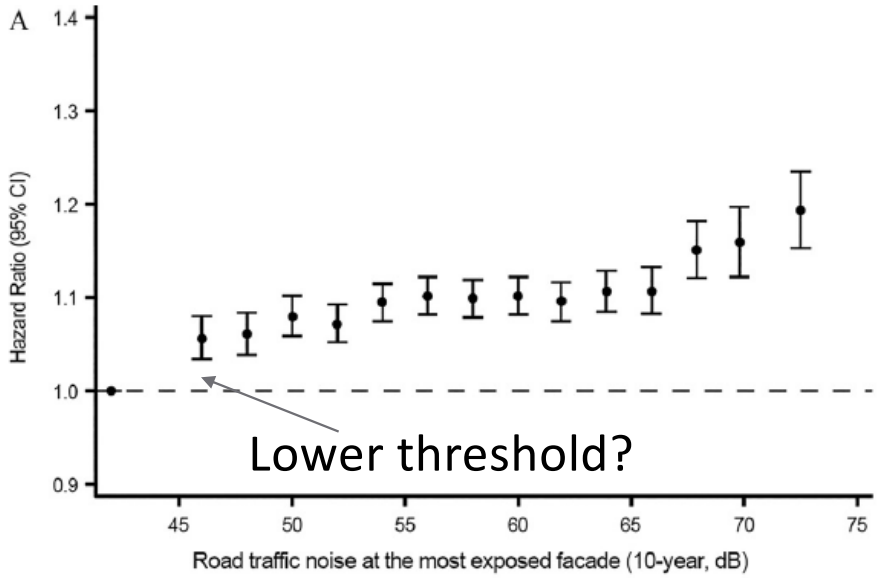
RESULTS – TYPE 2 DIABETES

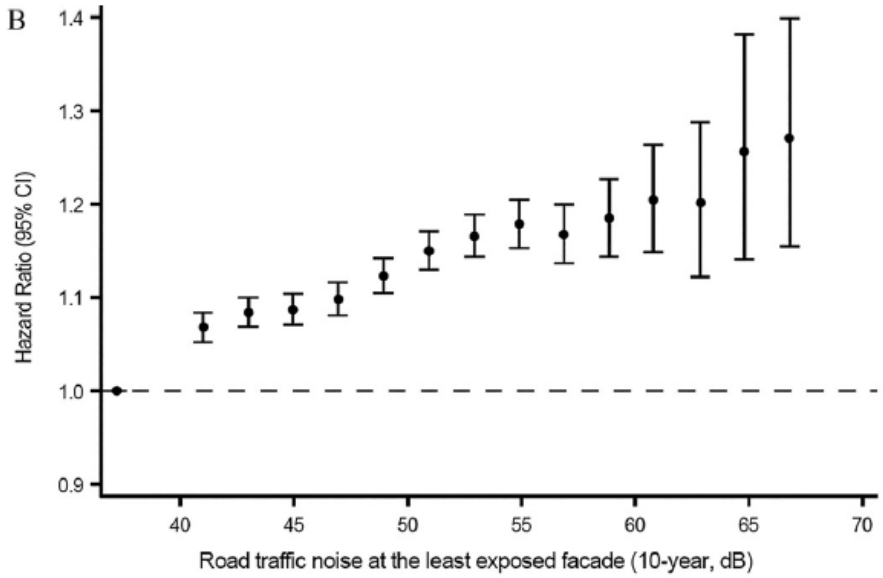
LINEAR ESTIMATES Noise per 10 dB 10-year estimates	Crude HR (95% CI)	Adjusted HR (95% CI)
Road traffic, L_{den} most	1.07 (1.06; 1.07)	1.05 (1.03; 1.04)
Road traffic, L_{den} least	1.08 (1.08; 1.09)	1.09 (1.08; 1.10)
Railway, L_{den} most	1.06 (1.05; 1.07)	1.03 (1.02; 1.04)
Railway, L_{den} least	1.09 (1.07; 1.10)	1.02 (1.01; 1.04)

Robust to adjustment for air pollution ($PM_{2.5}$)

Thacher et al, EHP, 2021

RESULTS – TYPE 2 DIABETES (ROAD)

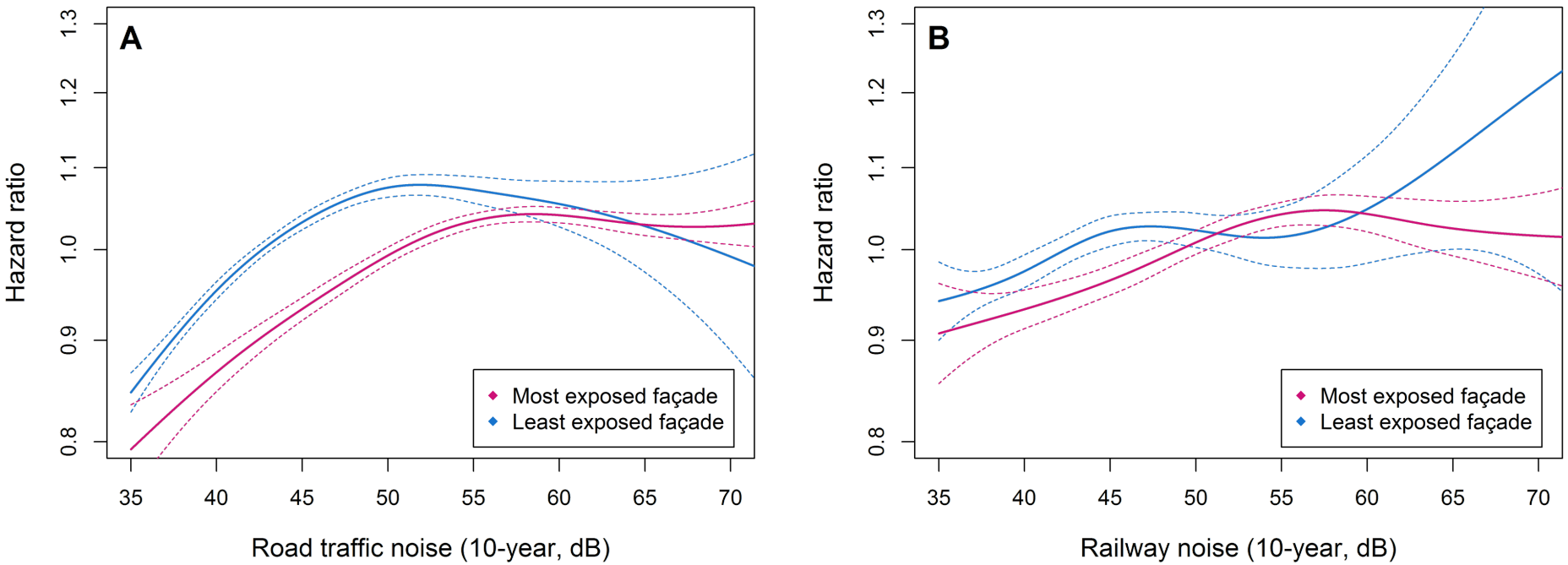




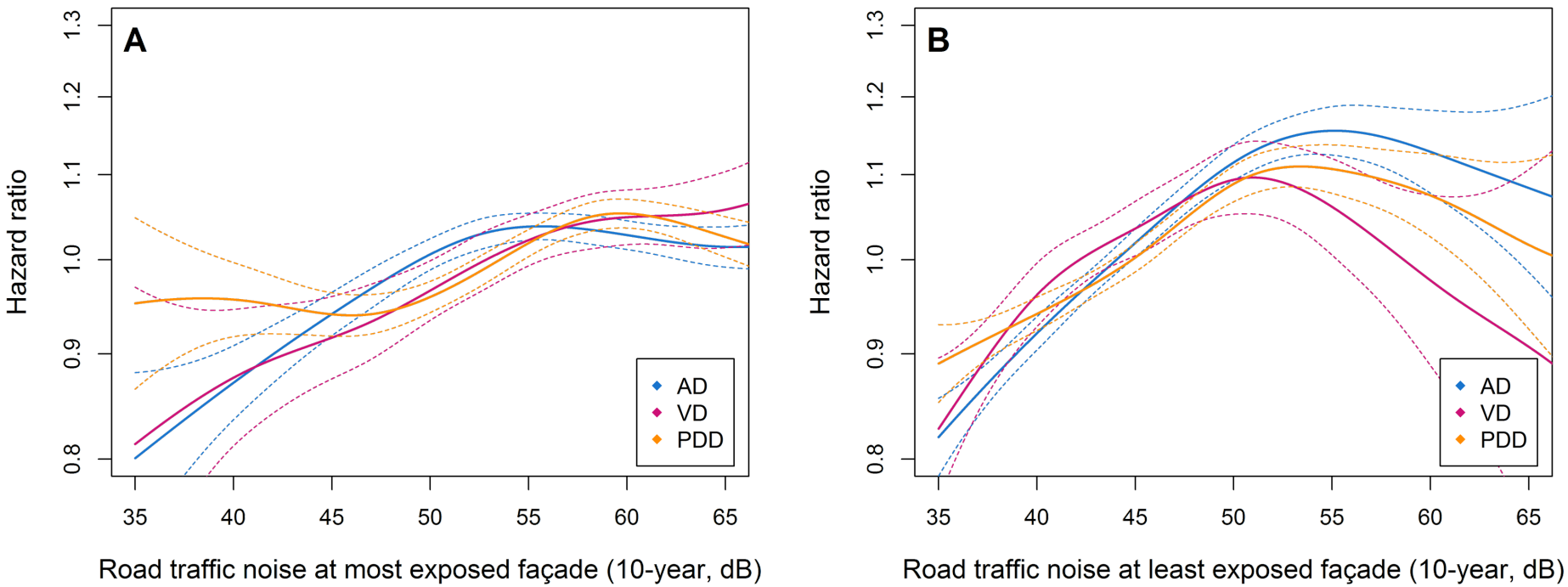
Thacher et al, EHP, 2021

DEMENTIA

Results – All Cause Dementia



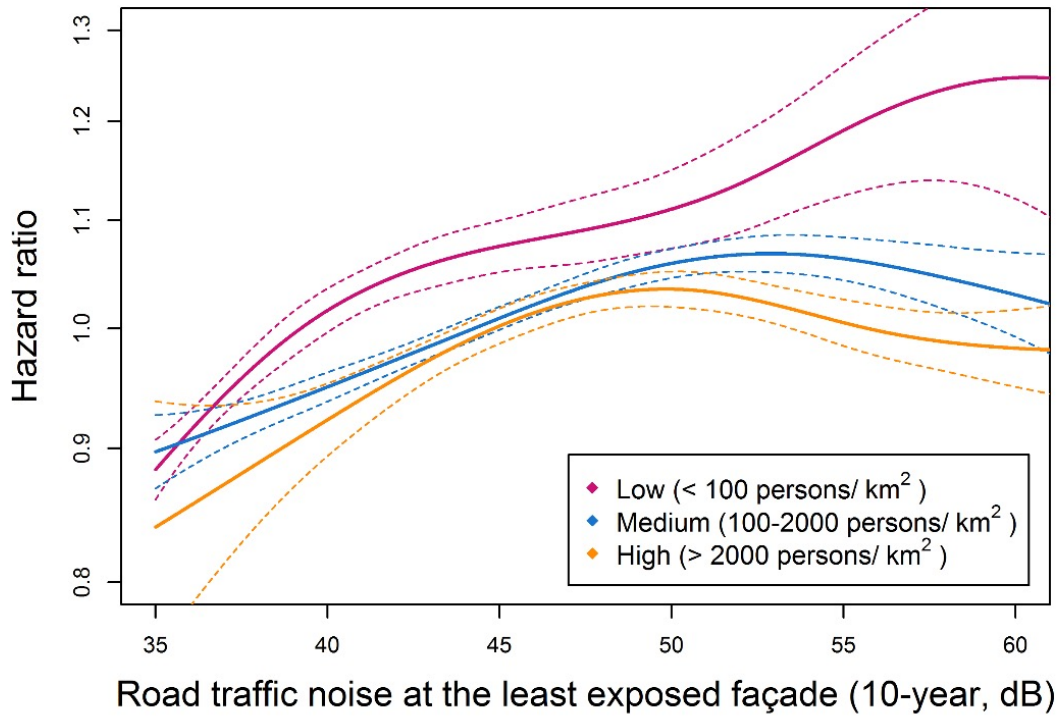
RESULTS – SUBTYPES OF DEMENTIA



AD= Alzheimer's (31,219), VD= vascular dementia (8,664), PPD= Parkinson's (2,192)

Cantuaria et al, BMJ, 2021

Potential Explanations – Levelling Off



Levelling off potentially due to:

- Masking of traffic noise by community noise in urban areas
- Investments in better sound insulation at higher noise levels

Breast Cancer

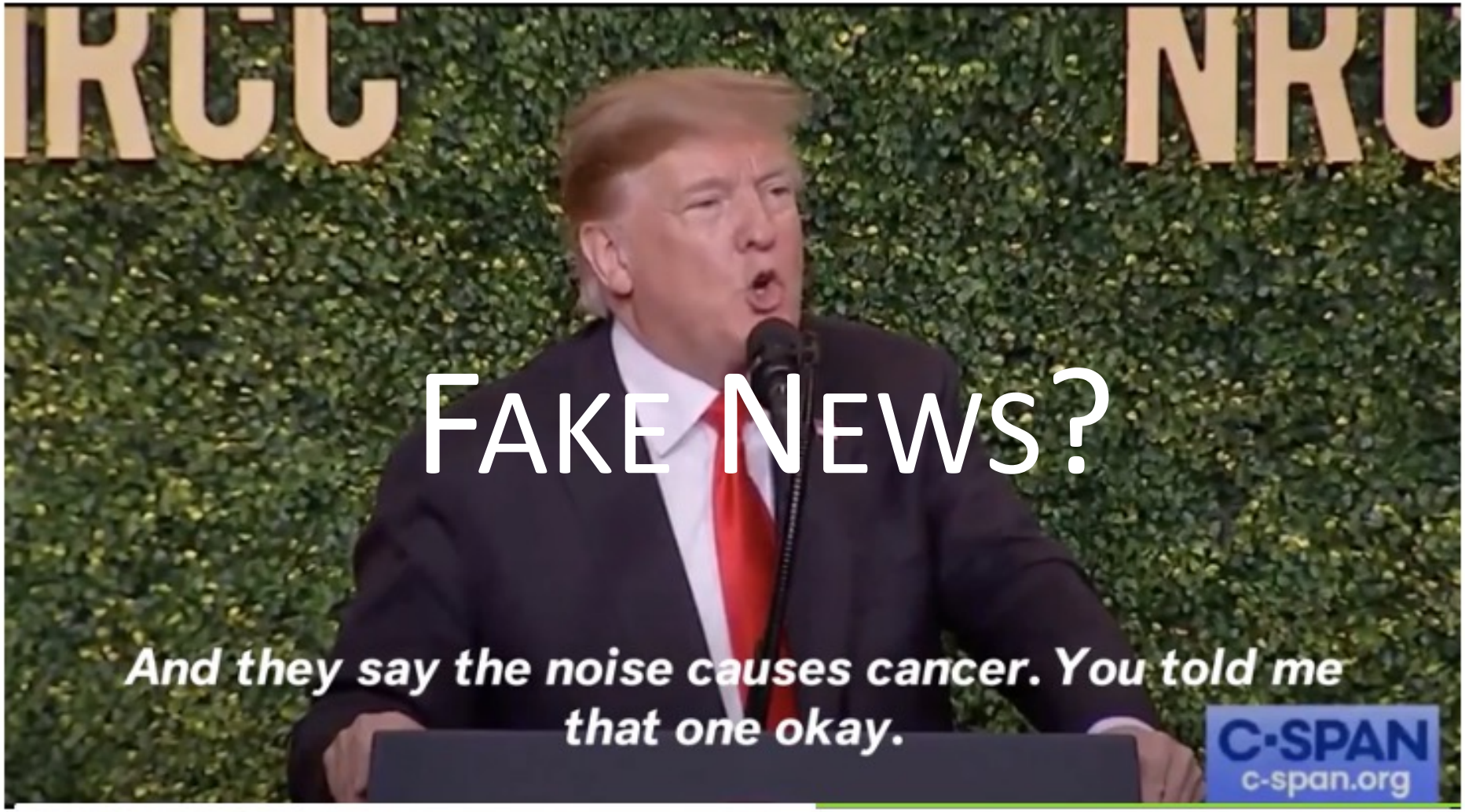
BREAST CANCER

LINEAR ESTIMATES Noise per 10 dB 10-year estimates	Crude HR (95% CI)	Adjusted HR (95% CI)
Road traffic, L_{den} most	1.02 (1.01; 1.03)	1.01 (1.00; 1.02)
Road traffic, L_{den} least	1.06 (1.04; 1.07)	1.03 (1.02; 1.05)
Railway, L_{den} most	1.02 (1.00; 1.04)	1.02 (1.00; 1.04)
Railway, L_{den} least	1.02 (0.99; 1.05)	1.02 (0.99; 1.05)

Robust to adjustment for air pollution ($PM_{2.5}$)

Sørensen et al, Env Res, 2021

Fake News?


And they say the noise causes cancer. You told me that one okay.
C-SPAN
c-span.org

CONCLUSIONS

Stroke

- Road traffic noise associated with higher risk of stroke
- This is in accordance with other high quality studies
- No association with railway noise

Type 2 diabetes

- Road and railway noise associated with higher risk of diabetes
- This is in accordance with other high quality studies
- Especially noise at the least exposed facade (sleep)

CONCLUSIONS

Dementia

- Road and railway noise associated with higher risk of dementia, especially Alzheimer's
- Especially noise at the least exposed facade (sleep)
- More studies needed on noise and dementia

Breast cancer

- Road and railway noise associated with higher risk of breast cancer
- Especially noise at the least exposed facade (sleep)
- More studies needed on noise and breast cancer

PERSPECTIVES

It is time for a new evaluation of evidence for road traffic noise and:

- Stroke
- Type 2 diabetes

In a new evaluation it is **CRUCIAL** to investigate the exposure-response function

- What is the lower threshold for a harmful effect of road traffic noise?
  - Studies point towards lower threshold than 55 dB (currently lowest calculated value in END)
  - Adding a lower threshold when calculating ”Health Impact” will result in large effect on the estimated “Disease Burden”

Roskilde Universitet

Thank You
Questions?

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