

For discussion on  
11 January 2013

**LEGISLATIVE COUNCIL**

**PANEL ON ENVIRONMENTAL AFFAIRS**

**SUBCOMMITTEE ON ISSUES RELATING TO  
AIR, NOISE AND LIGHT POLLUTION**

**Impact of Air, Noise and Light Pollution on Public Health**

**Purpose**

This paper informs Members of the impact of air, noise and light pollution on public health and the associated medical costs in Hong Kong.

**Air Pollution and Public Health**

2. Air pollution can have both short-term and long-term adverse health effects, particularly on the respiratory and cardiovascular systems, depending on factors such as the concentrations and nature of the pollutant, the receptor's age and general state of health, and the duration of exposure. The major health effects of common air pollutants are presented at Annex.

**Hospital Admissions, Mortality and Medical Costs Associated with Air Pollution**

3. The World Health Organization (WHO) accepts the worldwide practice of using epidemiological studies for establishing the exposure-response relationship between air pollutants and their adverse health effects, which could be higher risk of premature-death, increased hospital admission, etc. related to the respiratory and cardiovascular systems. Due to the differences, in particular, in the exposure levels and patterns, it is appropriate for individual city, region, country or economy to make its specific quantitative analysis on the impact on health of air pollution.

4. When estimating the implications of a certain exposure to air pollution for hospital admissions, mortality and the associated cost, one will have to make additional assumptions regarding the exposure of different sectors of the populace such as duration, extent, susceptibility, the combined effects of different pollutants in

coexistence, etc.. As different sets of assumptions will give rise to different estimates, there is a need to carefully establish the assumptions applicable to Hong Kong before a reasonable estimate on these air pollution impacts could be made.

5. There is also an additional complication as pointed out by WHO that “the total impact of air pollution on the population is likely to be dominated by the less severe health effects such as subclinical and symptomatic events”<sup>1</sup>. As these subclinical and symptomatic events are much more difficult to evaluate or quantify, the health costs estimated from the currently available studies which are focused on more severe events such as emergency admission to hospital and death would likely report only part of the actual costs associated with air pollution exposure.

6. Notwithstanding the above-mentioned limitations and constraints, we have since 1997 started engaging local academics and consultants to study the health impacts and costs associated with air pollution based on local data on air quality, hospital admission and mortality. We have also uploaded their reports on EPD’s website. According to the one completed in 2002 by a study team led by the University of Hong Kong, the economic losses (including consultation and hospitalization fees and productivity loss incurred) caused by respiratory and cardiovascular diseases possibly related to air pollution could reach HK\$ 1.7 billion each year, estimated on the basis of the air quality and population data of year 2000. The study also estimated that air pollution could attribute to about 800 premature deaths owing to respiratory and cardiovascular diseases, and approximate 8 000 hospital admissions a year.

7. When engaging the consultancy study to review the Air Quality Objectives (AQOs) in 2007, we also tasked it to estimate the health benefits upon delivery of the proposed new AQOs. Making reference to the earlier health studies, the study consultant has estimated that about 4 200 unnecessary hospital admissions and 7 400 statistical life years would be saved each year (or an improved average life expectancy of around one month for the entire population) upon attainment of the new AQOs<sup>2</sup>. Other health benefits, such as less people contracting asthma or other respiratory diseases, would also be expected.

8. As part of the review of the Air Pollution Index (API) system that was completed in July 2012, the review team, which comprised experts on health and air science from the local academia, also established the correlation between local hospital admissions with air pollution levels for developing a health-risk based Air Quality Health Index to enable more timely, robust and effective communication of the health

---

<sup>1</sup> WHO, Air Quality Guidelines – Global Update 2005, p.87.

<sup>2</sup> It should, however, be noted that these public health benefits are by no means definitive as the assessment is subject to different assumptions being used on namely activities, exposure and health risk factors , etc.

risk of air pollution to the public. It was found that the risks of emergency hospital admissions for respiratory and cardiovascular diseases would increase by 0.45%, 0.51% 0.28% and 0.14% for every 10 ug/m<sup>3</sup> increase in the concentrations of nitrogen dioxide, ozone, respirable suspended particulates, and sulphur dioxide respectively for the general population. The health risk would be increased by about 1.14 times for the susceptible sub-population, i.e., those aged 65 and above and children under 5 years of age.

9. Apart from conducting our own health studies with the assistance of local health experts, we also make reference to the recommendations and practices of authoritative organizations such as WHO to understand the health impacts of our air pollution. For example, WHO adopted an exposure-response relationship for PM<sub>2.5</sub> that for every 10 ug/m<sup>3</sup> increase in average PM<sub>2.5</sub> level, there would be an increase of 2 to 11%, with an average of about 6%, of annual mortality rates for long-term exposure.

10. Through studies of our own and overseas, we have a fairly good understanding of the exposure-response relationship between air pollutants and their adverse health effects. To further understand the implications of air pollution on hospital admissions, mortality and the associated cost, we will have to identify, in consultation with the relevant bureaux and departments including the Department of Health as well as experts in the field, the knowledge gaps and how best they could be filled.

## **Noise Pollution and Public Health**

11. Environmental noise is defined as noise emitted from all sources except occupational and workplaces settings. Main sources of environmental noise include road, rail and air traffic, construction and commercial activities and the neighbourhood.

12. The potential impact of environmental noise on public health is a subject still under research internationally. It is generally agreed that noise may cause two kinds of effects on human: auditory effects and non-auditory effects. Auditory effects include hearing impairment resulting from excessive noise exposure usually encountered in occupational and workplaces settings. Environmental noise seldom reaches levels that can induce hearing loss. Potential non-auditory effects under research include stress, annoyance, social and behavioural effects, speech interference<sup>3</sup>,

---

<sup>3</sup> Speech interference is basically a masking process, in which simultaneous interfering noise renders speech incapable of being understood.

sleep disturbance<sup>4</sup> and cardiovascular and physiological effects.

13. Social and behavioural effects are often complex, subtle and indirect. Some studies suggest that changes in social behaviour, such as a reduction in helpfulness and increased aggressiveness, are associated with noise exposure. However, there are too many factors affecting social behaviour. Noise exposure alone is not believed to be sufficient to produce aggression.

14. Environmental noise may cause annoyance and sleep disturbance. However, there have yet been any concrete international research results showing that environmental noise causes other health problems directly. For example for cardiovascular effects, WHO's overall conclusion is that their associations with noise are weak, although the association is somewhat stronger for ischaemic heart disease than for hypertension. According to WHO, road traffic noise is the main burden of environmental noise in Europe. One in five individuals in Europe has disturbed sleep at night because of traffic noise.

15. In Hong Kong, we completed a study about the adverse impact of traffic noise on public health in early 2012<sup>5</sup>. The study was conducted by a team of international and local experts in acoustic and medical science comprising professors and experts of the Chinese University of Hong Kong, Griffith University of Australia and the National Institute of Public Health and the Environment of the Netherlands, and included a thematic survey of over 10 000 households on environmental noise issues.

16. On direct health effects, the study could not draw any conclusion that physiological responses due to exposure to a high level of noise are associated with long-term risk of cardiovascular diseases. On noise annoyance and sleep disturbance, the response of the people in Hong Kong is not as strong as compared with that in developed economies. Also, while higher noise exposure would intensify annoyance, various factors like personal sensitivity to noise, satisfaction with the neighbourhood environment etc. would also affect one's perception and response.

17. In sum, the possible effects or health problems (e.g. sleep disturbance) associated with environmental noise are often multi-factorial. It is uncertain whether or the extent to which they should be attributed to environmental noise. The number of hospital admissions attributable to environmental noise and the related health care cost cannot be established.

---

<sup>4</sup> Such as difficulty in falling asleep (increased sleep latency time); awakenings; and alterations of sleep stages or depth.

<sup>5</sup> The report is available at [http://www.epd.gov.hk/epd/english/environmentinhk/noise/studyreports/files/study\\_health\\_effects.pdf](http://www.epd.gov.hk/epd/english/environmentinhk/noise/studyreports/files/study_health_effects.pdf)

## **Light Pollution and Public Health**

18. While research studies conducted in different countries so far have not come to any conclusive view on any direct relationship between light exposure and health problems, possible health effects of light pollution, if any, may include glare, nuisance and sleep problems.

19. Glare is a visual sensation caused by exposure to excessive bright light, which may be disabling or cause discomfort. “Disability glare” leads to a transient reduction in visibility caused by intense light sources in the field of view, while “discomfort glare” causes annoyance or pain induced by overly bright sources. However, it should be emphasized that glare is a subjective sensation, and sensitivity to glare can vary widely among individuals.

20. Exposure to excessive light at night may disturb people’s rest and sleep and may cause annoyance or nuisance in some individuals. Some individuals who are affected by excessive light for a prolonged period of time may also feel distressed. Separately, studies on experimental animals have indicated that excessive light exposure for a prolonged period of time may suppress secretion of melatonin and hence suggest that excessive light exposure may adversely affect biological rhythms in human. Night-time lighting may also cause suppression of melatonin release and disruption of the sleep-wake cycle or circadian rhythms. However, an overseas study has noted that the amount of light required to cause such an effect has to be of a high level and the exposure has to be for a sufficiently long time. It has concluded that light trespass through residential windows is an unlikely cause of melatonin suppression given its low light level, particularly with the eyes of the residents closed.

21. The possible effects or problems caused by light pollution are non-specific, and may be mitigated in most cases at a relatively low cost. Also, the aforesaid health problems (e.g. sleep problem) in an individual are often multi-factorial, which may or may not be related to light pollution. Therefore, we do not have the number of hospital admissions attributable to light pollution and the related health care cost.

**Environment Bureau/Environmental Protection Department  
January 2013**

## **Health Effects of Air Pollutants**

### **(a) Sulphur dioxide**

Exposure to high levels of sulphur dioxide (SO<sub>2</sub>) may cause a wide variety of health impacts, including –

- impairment of respiratory function;
- aggravation of existing respiratory and heart illnesses; and
- increasing the risk of developing chronic respiratory diseases.

Particularly sensitive groups include people with asthma, lung or heart disease, children and the elderly.

### **(b) Nitrogen dioxide**

Exposure to elevated levels of nitrogen dioxide (NO<sub>2</sub>) can give rise to adverse health effects including –

- lowering a person's resistance to respiratory infections;
- aggravation of existing respiratory diseases; and
- damaging lung tissue and reduction in lung function.

People with asthma or lung disease and children are more susceptible to the adverse effects of NO<sub>2</sub> exposure.

### **(c) Ozone**

Being a strong oxidant, ozone (O<sub>3</sub>) can cause a variety of adverse health problems, including –

- irritation to the eye, nose and throat even at low concentrations;
- airway irritation, coughing, wheezing and breathing difficulties;
- increase of lung inflammation; and
- aggravation of asthma and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

People with lung disease, children and the elderly will be more seriously affected by elevated O<sub>3</sub> exposure.

### **(d) Particulate Matters**

Particulate matters (PM) with particle sizes less than 10 microns, which are known as respirable suspended particulates or PM<sub>10</sub>, can get deep into the lungs and cause a broad

range of health effects, in particular, respiratory and cardiovascular illnesses, including –

- increasing respiratory symptoms, such as irritation of the airways, coughing, or difficulty in breathing;
- decreasing lung function;
- aggravation of asthma;
- development of chronic bronchitis;
- adverse effects on the cardiovascular system; and
- premature death in people with heart or lung disease.

People with heart or lung disease, children and the elderly are most likely to be affected by particulate pollution.

Recent medical researches show that the risk for various health impacts increases with exposure and there is little evidence to suggest a threshold below which no adverse health effects would be anticipated. It has also been shown that the health risks would be higher for those particles with particle sizes of 2.5 microns or less, which are commonly referred to as fine suspended particulates or PM<sub>2.5</sub>.

#### **(e) Carbon monoxide**

Carbon monoxide (CO) can cause harmful health effects by reducing oxygen delivery to the body's organs, e.g. heart, brain and tissues. Symptoms due to CO exposures include –

- chest pain, headache, shortness of breath and loss of co-ordination;
- reduction of ability to exercise and contributing to other cardiovascular effects; and
- vision problems, reduced ability to work or learn, reduced manual dexterity and difficulty in performing complex tasks.

These health threats are more severe for those who suffer from heart disease. Also, at extremely high levels, CO is poisonous and can cause death.

#### **(f) Lead**

Lead (Pb), once taken into the body, may distribute throughout the body in the blood and accumulate in the bones. Depending on the level of exposure, Pb can cause the following adverse health effects –

- adversely affecting the nervous system, kidney function, immune system, reproductive and developmental systems and cardiovascular system;
- affecting the oxygen carrying capacity of the blood;
- neurological effects in children which may contribute to behavioral problems and learning deficits; and
- cardiovascular effects such as high blood pressure and heart diseases.