National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Environmental Burden of Disease in the Netherlands

Skills building seminar:
Environmental Burden of Disease:
methods and applications

Henk Hilderink, Marjanne Plasmans, Marieke Verschuuren, Dieneke Schram, Brigit Staatsen and many others

European Public Health Conference
Marseille, 23 November 2019

Public Health Status and Foresight Studies

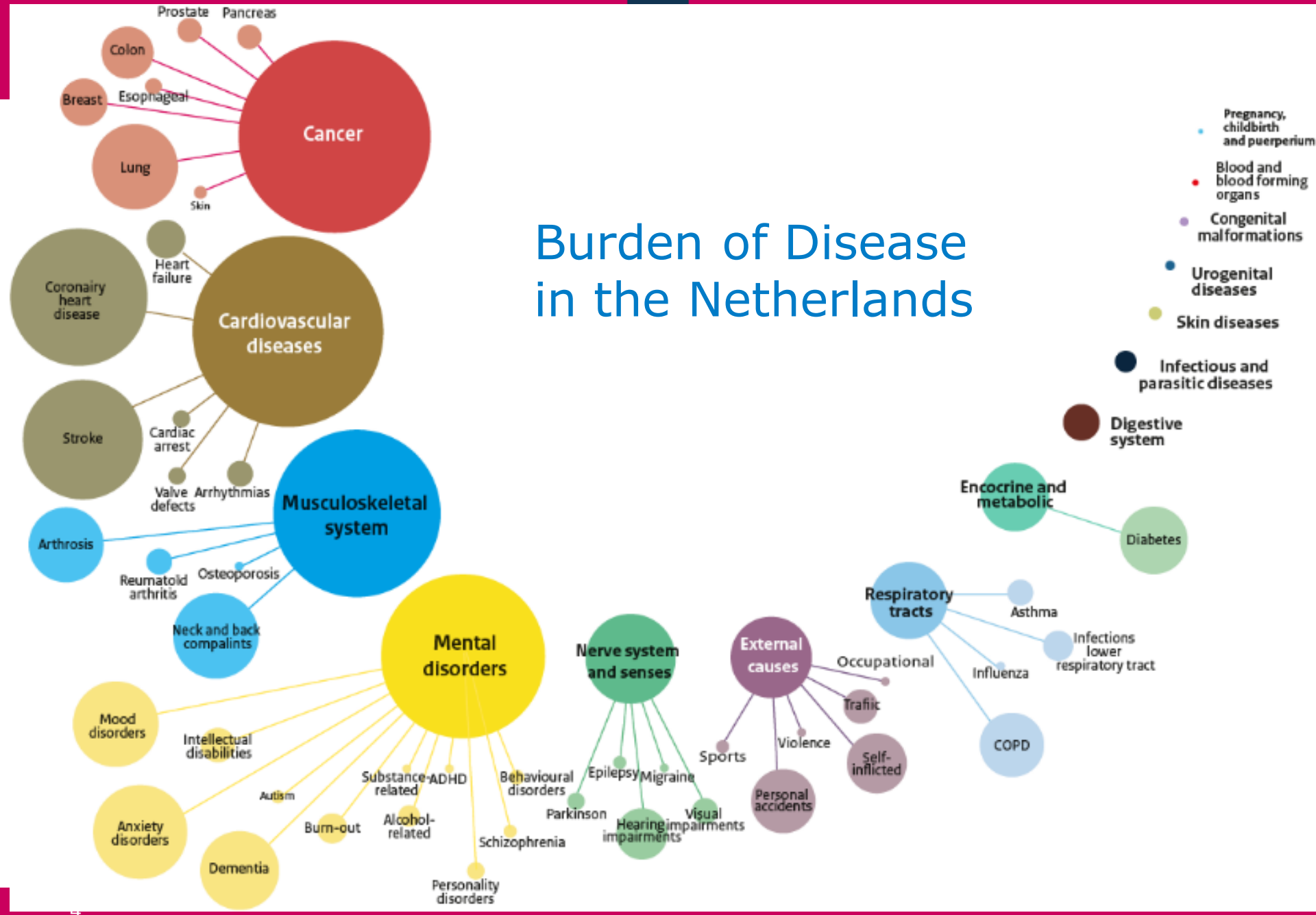
- Reporting on current and future developments in Public Health and Health care in the Netherlands
- Legal basis
- Every 4 years, first edition in 1993, VTV-2018 7th edition
- Input national and local public health policy
- Including Population Health Indicators (e.g. DALYs and Population attributable fractions)

Data & Methodology BoD 2018

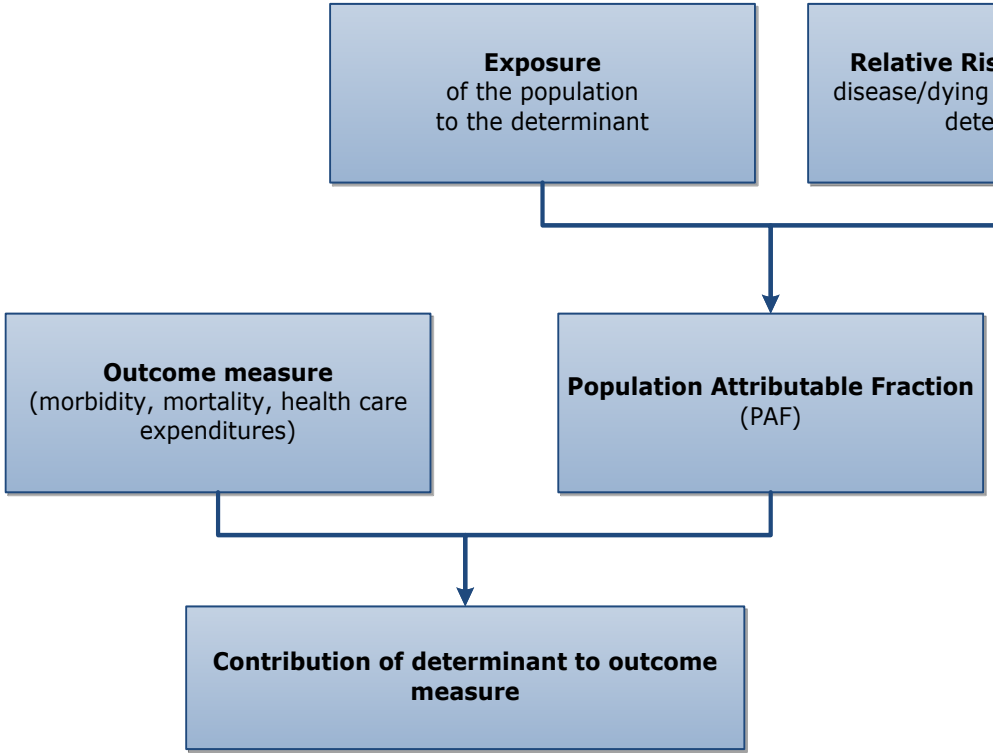
- Diseases / Causes of death (CoD)
  - All causes
  - 17 ICD chapters
  - Subdivided in 101 disease categories
  - By sex and 5-year age groups (0-1, 1-5 years separately for CoD)

- Data
  - Mortality: Cause-of-death statistics CBS-Statistics Netherlands
  - Morbidity: NIVEL Primary Care Database, NEMESIS, Dutch Cancer Registration, Injury Information System, …

Burden of Disease in the Netherlands



Methodology: Population Attributable Fraction



$$PAF = \frac{\sum_{i=0}^{k} P_i \times (RR_i - 1)}{1 + \sum_{i=0}^{k} P_i \times (RR_i - 1)}$$

Environmental determinants

- Outdoor Environment
  - Outdoor Air pollution (PM10, NO2, Ozone)
  - UV Radiation
  - Noise

- Indoor Environment
  - Secondhand Smoking
  - Dampness
  - Radon/Thoron
  - Carbon monoxide poisoning
  - *formaldehyde*

Outdoor environmental determinants: approach

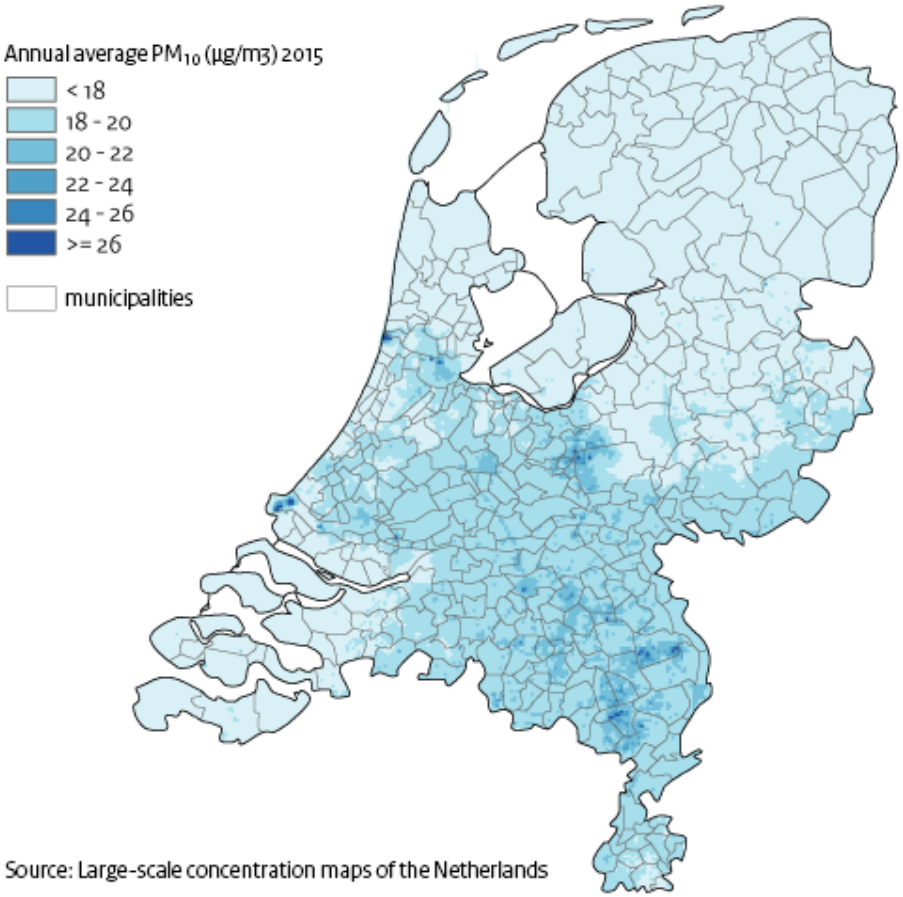
- Air pollution PM10/NO2 exposure
- Ozone (WHO HRAPIE, 2013)
  - Exposure: #days > 70 µg/ m3 (Source: ETC)
  - All cause (natural) mortality
- UV Radiation
  - PAF 90% (Slaper 2017 / TNO 2014)
  - Skin cancer (ICD10 C43-44)
- Noise (Houthuijs 2014, Van Kempen 2018)
  - Industry, planes, trains, road traffic
  - Threshold level of 53 dB (Lden, day-evening-night)
  - Coronary heart diseases (ICD-10: I20-I25) and stroke (ICD-10: I60-I64)

Noise from rail, road, planes, industry combined

Outdoor air polution

- Relative risks based on Fisher et al (2015):
  - Combined effects of PM10 and NO2
- Mortality of natural causes (ICD-10: A00–R99):
  - CoD of respiratory diseases (J00–J99), Cardiovascular diseases (I00-I99),lung cancer (C33–C34) and all other natural causes
- Morbidity based on PAFs of GBD (Lower respiratory infections, CHD, Stroke, COPD and lung cancer)
- Average exposure calculated based on concentration maps of NO2 en PM10 (1x1 km, 250x250m) weighted with population density
- Threshold 5 µg/m3 (PM10 or NO2)

Air quality:Pm10



Source: Large-scale concentration maps of the Netherlands

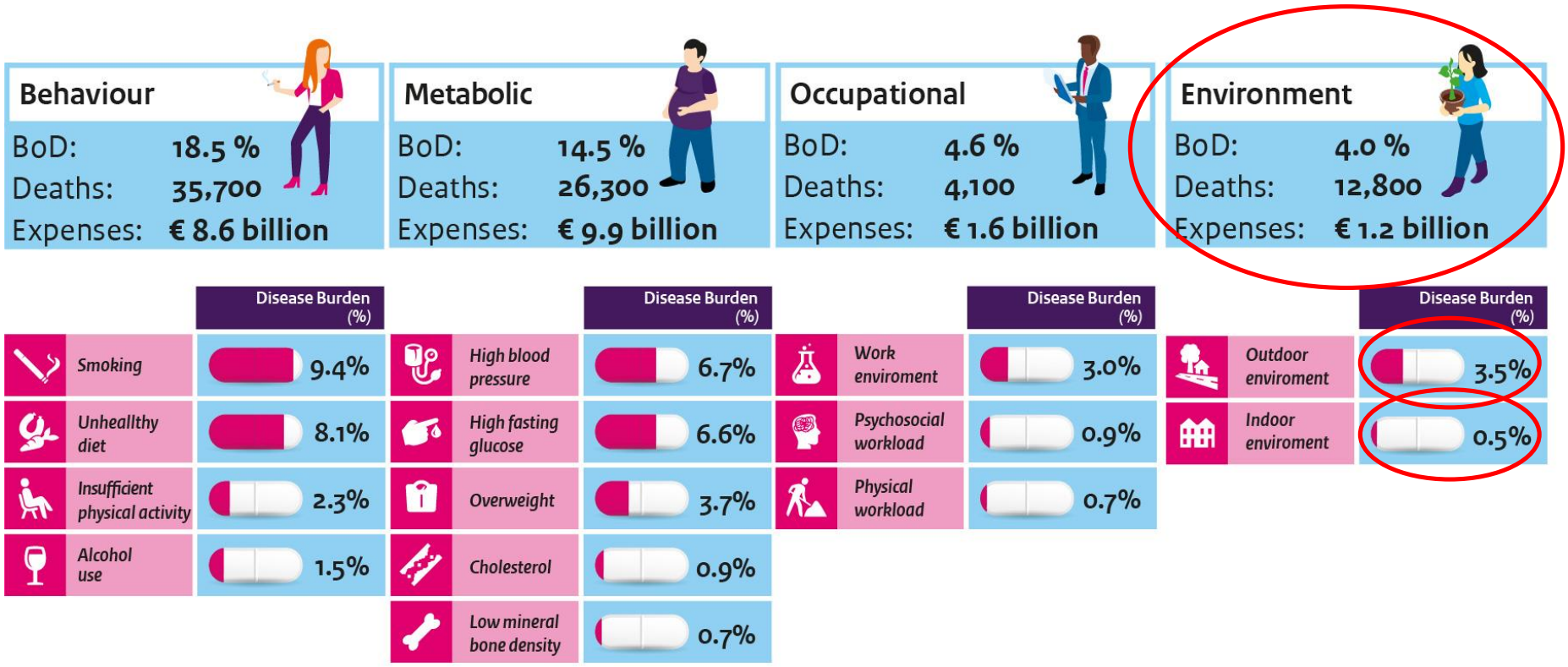
Indoor environment (Schram et al 2014)

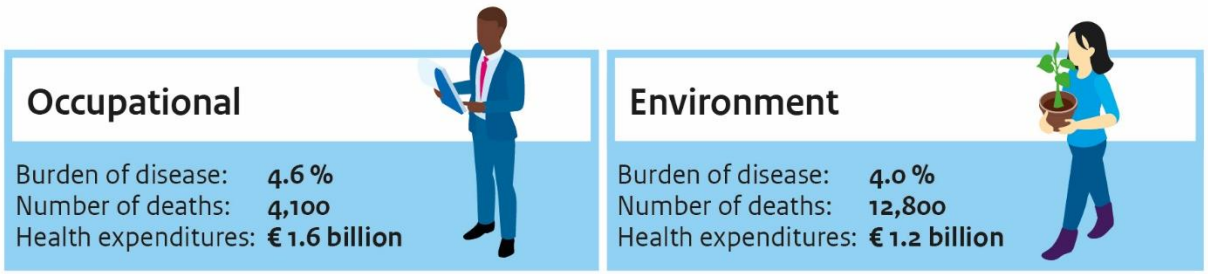
Table 1 Selected indoor air pollutants, health outcomes with severity weights and duration factors, exposure levels and the exposure–effect relationships

Air pollutants	Health outcomes	Exposure levels/percentage of population exposed	Exposure–effect relationship*	Severity	Duration (years)
Dampness	Upper respiratory tract symptoms	6–16%[19]	OR 1.70 (1.44–2.00), all[20]	0.01–0.03	0.04
	Lower respiratory tract infections (children)		OR 1.30 (1.00–1.70), 0–15 years[21]	0.03–0.10	0.04
	Asthma prevalence		OR 1.56 (1.30–1.86), all[20]	0.05–0.11	1
Carbon monoxide	Hospital admissions†	Not required in calculations	Not required in calculations	0.10–0.61	0.004 (children) 0.009 (adults)
Radon/thoron	Lung cancer†	0.45–0.74 mSv/year[18]	Derived from[22]	0.43–0.54	1.61
Formaldehyde	Asthma incidence (children)	4–25 μg/m^3[19]	OR 1.03 (1.02–1.04) per 10 μg/m^3, 0–3[23]	0.05–0.11	3.42
Environmental tobacco smoke	Lower respiratory tract infections (children)	18–40% of adult non-smokers[24]	OR 1.55 (1.42–1.69), 0–2[25]	0.03–0.10	0.04
	Asthma incidence	20–36% of children[24]	RR 1.32 (1.24–1.41), 0–14[26]	0.05–0.11	3.42 (children)
			OR 1.97 (1.19–3.25), 15+[27]		4.94 (adults
	Ischaemic heart disease†		RR 1.27 (1.19–1.36), 15+[25]	0.22–0.35	10
	Sudden infant death syndrome		RR 1.94 (1.55–2.43), 0–1[28]	1	76.1
	Otitis media (children)		RR 1.38 (1.21–1.56), 0–3[26 29]	0.31	0.06
	Lung cancer†		RR 1.21 (1.13–1.30), 15+[26]	0.43–0.54	1.61

*OR, Odds Ratio; RR, Relative Risk.
†Mortality was also taken into account, with a severity factor of 1 and duration (years of life lost) of 31.9 for carbon monoxide poisoning, 14.1 for lung cancer and 9.5 for ischaemic heart disease.

Disease burden by determinant





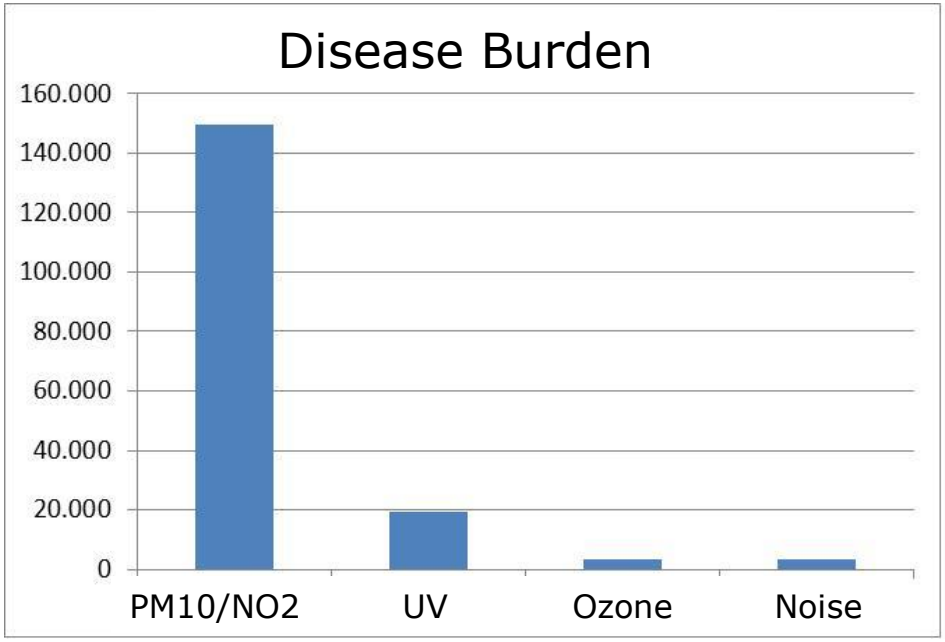
Occupational

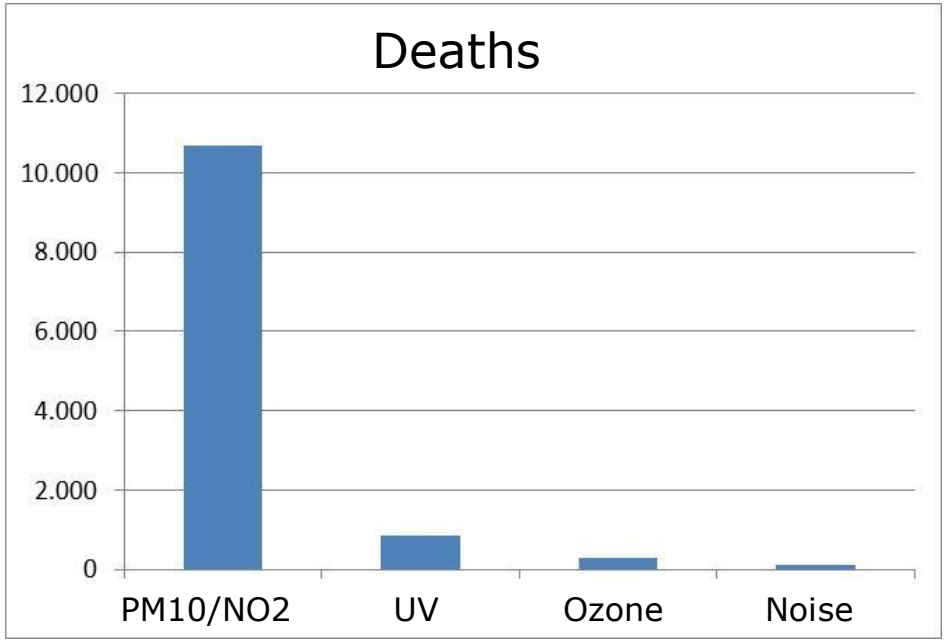
	BURDEN OF DISEASE (%)	NUMBER OF DEATHS (x1000)	HEALTH EXPENDITURES € (x billion)
Work environment	3.0%	4.1	1.1
Psychosocial workload	0.9%	0.0	0.2
Physical workload	0.7%	0.0	0.3

Environment

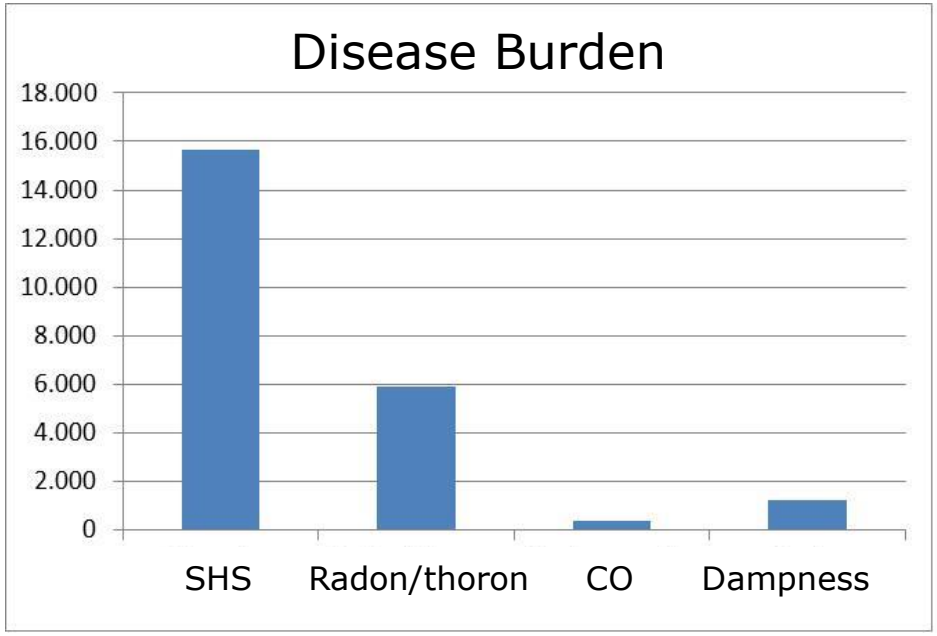
Outdoor environment	3.5%	11.9	0.8
Indoor environment	0.5%	1.1	0.4

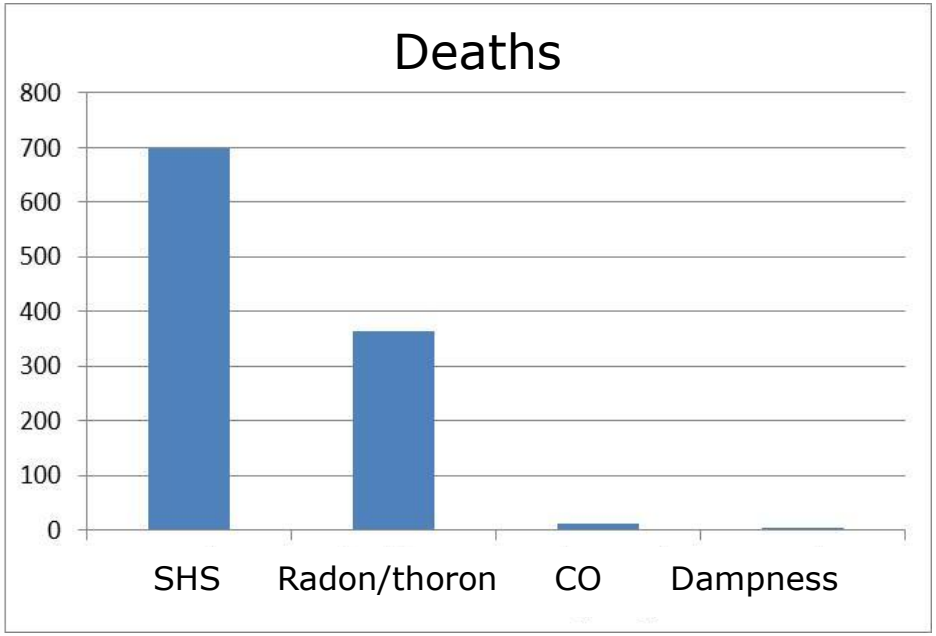
Outdoor Environment





Indoor Environment





Findings / Discussion

- Air Pollution by far the largest cause of environmental disease burden (but smaller than before)
- Many different studies for Relative Risks (lot of discussion)
- Other outcome indicators (e.g. noise and odor annoyance, IQ loss) relevant but not included

Epidemiology can not give you nine lives, but can make you die a thousand deaths…

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Thank you

Henk.Hilderink@rivm.nl

All data and results:
www.vtv2018.nl/en