Memorandum

To:	Jamie Cox (WDC) and Tom Simonson (LGNZ)
Organisation:	Convenors: Road Dust Working Group (Road Controlling Authorities)
Date:	31 October 2017
From:	Louise Wickham
Re:	New study: road dust and mortality

Dear Jamie & Tom,

On behalf of the Ministry of Health, please find attached a memo explaining some new research on the health effects of road dust presented at the conference of the International Society of Environmental Epidemiology in Sydney last month.

I welcome questions and discussion.

Regards,

Louise Wickham
Director and Senior Air Quality Specialist

New research into health effects of road dust

Researchers in Canada found a significant association between mortality and the coarse fraction of particulate matter (PM) attributed to road dust (Hong *et al.*, 2017).

The epidemiological study statistically analysed daily levels of PM in seven communities against daily mortality over the period 2003-2015. It found that an 8.6 μg/m^3 increase in coarse fraction particulate matter ($PM_{10-2.5}$) was associated with a 3.1% [95% confidence interval 0.8, 5.4] increase in non-accidental mortality during the road dust season – when adjusted for $PM_{2.5}$ (i.e. possible confounding effects of $PM_{2.5}$ removed).

The results suggest different impacts of different PM fractions by season, which in turn suggests different sources of particulate matter have different impacts. Few other studies have considered only the coarse fraction of PM attributed to a specific source.

Background

Particulate matter less than 10 and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$) are key size fractions from a health perspective. This is because they are sufficiently small to penetrate the thoracic region of the lung (PM_{10}) and have a high probability of deposition in the smaller conducting airways and alveoli ($PM_{2.5}$). $PM_{2.5}$ can also cross the blood-gas barrier and transport around the body causing adverse cardiovascular effects (Du *et al.*, 2016).

The US EPA estimates $PM_{2.5}$ is only 10 per cent of PM_{10} in fugitive dusts arising from unsealed roads (US EPA, 2006). Further, although many studies have documented the serious health effects associated with $PM_{2.5}$ and PM_{10}, the effects of the coarse fraction ($PM_{10-2.5}$) are still under debate.

Implications

This new study focusing on the coarse fraction of particulate matter ($PM_{10-2.5}$) appears sufficiently robust to be a welcome addition to the scientific literature. It directly addresses a known gap in the data on health effects associated with the coarse fraction generally, and more specifically, road dust.

In New Zealand, most air quality monitoring programmes measure mass concentrations of PM_{10}. Like Canada, the Ministry for the Environment is considering changing to measurement of $PM_{2.5}$ instead (PCE, 2015) because studies have typically found that exposure to $PM_{2.5}$ is more strongly associated with cardiopulmonary health outcomes than PM_{10} (EPA, 2009; World Health Organisation Europe, 2013).

As noted in the paper, the acute and chronic health effects associated with exposure to the coarse fraction (PM_{10}) remain unclear. The researchers therefore, recommend that Canada maintain PM_{10} monitoring networks to provide feedback for future research and dust mitigation programmes.

It is apparent that it is not a matter of either PM_{10} or $PM_{2.5}$, but rather both are needed (at least until the research findings around health effects and the coarse fraction of PM are clearer and their implications in the NZ context have been determined).

Details

The study followed a time-series design using Poisson regression with analyses stratified by three seasons:

- Residential wood smoke in winter (Oct – Feb)
- Road dust in spring (Mar – Apr)
- Wildfire smoke in summer (Jul – Aug)

The study adjusted for temperature, relative humidity, influenza periods, year and month, day of the week and holidays. The researchers fitted two additional models to control for any residual confounding; one for $PM_{2.5}$ adjusted for $PM_{10-2.5}$ and one for $PM_{10-2.5}$ adjusted for $PM_{2.5}$. They also undertook a random effects meta-analysis to establish a pooled estimate.

The total population was 532,210 in seven communities for a total of 14,471 days of data. The average daily mortality ranged from 0.1 to 0.2 per 10,000 and dispensations of salbutamol sulfate (asthma medication) ranged from 3.1 to 5.4 per 10,000.

Median daily concentrations of PM_{10}, $PM_{2.5}$ and $PM_{10-2.5}$ were similar to levels in New Zealand, ranging from 13.4-18.2 µg/m^3, 4.7-6.5 µg/m^3 and 6.3-11.9 µg/m^3 respectively.

Specific findings were:

- An increase of 8.6 µg/m^3 in coarse fraction particulate matter ($PM_{10-2.5}$) was associated with a 3.6% [1.6, 5.6] increase in non-accidental mortality during the road dust season. This association reduced to 3.1% [0.8, 5.4] after adjustment for $PM_{2.5}$.
- Null result for $PM_{10-2.5}$ and dispensations of salbutamol sulfate during the road dust season.

The coarse fraction results for mortality during the road dust season are consistent with a recent study in Stockholm, Sweden (Meister *et al.*, 2012). However, unlike this study the Swedish study association was not statistically significant after adjusting for $PM_{2.5}$.

Saharan windblown dust studies have observed a similar phenomenon with stronger associations on days with sandstorms for $PM_{10-2.5}$, but not $PM_{2.5}$ (Mallone *et al.*, 2011; Perez *et al.*, 2008).

The null results for the respiratory indicator (salbutamol sulfate dispensations) during the road dust season are generally consistent with other studies (Pekkanen *et al.*, 1997, Penttinen *el al.*, 2001). One study did show a weak increase in cough during road dust season when averaged over 4 days (Tiittanen *et al,*, 1999). The researchers speculated, “Although the literature specific to road dust is very limited, the exposure may be more strongly associated with mortality than with respiratory outcomes.”

References

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