Recent health impact research in Denmark

Mette Sørensen

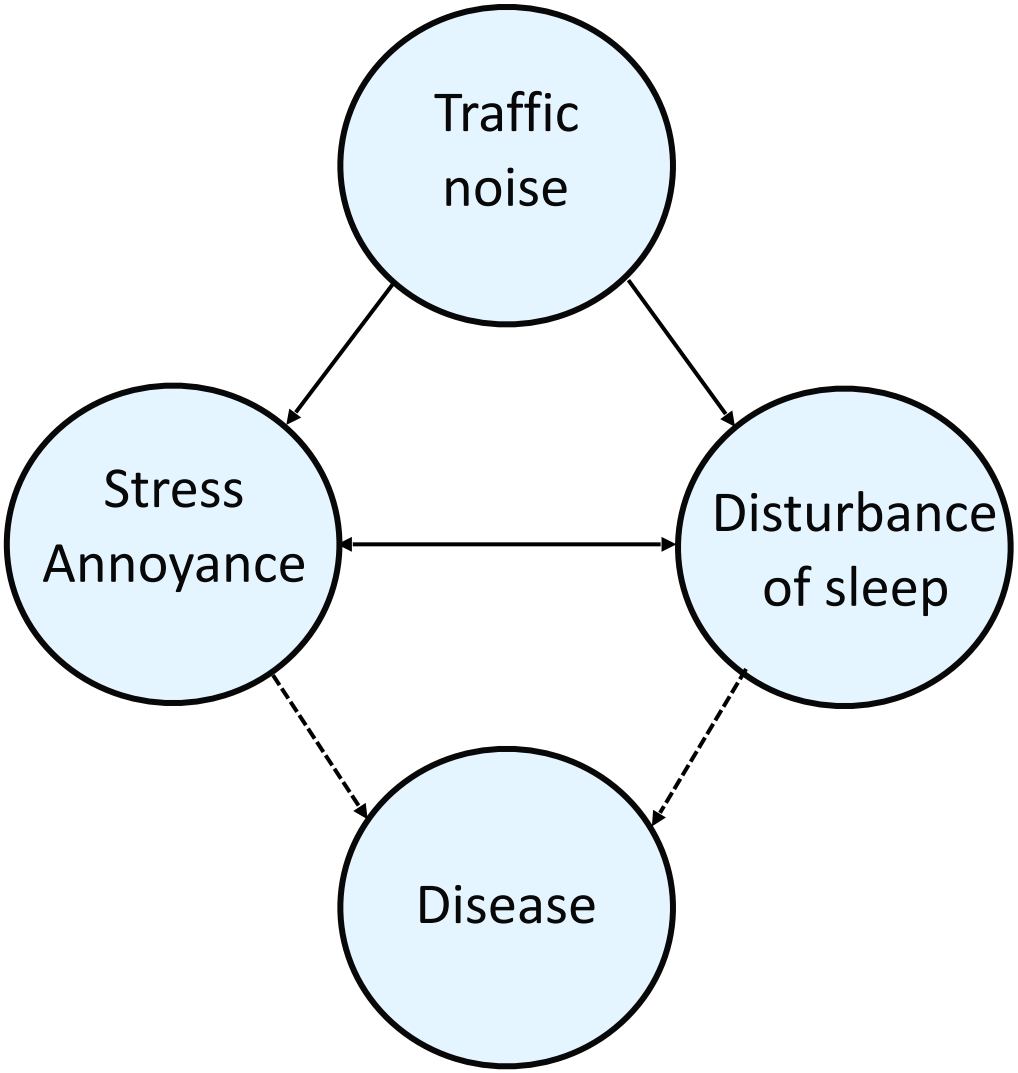
Senior researcher

Diet, Genes and Environment

Danish Cancer Society Research Center

Denmark

Noise, mechanisms



Long-term exposure and disease

Traffic noise

↓

Stress and sleep disturbance

↓

Biological risk factors

↓

↑ blood pressure
↑ cholesterol, LDL
↑ inflammation
↑ oxidative stress
↓ endothelial function

↓

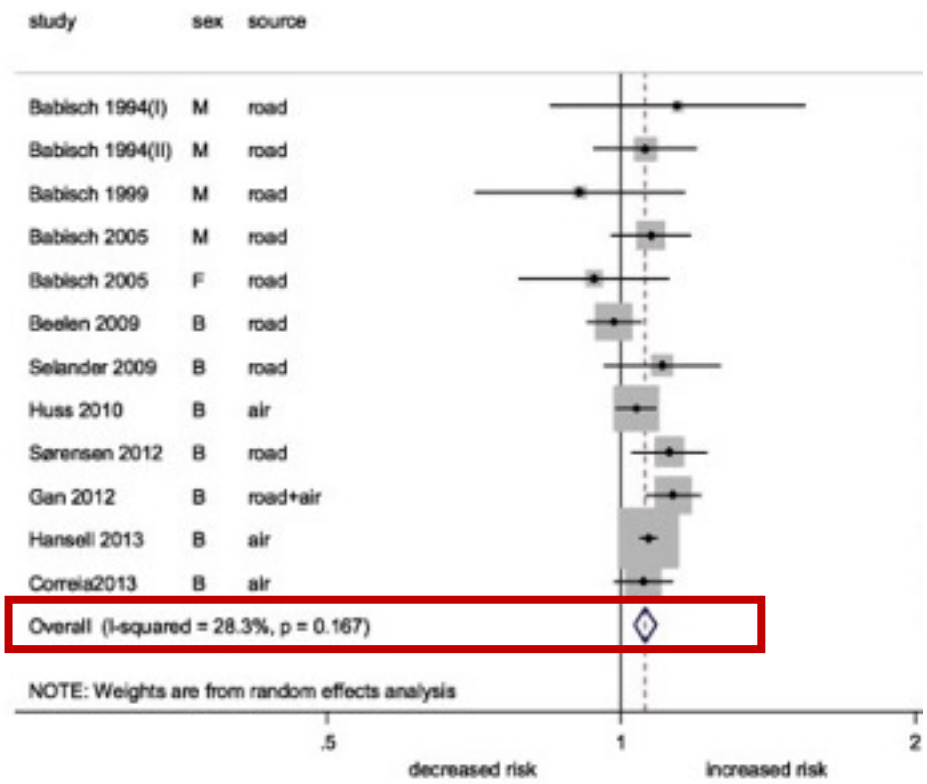
Cardiovascular disease

Ischemic heart disease

- Many studies
- Evidence is good

- 10 decibel increase -> <u>6%</u> increase in risk

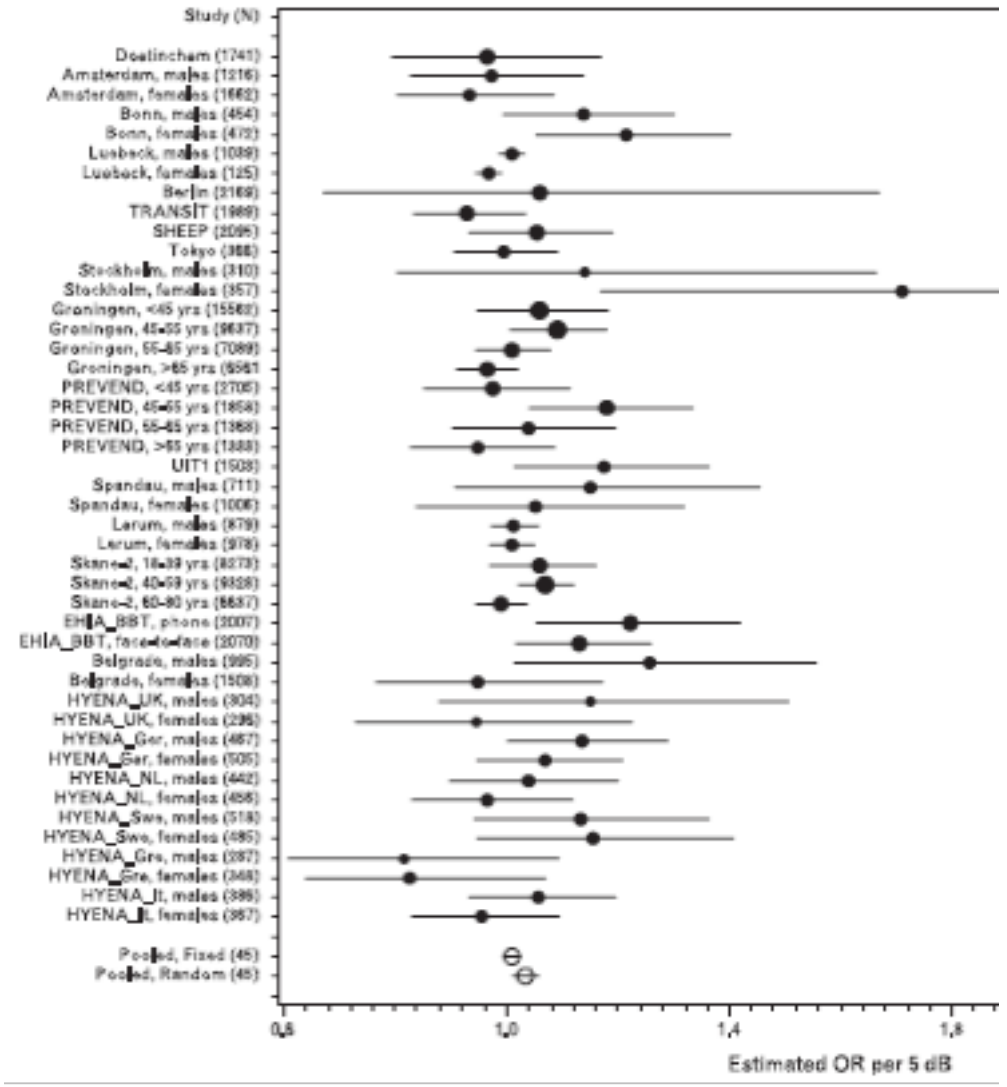
Vienneau et al, 2015, Environ Res



Hypertension

- Many studies
- Evidence OK
  - Problem – cross-sectional!
- 5 decibel increase in road traffic noise -> 3,4 % increase in risk

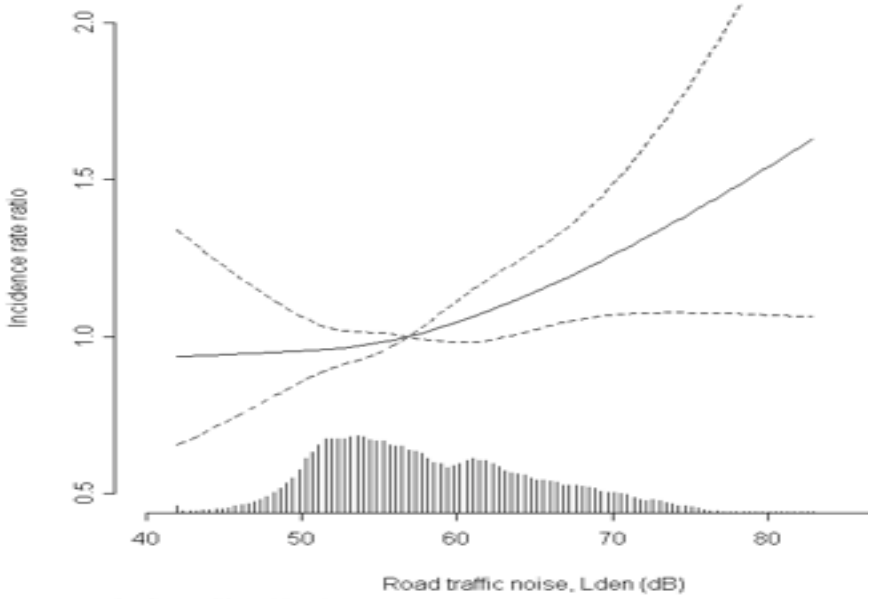
Van Kempen and Babisch 2012, J Hyperten



Traffic noise and stroke

Sørensen et al, 2011

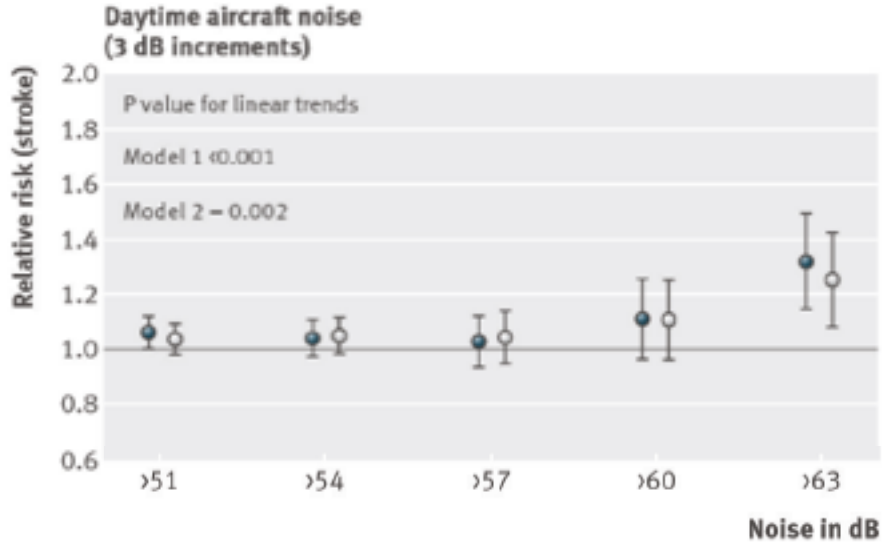
- 10 dB rise in road traffic noise -> 11 % increase in risk for stroke (1.04-1.19)
- Mainly ischemic strokes



Two studies from London

Road: from < 55 decibel to > 60 decibel
9% increase in risk among elderly

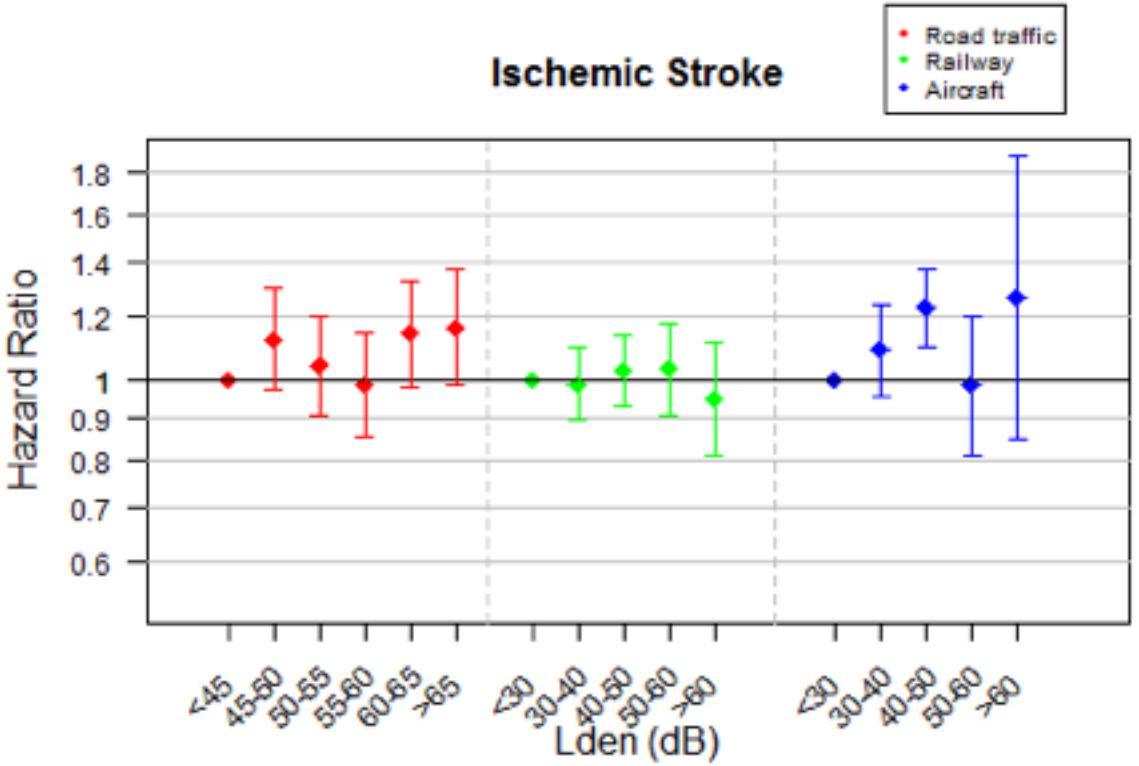
Aircraft: from low (<51) to high (>63) 24 % increase in risk



Traffic noise and stroke

Heritier et al, 2017, Eur J Epidemiol

- 4.4 million adults (Switzerland)
- 10 dB rise in road traffic noise -> 5 % increase in risk for stroke mortality (1.00-1.10)



Traffic noise and health

- Hypertension
- Ischemic heart disease
- Stroke

- Obesity
- Diabetes
- Cancer
- Behavioural problems in children

?

Long-term exposure and disease

Traffic noise

Stress and sleep disturbance

Biological risk factors

↑ blood pressure ↑ cholesterol, LDL ↑ inflammation ↑ oxidative stress ↓ endothelial function	↓ Insulin level and sensitivity ↓ Glycose tolerance ↑ Morning glucose ↓ Leptin (satiety) ↑ Ghrelin (hunger)	↓ Apoptosis, ↑ Angiogenesis ↓ immune system ↑ oxidative stress ↓ Melatonin: ↓ DNA repair, ↑ estrogen, antioxidant
Cardiovascular disease	Obesity, diabetes	Cancer

Study population

Diet, Cancer and Health cohort

- Enrolment in 1993-1997
- 57,053 persons aged 50-64 years
- Copenhagen and Aarhus
- Questionnaire
  - Lifestyle: e.g. diet, smoking, alcohol
  - SES: e.g. education
- Weight, height and waist circumference measured

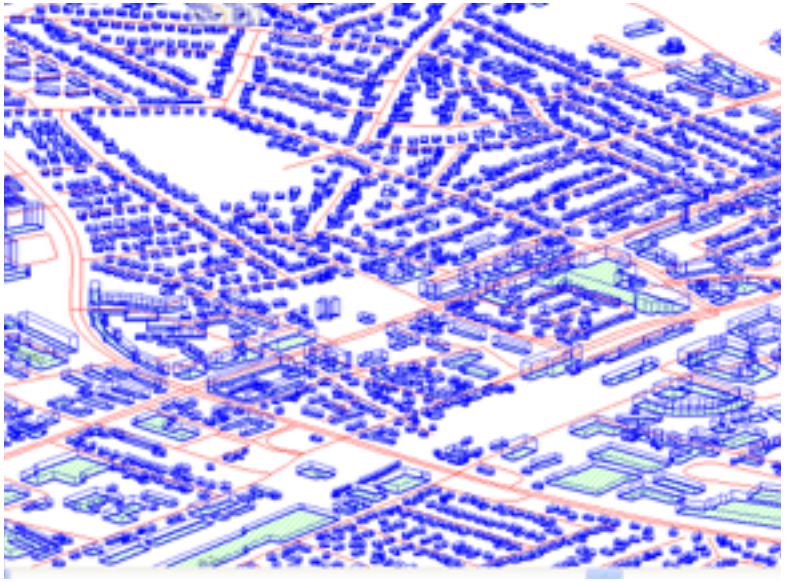
National registries

- Long tradition for registers in Denmark
- Central Population Registry (1971)
  - all present and historical addresses from 1987-2011
- The National Patient Registry (1977) - all hospital submissions
- The National Diabetes Registry (1995)
- The Cancer Registry (1942)

Noise exposure, road and rail

SoundPLAN – the Nordic Prediction Method

- Geocode and height (floor) for each address (1987-2011)
- Building polygons
- All road lines with > 1000 vehicles
  - Traffic composition (heavy/light)
  - Yearly average daily traffic
  - Traffic speed
- All railway links
  - Annual average daily train lengths
  - Train types and travel speed
  - Noise barriers



AirGIS – dispersion model for estimation of air pollution

Study design

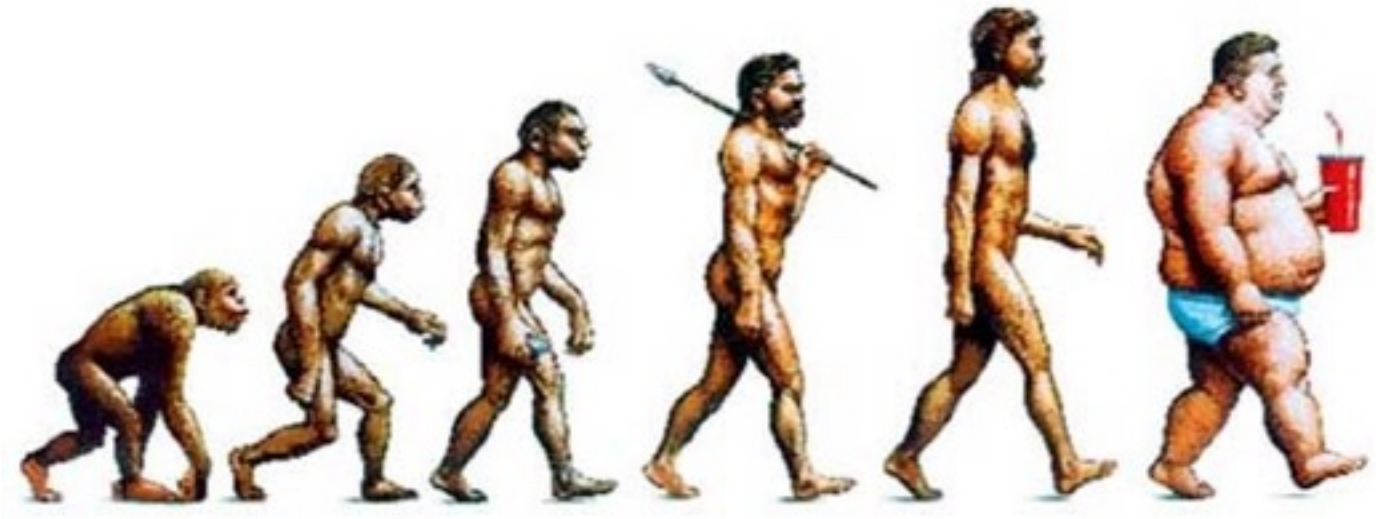
For each disease

- Estimate traffic noise for cases, e.g. 5-years before disease
- Compare with all person without disease

Include a number of variables that may blur results

- Gender
- Socioeconomic status
- Lifestyle (smoking, alcohol, diet)
- Air pollution, other noise sources

Metabolic disease



Traffic noise and obesity

Epidemiological studies, sleep disturbance:

- Reduced sleep quality and quantity -> waist circumference and BMI

Design

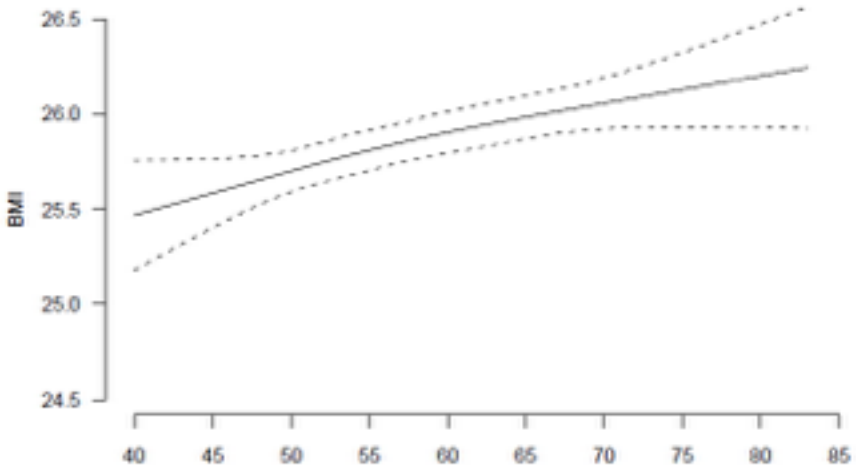
- BMI, waist circumference, fat percentage of 57,000 persons (50-64 y)
- Long-term residential road traffic noise

Results for road traffic noise

↑ BMI

↑ waist circumference

↑ fat percentage



Christensen et al, 2015

Traffic noise and obesity

Traffic noise and obesity

- Two Swedish studies -> association between traffic noise and obesity (Pyko et al 2015; Eriksson et al 2014)
- One Norwegian study find no association (Oftedal et al, 2015)
- One Danish study on children indicate association with childhood obesity (Christensen et al 2016)

Traffic noise and diabetes

Epidemiological studies on sleep disturbance

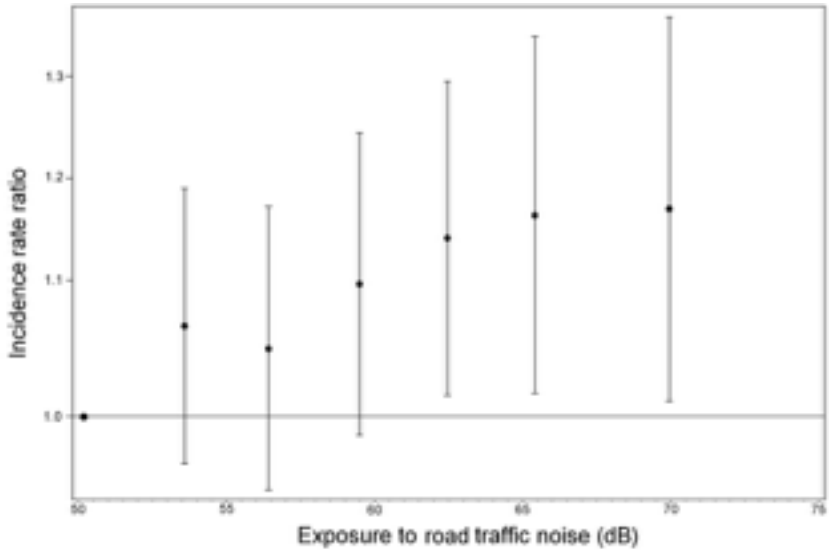
- Increased risk for diabetes -> meta-analysis: 10 prospective studies, >100,000 participants, 3,500 diabetes cases

Design and results

- 57,000 / 3,869 diabetes cases
- 10 dB rise in road traffic noise (5-years)

  -> 11 % increase in risk

  (IRR: 1.11 (1.05-1.18))



Sørensen et al, 2013

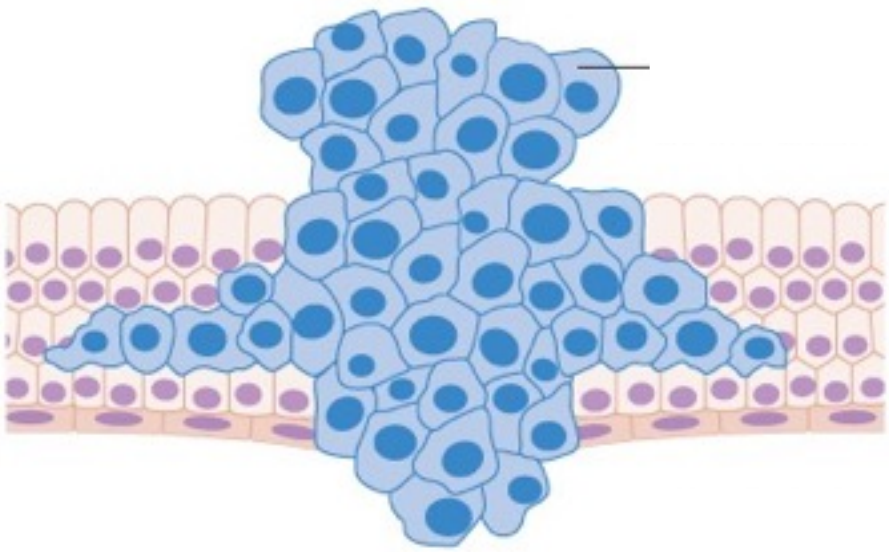
Traffic noise and physical activity

- One study found exposure to traffic noise to result in lower levels of physical activity (Foraster 2016)

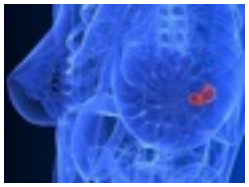
Study

- Information on sport during leisure time for all participants in DCH
- 10 dB higher road traffic noise increase odds for being physically inactive with 10 % (95% CI: 1.07-1.13)
- Railway noise > 55 dB increase odds for being physically inactive with 8 % (95% CI: 1.01-1.16)

Traffic noise and cancer



Breast cancer

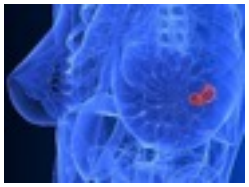


- The most frequent cancer in women – 1 in 10 women
- Incidence rates increasing

Sleep

- Short term sleep suspected of causing breast cancer
- Inconsistent findings on self-reported sleep and breast cancer
- Night work increases risk for breast cancer

Breast cancer

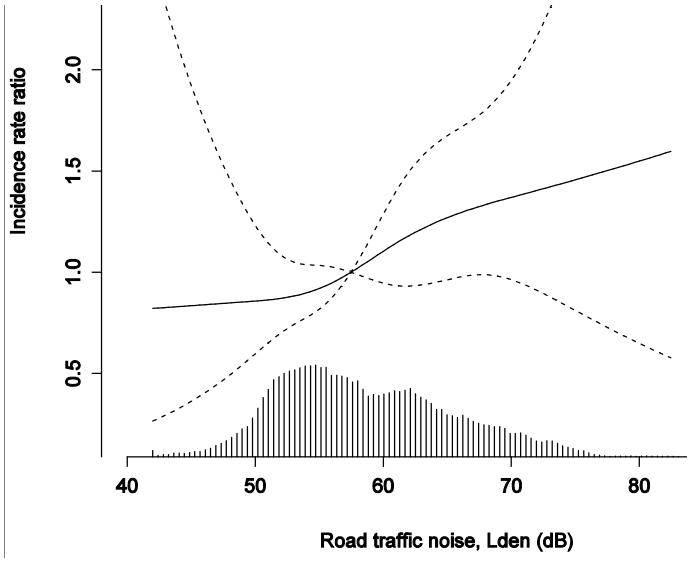


Sørensen et al, 2014

- Cohort study: 30,000 women
- 1,219 women developed breast cancer (national register)
  - Estrogen receptor: 858 positive / 203 negative cases

Results

- Road and railway: no association with ER positive BC
- Among ER negative BC:
  - Road: IRR = 1.23 (1.00-1.51)
  - Railway: IRR = 1.38 (1.01-1.89)

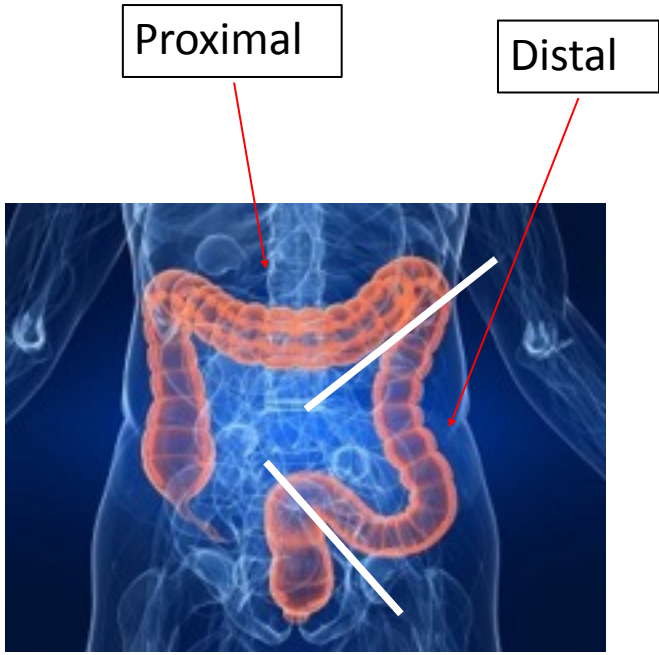


Colon cancer

- third most common type of cancer -> 10 % of all cancers
- sleep disturbances associated with higher risk of colon cancer

Study

- 328 proximal cases / 351 distal cases
- 10-y mean exposure to road noise
  - No association for proximal CC
  - 18 % higher risk per 10 dB for distal CC



Roswall et al, in press, CCC


Traffic noise and behavioral problems in children

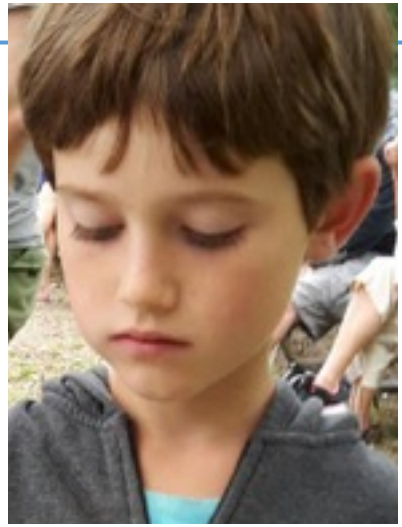
Behavioral problems in children

Traffic noise may affect child behavioral problems

- studies have shown inconsistent results

- Most studies focused on exposure to traffic noise at schools
- Traffic noise at home possibly more relevant (sleeping)?
- One study on road traffic noise at home (Tiesler et al., 2013)
  - 872 children, 10-y, SDQ, road traffic noise
  - 9 dB higher road traffic noise increased odds for hyperactivity/inattention by 28 % (OR = 1.28; 1.03-1.58)

Behavioral problems in children



- Danish study on 47 000 children
- Strengths and difficulties questionnaire
  - Screening questionnaire of child behavior
  - Measures mental difficulties in children

Findings

- Traffic noise at home during pregnancy
  - not associated with behavioral problems in children 7-y
- Road traffic and railway noise during childhood
  - associated with behavioral problems at age 7:
    - Hyperactivity/inattention
    - Peer relationship problems

Conclusions

Cardiovascular disease

- Association with ischemic heart disease
- Probably association with hypertension
- Probably association with stroke

Diabetes and obesity

- Possibly association w
- Possibly associ
- Possibl physical activity

Ca

ibly association with some cancer types

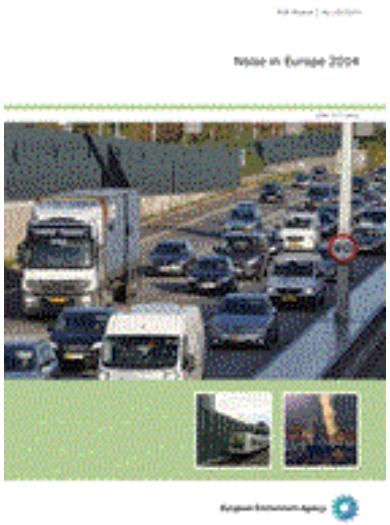
Behavioral problems (children)

- Possibly association with behavioral problems

MORE STUDIES ARE NEEDED

European Environment Agency

Report: “Noise in Europe, 2014”



- Transportation noise causes each year:
  - at least 10 000 cases of premature death in Europe each year
  - over 900 000 cases of hypertension are caused by environmental noise each year
  - 43 000 hospital admissions in Europe per year

Based on associations with hypertension, ischemic heart disease and stroke

Questions