Health effects of road traffic noise

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How can noise affect health?

Traffic noise

Stress Annoyance

Disturbance of sleep

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)

Lifestyle habits (smoking, alcohol, physical activity)
Disturb circadian rhythm
↓ immune system
↑ oxidative stress

Cardiovascular disease
Obesity, diabetes
Cancer

Which diseases?
Traffic noise and CVD

Coronary heart disease

Hypertension

• Many studies
• Evidence is good
Coronary heart disease

- 10 dB increase -> 6% increase in risk
- Babisch, road traffic noise:
  10 dB increase -> 8% increase in risk

Vienneau et al, 2015, Environ Res
Hypertension

5 dB increase in road traffic noise -> 3.4% increase in risk

Van Kempen and Babisch 2012, J Hyperten
Traffic noise and health

- Coronary heart disease
- Hypertension
- Stroke
- 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

- Central Population Registry (1971)
  - all present and historical addresses from 1987-2011
- The National Patient Registry (1977) - all hospital submissions
- The Cancer Registry (1942)
Estimation, road traffic noise

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

AirGIS – dispersion model for estimation of air pollution
Study design

For each disease
• Estimate traffic noise for cases, e.g. mean 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
Traffic noise and stroke

Sørensen et al, 2011
- 57,000 / 1,881 strokes
- 10 dB rise in road traffic noise -> 11% increase in risk for stroke (1.04-1.19)

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

One Swiss study
10 dB road -> 5% increase in risk for stroke mortality
Traffic noise and obesity

Danish studies
• association between traffic noise and obesity in adults
• association between traffic noise and obesity in children

• Two Swedish studies: association between traffic noise (road and aircraft) and obesity (Pyko et al; Eriksson et al)
• One Norwegian study find no association (Oftedal et al)
Traffic noise and diabetes

Sørensen et al 2013

- 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))

- New study from Switzerland found similar results (Eze et al, 2017); (10 dB increase risk by 35%)
Breast cancer
- Estrogen receptor positive: no association
- Estrogen receptor negative:
  - Road: 10 dB increase risk by 23 % (1.00-1.51)
  - Railway: 10 dB increase risk by 38 % (1.01-1.89)

Colon cancer
- Proximal colon cancer: no association
- Distal colon cancer: 10 dB increases risk by 18 % (1.00-1.40)

Non-Hodgkin’s lymphoma
- Road traffic noise > 65 dB increases risk for NHL with 18 % (1.01-1.37)
Conclusions

Cardiovascular disease
- Association with coronary heart disease
- Probably association with stroke

Diabetes and obesity
- Possibly association with diabetes
- Possibly association with obesity

Cancer
- Association with cancer uncertain due to very few studies

• 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, coronary heart disease and stroke
Questions?