




Urban road traffic noise

Exposure and human response in a dense, high-rise city in Asia



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PREAMBLE

Action on **road traffic noise** requires knowledge of:

- exposure of the community
- relationships between exposure and human response.

Extensive reporting on both over the decades but:

- most has been from cities in Europe and North America.


Growth of urban traffic noise problems is a corollary of:

- economic development
- urbanization, and
- motorization

There are global transformations occurring in these factors:

- in Asia and elsewhere, dense, traffic intense, and usually high-rise cities (and megacities) are increasingly the norm.

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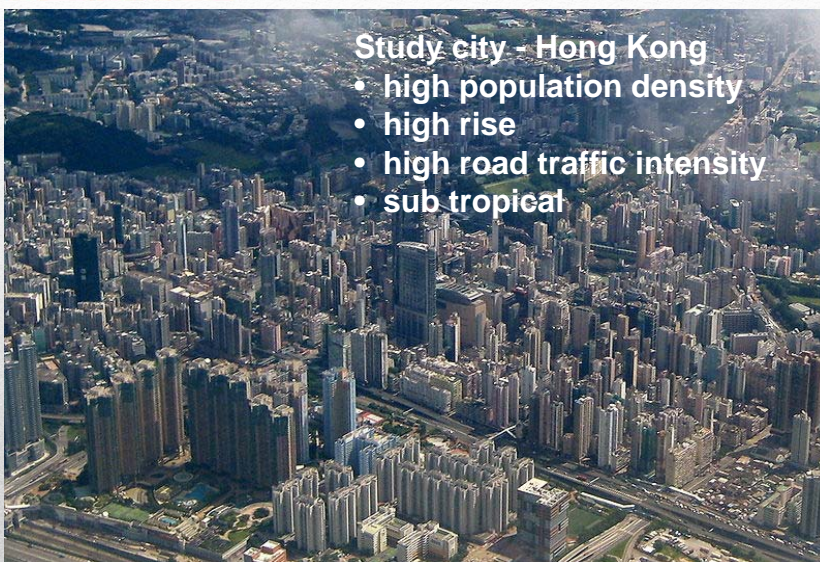




Some urban geography.....

- global shift in the locus of urbanization
- by 2025 > half of the 25 megacities of the world will be in Asia.... (UN Habitat 2013)
- ...and will be located in the tropics or sub-tropics
- HK city form: high-density, high-rise, dense road traffic - is being emulated elsewhere (Lau 2011).

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Study city - Hong Kong

- high population density
- high rise
- high road traffic intensity
- sub tropical

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The Study

Road traffic noise in HK

- exposure of the population
- human response
 - annoyance
 - self-reported sleep disturbance
- exposure-response



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Focus of this presentation:

Methods and (some) results of the HK study


- Largest ever exposure-response studies of transport noise?
- Sets a benchmark for future studies.

Comparison of HK population exposure to Europe.

Comparison of HK exposure-response relationships with previous syntheses

How should we compare exposure-response relationships?

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HK study: methods

- Sampling frame: population of all residential addresses in the HK SAR - 2.2m households ~7m people (2010)
- Interviews conducted by the Census and Statistics Department – routine thematic household survey
- Random selection of adult in each household (18+ years)
- Rigorous data verification protocol



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HK study: methods

- Noise questionnaire designed to best international practice (ISO/TS 15666, 2003)
- Annoyance, and Annoyance at Night – 10 point scales
- Self-reported sleep disturbance - 10 point scales
- Questionnaire prepared in Cantonese, Mandarin and English – translation crosscheck.
- Verbal annoyance descriptors in Cantonese derived from study akin to that for Mandarin (Ma et al. 2003)

10,077 completed interviews

76% response rate

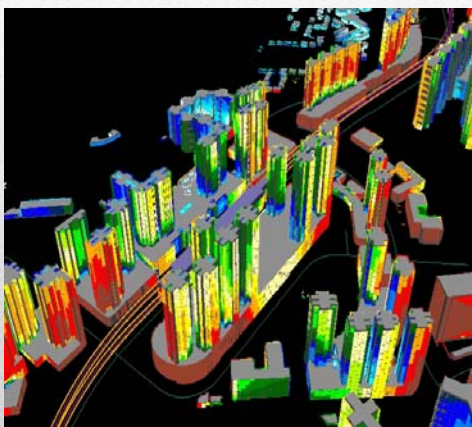


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HK Study: Methods

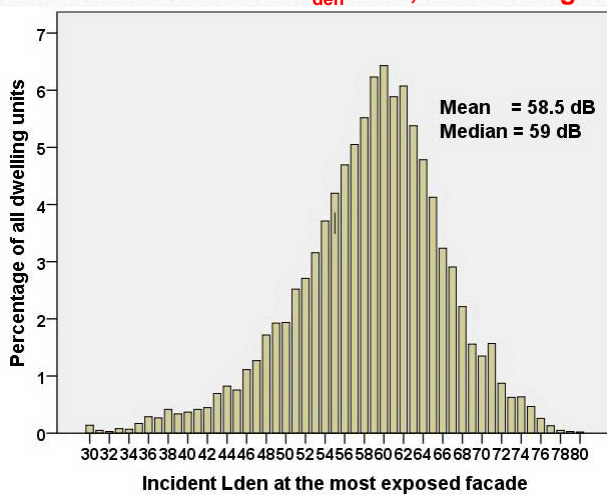


- City-wide traffic noise mapping used 3D technology (Law et al. 2011)
- Level of road traffic noise incident on façade modelled individually for **each** of 10,077 dwellings

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Road traffic noise L_{den} at 10,077 dwellings



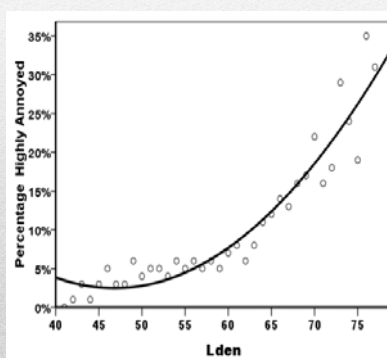
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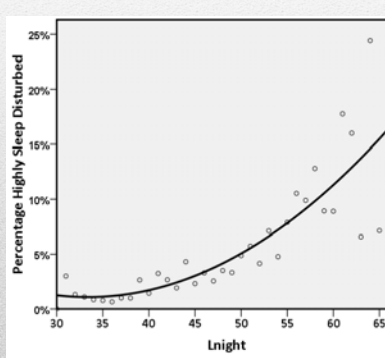


Exposure-response - quadratic best fit

% Highly Annoyed



% Highly Sleep Disturbed



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Estimates of the proportion of the population of Hong Kong annoyed, or sleep disturbed, by road traffic noise

	% of the sample	95% confidence interval of the % in the HK population
Annoyed with road traffic noise (over whole day)		
Highly annoyed	11.2%	10.9 to 11.5%
Annoyed	30.5%	30.0 to 31.0%
(at least) A little annoyed	50.6%	50.1 to 51.1%
Annoyed with road traffic noise (at night)		
Highly annoyed at night	5.2%	5.0 to 5.4%
Annoyed at night	19.5%	19.1 to 19.9%
(at least) A little annoyed at night	39.2%	38.7 to 39.7%
Sleep disturbed by road traffic noise		
Highly sleep disturbed	5.6%	5.4 to 5.8%
Sleep disturbed	14.0%	13.7 to 14.3%
(at least) A little sleep disturbed	30.0%	29.5 to 30.5%

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Traffic noise questions

...that arise from changing urban geography

Is the exposure of the population in a city such as HK different from “western” cities?

.....popular notions/anecdotal information

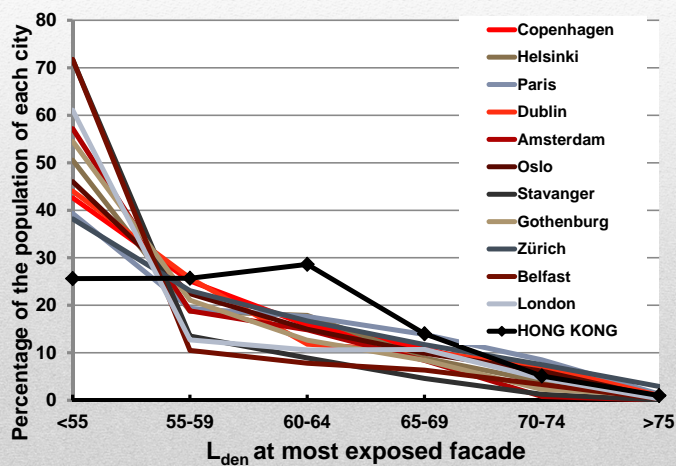
Are responses in a city such as HK the same or different to elsewhere?

.....different buildings, climates, behaviours, peoples...

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Exposure to road traffic noise in HK compared to a selection of European cities (EEA 2013)



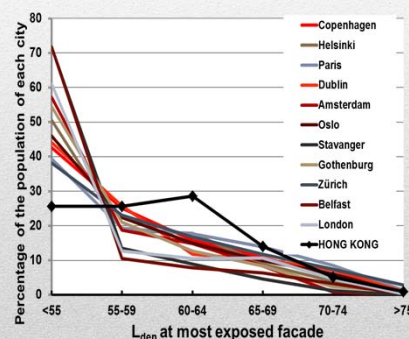
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Summary: comparing HK and European exposures to road traffic noise

- differences are striking, and consistent across cities
- at higher levels, HK exposure similar to European cities
- much higher proportion of HK population are exposed to moderate levels (60-64 dB)
- much lower proportion of HK are exposed to the lower levels (< 55 dB).....no "quiet areas".



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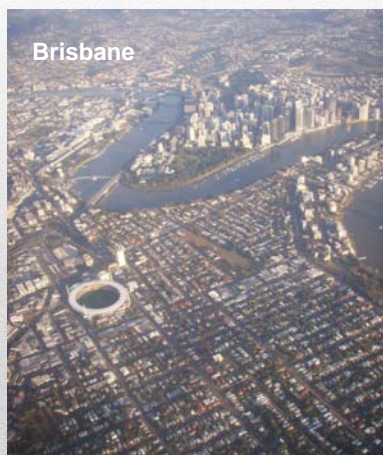


The absence of shielding by the urban fabric?

Hong Kong



Brisbane



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Traffic noise questions ...that arise from this changing geography

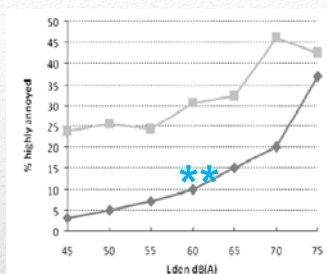
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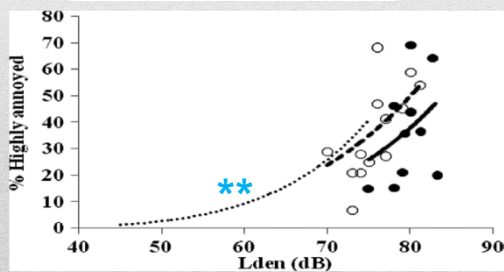
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Previous examples that compare a new exposure-response curve to the “norm” – eg to the synthesized curve of Miedema and Oudshoorn (2001)**

Belgrade study: Jakovljevic et al. (2009)



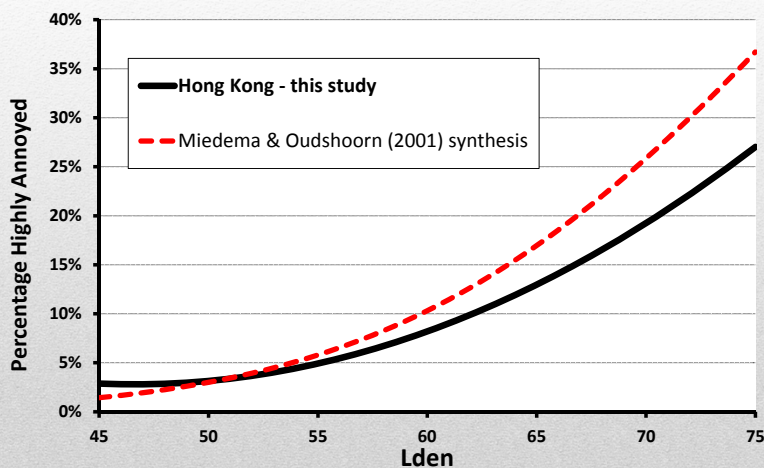
Hanoi & Ho Chi Minh: Phan et al. (2010)

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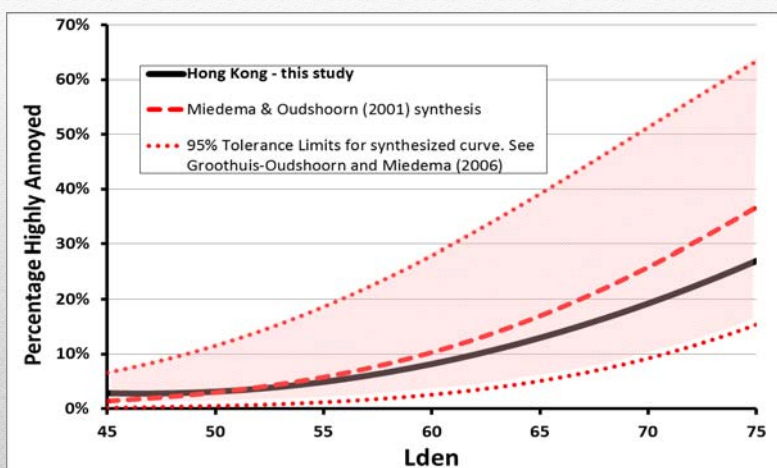
Exposure-response %HA with road traffic noise in HK compared to a previous synthesis



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Exposure-response %HA with road traffic noise in HK compared to a previous synthesis: with Tolerance Limits

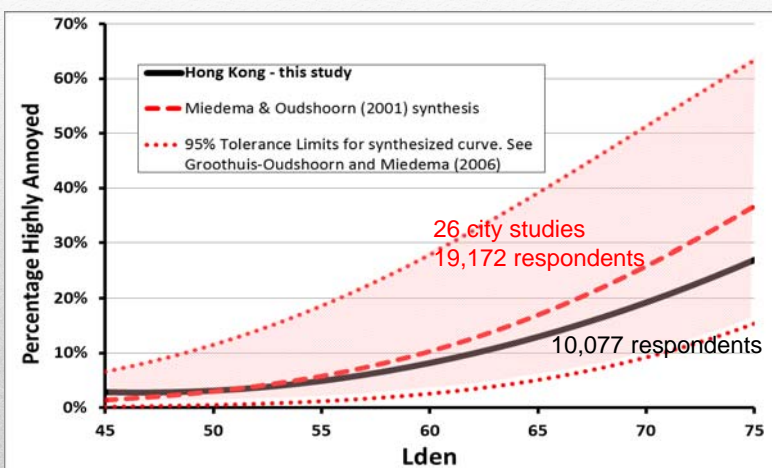


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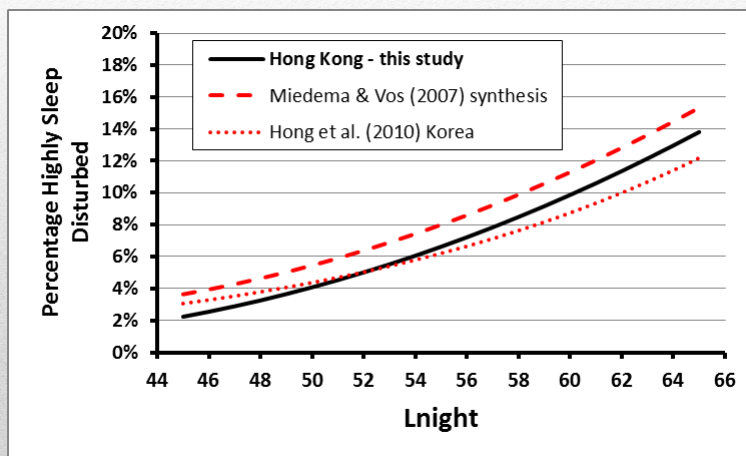
Exposure-response %HA with road traffic noise in HK compared to a previous synthesis: with Tolerance Limits



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Comparing %Highly Sleep Disturbed with road traffic noise in HK compared to a previous synthesis/study

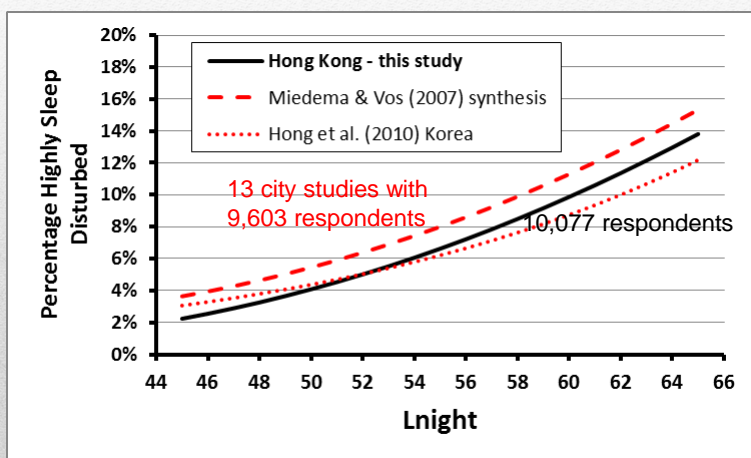


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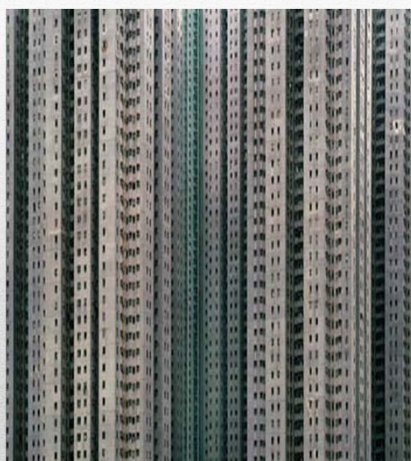


Summary...1

Exposure and response has been measured for each of 10,077 Hong Kong residents (one of the largest exposure-response studies for road traffic noise)

Hong Kong is not a noisier city at high levels, but has more exposed at 55-69 dB; less exposed to low levels

Future large cities will likely reflect the urban form of Hong Kong



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Summary...2

Existing annoyance/sleep disturbance syntheses have been constructed primarily on “western” data

Response curve comparison should be based on *tolerance limits* of previous syntheses

HK annoyance and sleep disturbance exposure-response are **not** different

Thank you

