FOR MEMBERS USE ONLY **COMEAP/2002/12C**

COMMITTEE ON THE MEDICAL EFFECTS OF AIR POLLUTANTS

OZONE – FURTHER ANALYSIS OF EFFECTS ON MORTALITY AND HOSPITAL ADMISSIONS

Introduction

1. The effects of 8 hour average ozone on mortality and hospital admissions was discussed in a paper (COMEAP/2002/9a) at the last meeting. It was suggested at that meeting that some further analysis of this evidence would be helpful. This paper covers a further consideration of seasonal differences and publication bias.

Seasonal differences

2. The previous paper discussed whether effects were greater in summer than winter but did not specify the actual coefficients or the ozone concentrations in summer and winter. To see whether seasonal differences can give clues as to the possibility of a threshold, both the ozone coefficients and the ozone concentrations are needed. If there is no threshold, then the slope in one season with lower concentrations should be the same as the slope in another season with higher concentrations (assuming no difference in confounding factors). If there is a threshold at the boundary between the lower and upper concentrations, then a greater slope might be expected in the season with higher concentrations. Unfortunately, many of the papers describing seasonal differences do not present ozone concentrations by season. Those that do are described below.

3. Simpson *et al.* (1997) provided information on both seasonal ozone concentrations and effects on all cause, cardiovascular and respiratory mortality by season. The results are summarised in the table below. It can be seen that the difference in ozone concentrations between summer and winter is not that great with substantial overlap in the concentration range. Nonetheless, there is a marked drop in the effect estimate, perhaps more than might have been expected from the overlap in concentrations.

Table 1 Seasonal differences in Brisbane, Australia

Season	Outcome	Mean ozone (8 hour)	Ozone range	Estimate % per 10 µg/m^3 or 5ppb	95% CIs
Summer Oct - Mar	All-cause mortality	20 ppb	3-63ppb	1.48	0.49-2.48
	Respiratory mortality			1.14	-2.65-5.07
	Cardiovascular mortality			1.19	-0.58-2.99
Winter Apr-Sep	All-cause mortality	16 ppb	2-57ppb	0.65	-0.72-2.04
	Respiratory mortality			0.51	-2.41-3.51
	Cardiovascular mortality			0.73	-1.81-3.33

4. Wong *et al.* (2001) examined seasonal differences in Hong Kong. The results are summarised in Table 2. It should be noted that mean ozone levels are actually slightly higher in the cool season than the warm season (when there is more rain). On the other hand the maximum concentration is higher, and the 90th percentile slightly higher in the warm season. The coefficients were positive and significant in the cool season and negative but non-significant in the warm season. The between season p values were less than 0.05. Again, there is perhaps a greater difference than might be expected from the mean ozone concentration alone, and the difference is in the opposite direction to that expected when considering maximum concentrations. It is possible that the pattern of confounding by other pollutants differs by season. The coefficients given are for single pollutant models but were little affected by the inclusion of nitrogen dioxide in multipollutant models.

Table 2 Seasonal differences in Hong Kong (mortality)

Season	Outcome	Mean ozone (8 hour)	Ozone range	Estimate % per 10 µg/m^3 or 5ppb	95% CIs
Warm Apr-Sep	All-cause mortality	16 ppb (Median 12)	0-84ppb (min/max) 4-32ppb (10th/90th percentile)	-0.18	-0.54-0.18
	Respiratory mortality			-0.18	-1.09-0.74
	Cardiovascular mortality			-0.36	-1.09-0.38
Cool Oct to Mar	All-cause mortality	18 ppb (Median 17)	0-51ppb (min/max) 4-31ppb (10th/90th percentile)	0.72	0.18-1.26
	Respiratory mortality			1.41	0.36-2.47
	Cardiovascular mortality			0.89	0-1.79

5. Wong *et al.* (2002) compared the effect of air pollution on hospital admissions in London and Hong Kong. The results of the seasonal analysis are given in Tables 3 and 4. All the estimates increase from the warm to the cool season while mean ozone levels rise only slightly and maximum ozone levels fall. In London, there was a greater contrast in ozone levels between the warm and cool season. The estimates were lower in the cool season with the lower mean ozone concentration. The effect on respiratory hospital admissions became statistically insignificant. A threshold could be one explanation for this. For the other outcomes, there were no positive significant effects even in the warm season so the change by season is hard to interpret.

Table 3 Seasonal differences in Hong Kong (hospital admissions)

Season	Outcome	Mean ozone (8 hour)	Ozone range	Estimate % per 10 μg/m^3 or 5ppb	95% Cis
Warm Apr-Sep	Respiratory hospital admissions >65	16 ppb (Median 12)	0-84ppb (min/max) 4-32ppb (10th/90th percentile)	0.8	0.2-1.4
	Asthma admissions 15-64			-0.3	-2.0-1.3
	Cardiac admissions			0.0	-0.5-0.6
	IHD admissions			0.4	-0.4-1.2
Cool Oct - Mar	Respiratory hospital admissions >65	18 ppb (Median 17)	0-51ppb (min/max) 4-31ppb (10th/90th percentile)	1.0	0.2-1.7
	Asthma admissions 15-64			0.6	-1.4-2.6
	Cardiac admissions			0.9	0.2-1.6
	IHD admissions			0.6	-0.5-1.6

Table 4 Seasonal differences in London (hospital admissions)

Season	Outcome	Mean ozone (8 hour)	Ozone range	Estimate % per 10 μg/m^3 or 5ppb	95% Cis
Warm Apr – Sep	Respiratory hospital admissions >65	23 ppb	Not given	1.0	0.3 to 1.7
	Asthma admissions 15-64			-0.1	-1.4 to 1.2
	Cardiac admissions			-0.2	-0.7 to 0.3
	IHD admissions			-0.5	-1.2 to 0.2
Cool Oct – Mar	Respiratory hospital admissions >65	12 ppb	Not given	0.2	-0.7 to 1.2
	Asthma admissions 15-64			-2.6	-4.6 to –0.5
	Cardiac admissions			-1.1	-1.8 to –0.4
	IHD admissions			-1.3	-2.3 to –0.3

Publication bias

10. The studies used to derive the summary estimates given in COMEAP/2002/9a have been checked for publication bias using the Egger test (Egger *et al.* 1997). No evidence of publication bias was found.

Outcome	Summary estimate (% increase per 10 μg/m^3 8-hour average ozone concentration)	95% confidence interval	No studies	P-Value Pub Bias
All-cause mortality	0.3%	0.2 – 0.4	20	0.244
Respiratory mortality	0.7%	0.3 - 1.2	17	0.810
All circulatory mortality	0.3%	0 – 0.6	13	0.813
Respiratory admissions	0.3%	0 – 0.7	6	0.728
COPD admissions	1.0%	0.2 – 1.9	7	0.823
Asthma admissions 0-14 y	0.3%	-1.3 – 2.0	6	0.320
Asthma admissions 15-64y	1.4%	-0.1 – 3.0	4	0.912
All circulatory admissions	-0.2%	-0.7 – 0.3	5	0.170

Conclusions

11. For the small number of studies for which seasonal pollutant concentrations were available, the seasonal comparisons were not that helpful in providing clues to a possible threshold. In part this was because in some areas there is substantial overlap in concentrations between the two six month periods.

12. Does the Committee :

a) agree that, for the studies available, the seasonal comparison was not informative about a possible threshold?

b) wish to make any recommendations about future analysis by season e.g. comparing summer and winter months but not including autumn or spring which reduce the contrast in ozone concentrations?

Secretariat
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Reference List

Egger M, Smith GD, Schneider M, Minder C. (1997). Bias in meta-analysis detected using a simple graphical test. *BMJ* **315**: 629-634

Simpson, R.W., Williams, G., Petroeschevsky, A., Morgan, G. and Rutherford, S. (1997) Associations between outdoor air pollution and daily mortality in Brisbane, Australia. *Archives of Environmental Health* **52**, 442-454.

Wong, C.M., Atkinson, R.W., Anderson, H.R., Hedley, A.J., Ma, S., Chau, P.Y. and Lam, T.H. (2002) A tale of two cities: effects of air pollution on hospital admissions in Hong Kong and London compared. *Environ Health Perspect* **110**, 67-77.

Wong, C.-M., Ma, S., Hedley, A.J. and Lam, T.-H. (2001) Effect of air pollution on daily mortality in Hong Kong. *Environmental Health Perspectives* **109**, 355-340.