

The Relation between Targets for Noise Emission and Public Health

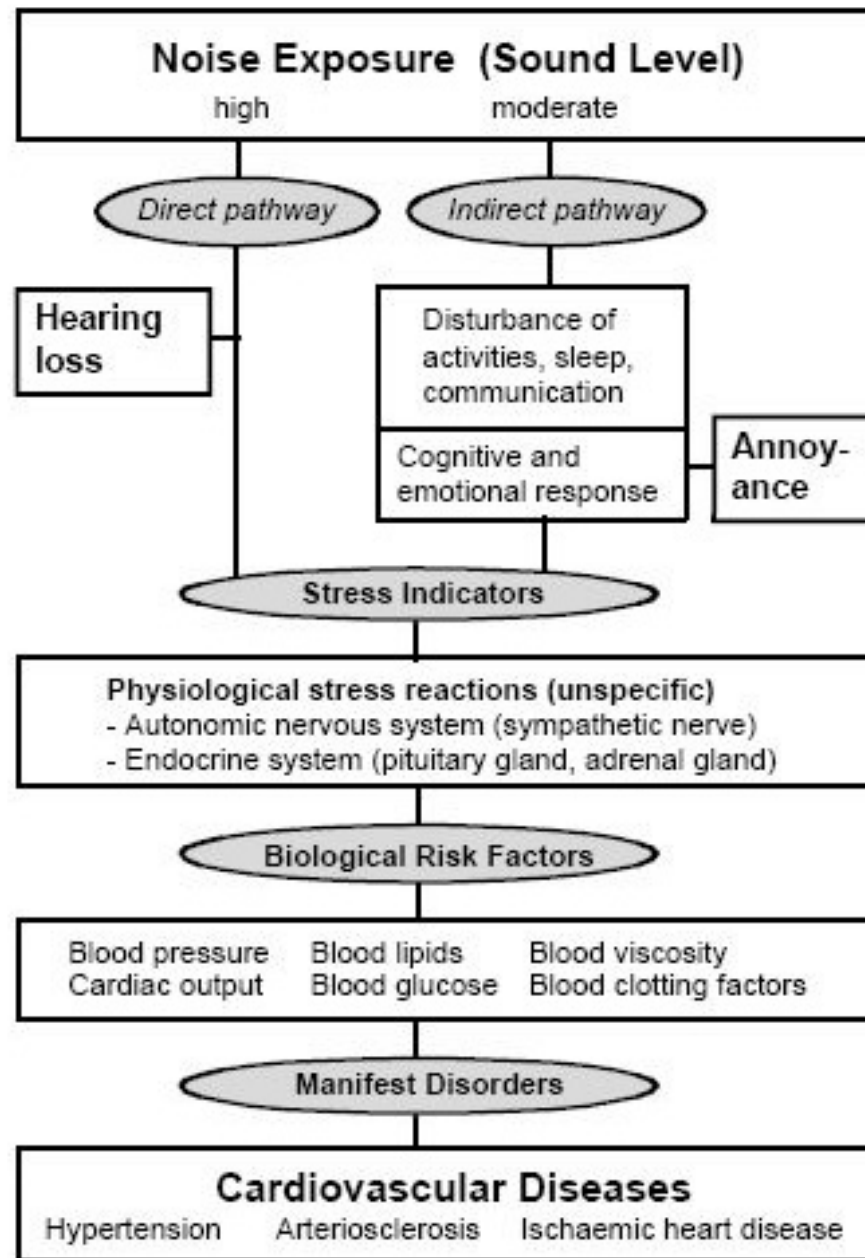
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Stress model



Effects of noise on health and wellbeing

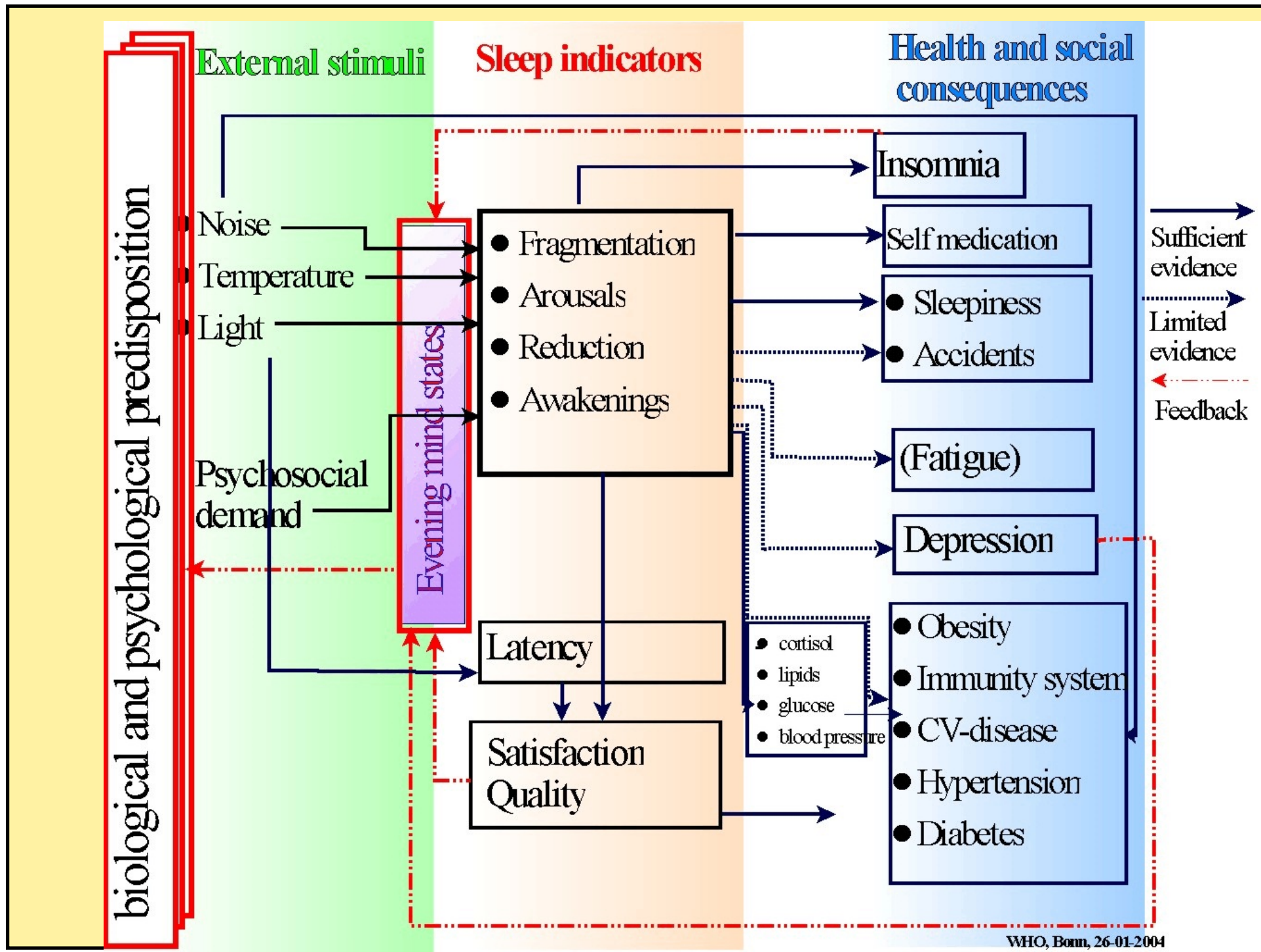
Threshold levels for effects for which sufficient evidence*) is available

Effect	Where	Indicator	Level	
Hearing damage	Work	LAeq, 8hr>	75	inside
	Sport	LAeq, 24 hr>	70	inside
Hypertension	Work	LAeq, 8 hr>	80	inside
	Home	LAeq, 16hr>	55	outside
Cardio-vasculair	Home	LAeq, 16hr>	60	outside
Sleep disturbance	Home	Lnight	30	outside
Annoyance	Home	Lden	42	outside
Learning	School	LAeq, 12 hr>	60	outside



*) According to IARC-criteria





Effects on health and well-being during sleep

Sleep quality

- Reduced perceived sleep quality Sufficient evidence
- Difficulty getting to sleep, difficulty staying asleep Sufficient evidence
- Sleep fragmentation, reduced sleeping time Sufficient evidence
- Increased average motility when sleeping Sufficient evidence

Well being

- Sleep disturbance Sufficient evidence
- Health problems Sufficient evidence
- Use of somnifacient drugs and sedatives Sufficient evidence
- Increased daytime irritability Limited evidence, plausible
- Impaired social contacts Limited evidence, plausible
- Impaired cognitive performance Limited evidence, plausible

Medical

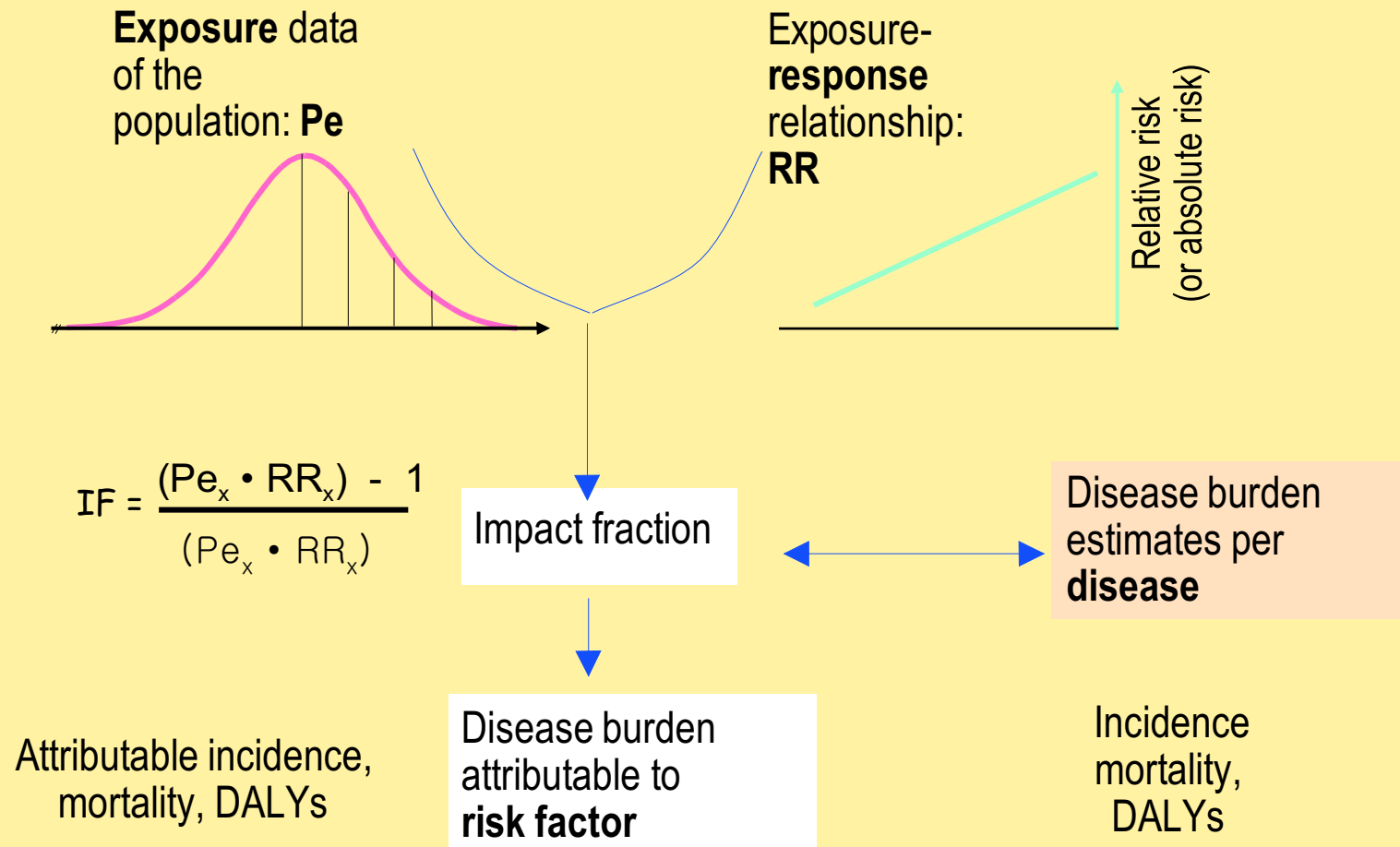
- Insomnia Sufficient evidence
- Hypertension Limited, indirect evidence, plausible
- Depression (in women) Limited, indirect evidence, plausible

Premature mortality

- Cardiovascular disease Limited, indirect evidence, plausible
- Occupational accidents Limited, indirect evidence, plausible

The WHO Burden of Disease Project

EBD method

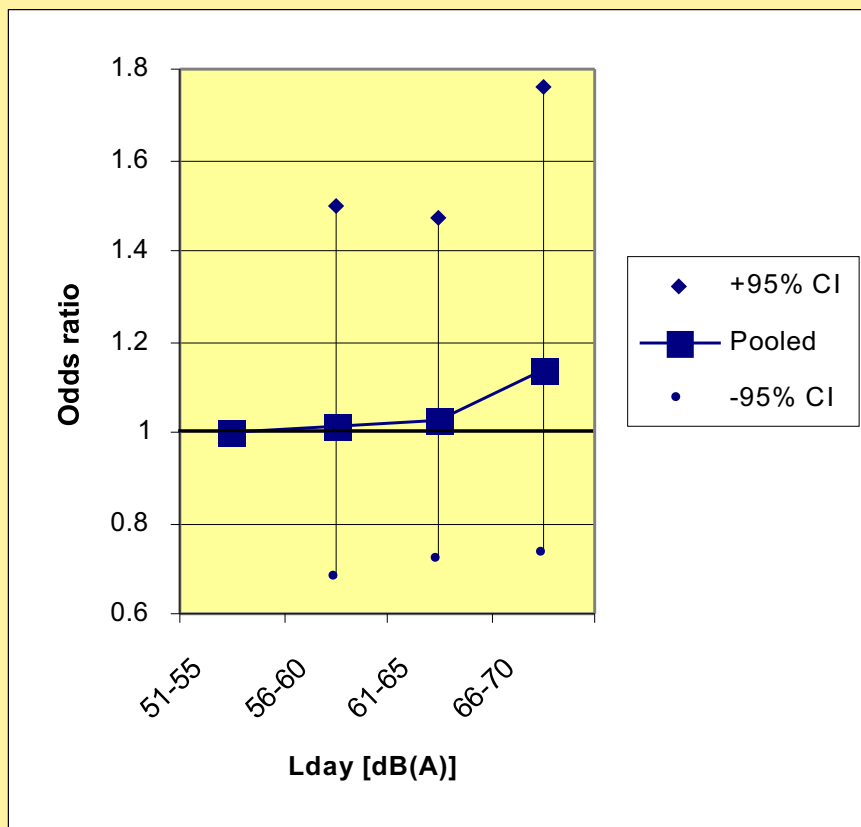


Burden of CVD from road traffic noise

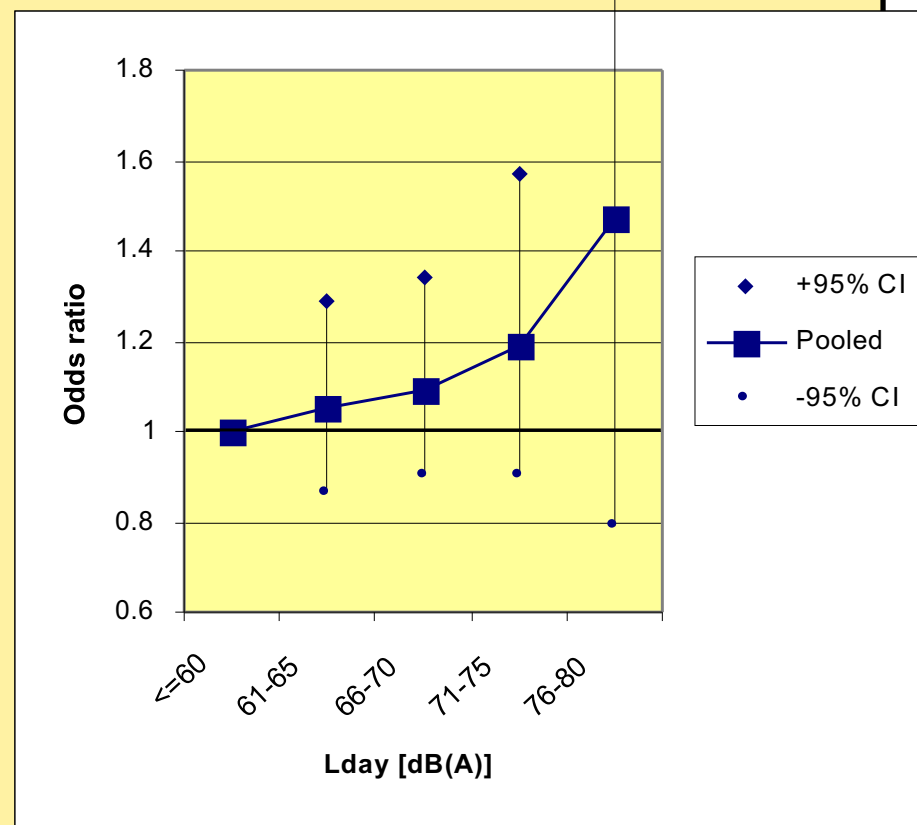
- Meta-analyses by Babisch
 - ▶ Exposure: Road traffic noise (Lday)
 - ▶ Outcome: Myocardial infarction
 - ▶ ER relation: pooled from case-control and cohort studies
- Impact fractions in countries with available exposure data
- Estimate DALYs for EURO sub-regions by extrapolation

Noise and MI risk relationship

Descriptive studies (CS)



Analytic studies (CC, CO)



DALY for IHD from road traffic noise in Europe

- Assumptions
 - ▶ Similar exposure patterns in industrialized countries
 - ▶ Sub-regional impact fraction = 3%
 - ▶ Same effects on men and women
 - ▶ Same ER relations for all IHD
- EBD from noise = Impact fraction of DALYs for IHD (reported by WHO Global Burden of Disease Study)

DALY for IHD attributable to road traffic noise in Western Europe (EUR-A), 2000-2002

	2000	2001	2002
MEN	4066000	4916000	4504894
Impact of traffic noise	121980	147480	135147
WOMEN	2970541	3144000	2828662
Impact of traffic noise	89116	94320	84860
Total impact of traffic noise	211096	241800	220007

Burden of annoyance in EU: exposure-based

	% Pop. exposed	% of people HA	Pop.	DALYs, SW 0.02 >
Noise levels, Lden				
< 55 dB(A)	46%	2.9		97640
55 – 65 dB(A)	42%	10.7		330289
66 – 75 dB(A)	11%	26.3		218219
> 75 dB(A)	1%	45		20946
Total	100%		366.5	667094

updated by using
most recent
exposure data

Summary of findings

Outcome	Exposure	Outcome	ER Relation	Impact fraction	DALYs in EUR-A
Cardiovascular disease	Traffic noise L _{day}	MI and IHD	Pooled estimate	3% of IHD	211 096
Sleep disturbance	L _{night}	Severely disturbed	Pooled estimate	2% of population	?
Annoyance	L _{den} and L _{dn}	Highly annoyed	Pooled estimate	15% of population	667 094
Tinnitus	Traffic and leisure noise	Ringling sound causing sleep disturbance	Not available	3% of tinnitus (0.75% of population)	9 328
Cognitive impairment	L _{dn}	Reduction in cognitive	Hypothetical curve	0.01%	45 036
Hearing loss	Leisure noise	Moderate hearing loss	ISO	0.02% of 6-19 years old	6 800

Comparison with other environmental risks

Total impact of traffic noise	211096
	EUR A
Injuries in children 0-19, 2001	894947
Road traffic noise burden of IHD, 2000	211096
Occupational noise	164000
Outdoor air pollution	151000
Poor water and sanitation, 2001	25946
Pb burden of MMR, children 0-4	14092

Limit Values

Country	planning value	maximum limit (new situations) >	remarks
BRD	day 55 night 45	day 59 night 49	Higher value for mixed areas >
Switzerland	day 50 night 40	day 55 night 45	Higher value for mixed areas >
Austria	55		L _{Aeq} 24 hr
France	dag 60 night 55	65	L _{Aeq} 8-20.00 hr > night 22-06
Denmark	55		L _{Aeq} 24 hr
UK	day 55 night 45	day 72 night 66	day from 07.-23. >
Netherlands	day 55/52 night 45/42 >	day 58/62/70 > night 48/52/60 >	35 dB(A) inside > 25 dB(A) at night >
Sweden	55		30 dB(A) inside >

WHO-guidelines 2000

Specific environment	Critical health effect	[hours]	LAeq	LAmx
Outdoor living area	Serious annoyance	16	55	
	Moderate annoyance	16	50	
Dwelling, indoors	Speech intelligibility	16	35	
	sleep disturbance	8	30	45
outside bedrooms	sleep disturbance	8	45	60
school class rooms	Speech intelligibility	class hr	35	

Highly Annoyed

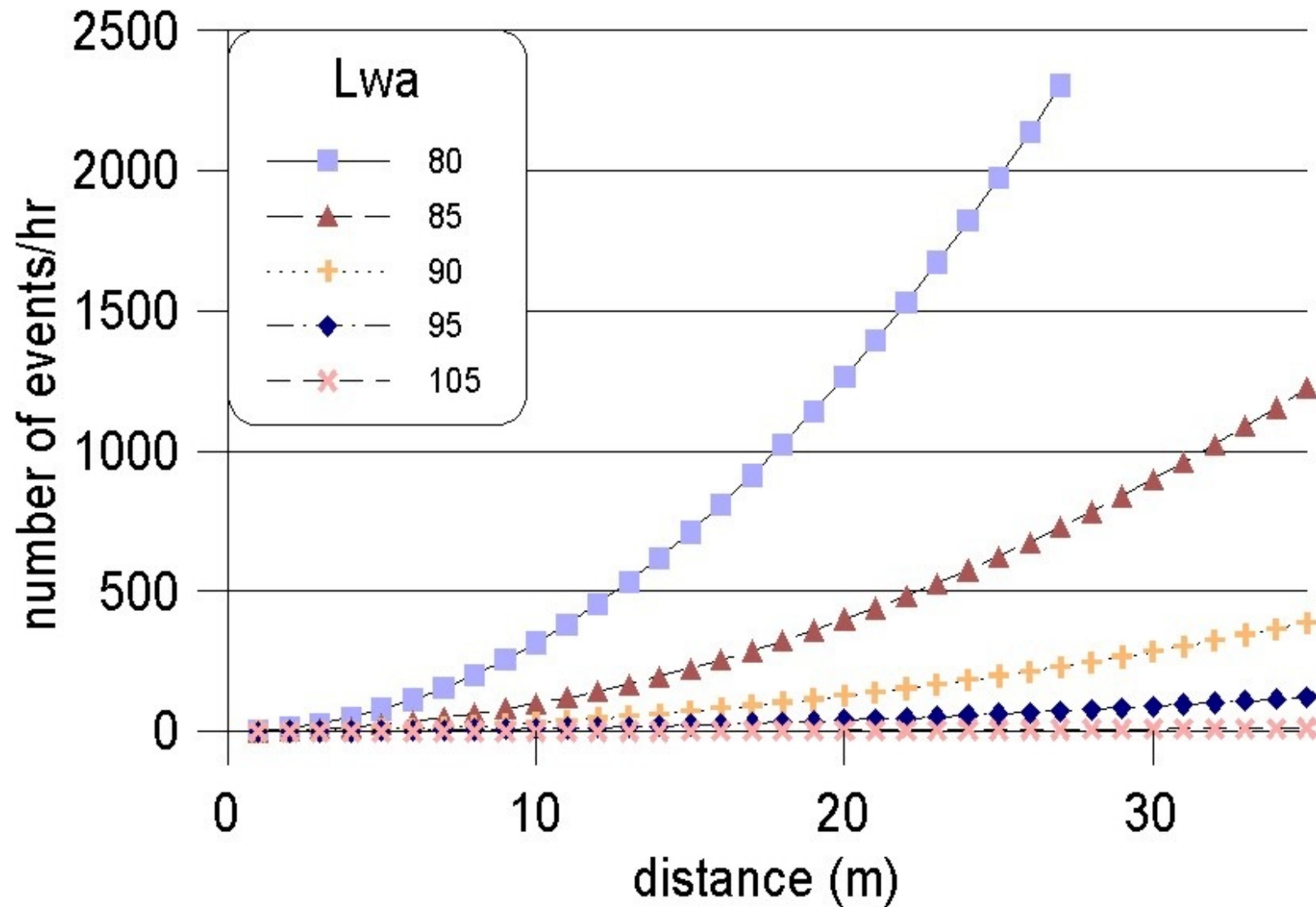
	Road	Rail	Aircraft	Industry
50 Lden	3%	2%	5%	5%
55 Lden	4%	4%	10%	8%

	Road	Rail	Aircraft	Industry
40 Lnight	3%	1%	4%	3%
45 Lnight	4%	2%	5%	4%

For the present purpose 50 Lden (40 Lnight) is assumed as the long term target

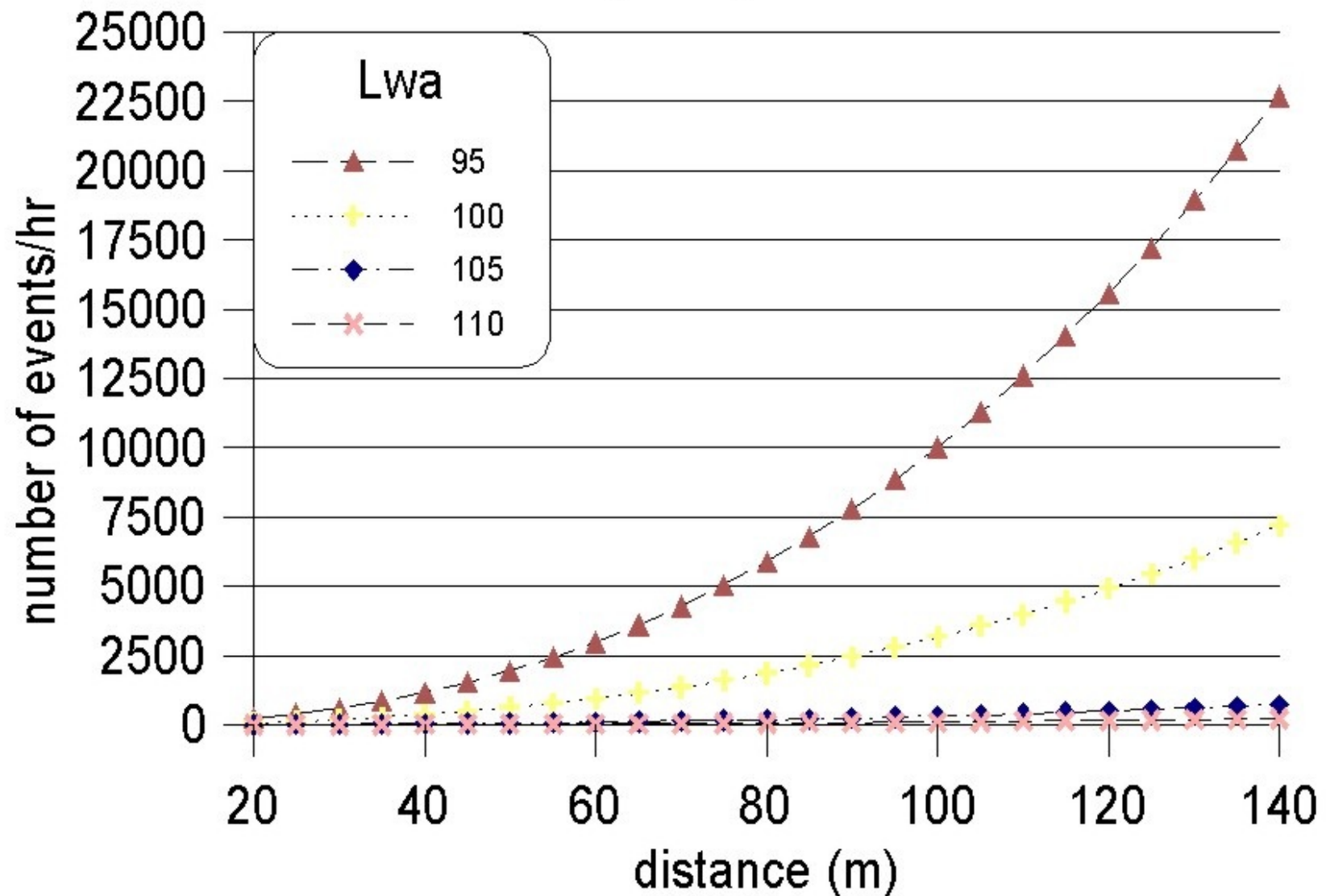
Number of events for 50 LAeq

Short range



Number of events for 50 LAeq

Medium range, high volume



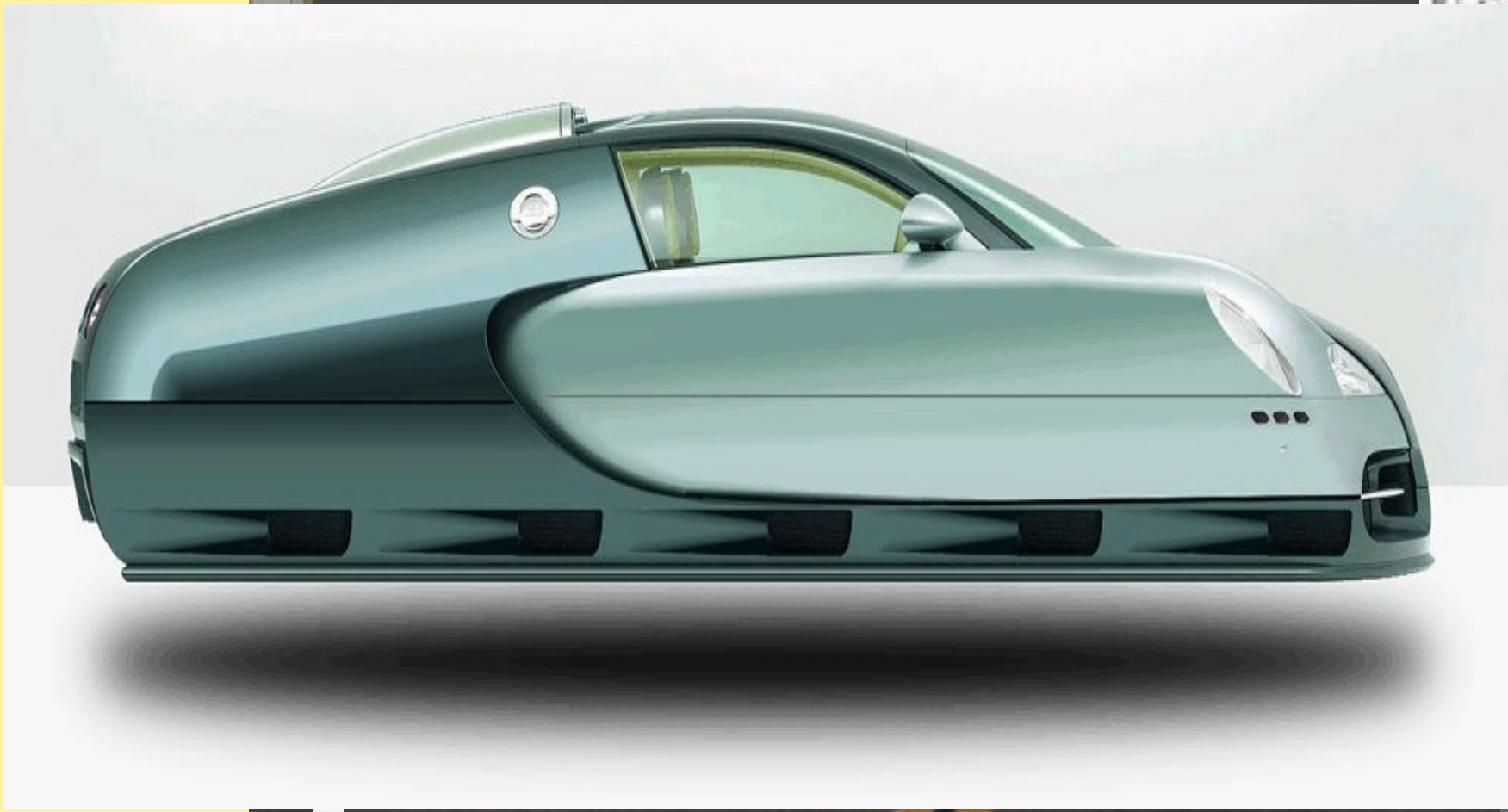
Design Targets

Range of distance	design target L _{wa}	Estimated L _{max}
5-25 m urban road	80	55 (7.5m)
25-100 m railway	105	70 (25 m)
25-100 m motorway	95	70 (7.5m)
>500 m airport	120	60 (300 m)

Realistic Targets?

	Target	Range of Lwa	Effect of Best practice
Short range:			
cars, vans low speed (<50 km/hr)	80	85-95	-3: quiet tyre -5: quiet road surface
Short range: streetcars, metro	80	90-100	-5: smooth rail/wheel
Short range: outdoor machinery	80	82-108	
Medium range rail			
passenger trains	105	110-130	-3: smooth rail/wheel surface> -5: auxillary equipment
Medium range rail			
freight trains	105	125-130	smooth surfaces -3 wheel absorbers -5 : wheel screens
Medium range motorway			
cars (120 km/hr)	95	100-105	-3: quiet tyres -5:road surface
Medium range (>20 /hr)			
heavy duty	95	105-115	-3: quiet tyres -5: road surface
airplanes (>20000 kg)	120	125-170	

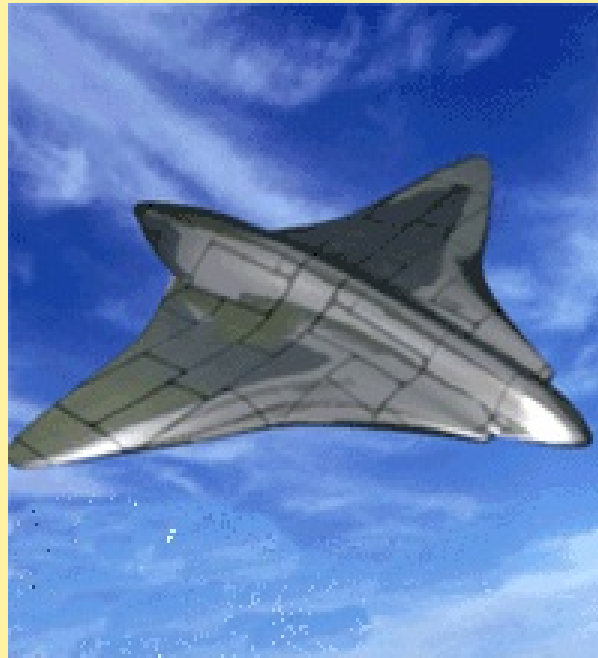
Redesign?



Conclusions

- Long term environmental goals give an indication of design targets for machines
- Current technology doesn't succeed in reducing sufficiently the health impact
- Needed: more studies to verify these data
 - ▶ Scenario-studies
 - ▶ Cost-benefit issues
 - ▶ Design targets
- First impression: targets are well in reach of today's technology

Thank you for your attention



Classification of evidence

■ Sufficient evidence

- ▶ A causal relation has been established between exposure and an effect. In studies where coincidence, bias and distortion could reasonably be excluded, the relation could be observed and it is plausible that the effect is (also) caused by the exposure.

■ Limited evidence

- ▶ A relation was observed between exposure and an effect in studies where coincidence, bias and distortion could not reasonably be excluded. The relation is, however, plausible. A direct relation between cause and effect has not been observed, but there is indirect evidence of good quality and the relation is plausible. Indirect evidence is assumed if exposure leads to an intermediate effect and other studies prove that the intermediate effect leads to the effect.

■ Insufficient evidence

- ▶ Available studies are of low quality and lack significance to allow conclusions about causality of the relation between exposure and effect. Plausibility of the relation is limited or absent

