ROYAL COLLEGE of PHYSICIANS of EDINBURGH

4 April 2023

Dear Net Zero Committee,

RE: Air Quality Monitors around Schools

The Royal College of Physicians of Edinburgh would like to recommend to the Net-Zero Committee that air quality monitors should be placed at all Scottish city primary schools for a period of at least one year (to avoid confounding by the significant seasonal variation in pollution). Once complete the same proposal should be rolled out to all city secondary schools. Our reasons for this are set out below.

Scotland has some of the cleanest air globally, along with some of the more stringent air quality objectives in Europe (1, 2). Scotland aims to limit annual average levels of nitrogen dioxide (NO_2) to below 40 µg/m^3, particulate matter (PM) to 18 µg/m^3 and 10 µg/m^3, for PM_{10} (PM with a diameter of less than 10 µm or less) and $PM_{2.5}$ (PM with a diameter of less than 2.5 µm or less).

Achieving levels below these targets is key to maximise health gains. Where exceedances repeatedly occur, Local Air Quality Management Areas (LAQMA) can be set up. Additionally, Low Emission Zones (LEZs) were established, or are being established, in our major cities. The low population density of Scotland is a major factor in meeting these air quality standards, however, LEZ and subsidies for non-polluting buses have also allowed Scotland to meet these targets in urban areas for the first time.

But we should not be complacent. Areas of significant transport-linked air pollution still exist in and around our city streets. Furthermore, harmful effects of air pollution are seen below the current target Scottish levels, which has recently led the World Health Organisation (WHO) to recommended far more stringent air quality guidelines (WHO Global Air Quality Guidelines 2021; NO2 below 10 µg/m^3, PM_{10} below 15 µg/m^3, $PM_{2.5}$ below 5 µg/m^3) (3). Thus, air pollution in Scotland is still damaging our health and increasing our risk of dying early.

In addition, the above limits are *yearly averages*. Regulations also state maximum allowable 24hr average levels, yet local authorities do not publish these and we cannot therefore know how we perform against these standards. Scotland's central monitoring webpage shows exceedances of these 24hr levels, particularly in winter months. We now know that even short-term peaks in air pollution can have significant unwanted effects on health (4, 5).

Children, older people, and people with chronic health problems are among the most susceptible to air pollution (6). Gestation, infancy, and early childhood are vulnerable times because the young body is growing, developing rapidly and has immature immune systems. Also, children spend a higher proportion of their time outdoors and are therefore at greater risk of exposure to air pollutants. Furthermore, our poorest children(7) and adults live in areas of highest pollution thus exacerbating prexisting health inequalities.

Air pollution around our schools is a particularly sensitive issue. Not infrequently, schools are located near busy roads and traffic junctions, and air quality is harmed by the 'school run' and idling engines as parents drop off or wait for their children (8). It is essential that our schoolchildren are protected from air pollution in playgrounds and on the roads surrounding schools, with considerable health and other benefits to be gained.

In schoolchildren, we know that the lung, heart, brain, hormone systems and immunity can all be harmed by air pollution (9). Research points towards effects on growth, intelligence and development of the brain and coordination (10); impacts that last well into their future lives. A recent review of studies showed excess PM_{10} led to loss of attention, thinking, reasoning, and academic scores (9) (11). PM2.5 and NO_2 also adversely affected memory in children, and increased the likelihood of major depressive illness in teenagers (12).

Suppression of lung growth and function was found in children living in communities with the highest concentrations of air pollution, and declining levels were associated with improvement (13). A recent review of studies investigating the long-term effect of air pollution on new cases of asthma in schoolchildren found a 7% and 16% increase asthma for a 10 $\mu g/m^3$ increase in either NO_2 or $PM_{2.5}$ (14). Exposure to NO2 and PM10 has also been linked to insulin resistance, a sign of diabetes (15). Cardiovascular effects are also seen in children, with air pollution increasing blood pressure (16, 17). In Scotland we also have evidence that air pollution is linked to DNA damage and aging (18) in children. On days where air pollution was above guideline levels, hospital admissions for children rose significantly, with over 1000 excess admissions on high pollution days per year (19). We can be confident of the validity of these studies because many other studies worldwide have replicated these findings.

Because of the serious and long-term effects of air pollution on children, the Royal College of Physicians of Edinburgh's Working Group on Air Pollution and Health was establisged to evaluate air quality around Scottish Schools. We sought data from the Scottish Government and local authority published levels of air pollution in the larger cities of Edinburgh, Glasgow, Aberdeen, Dundee, and Perth. We were surprised to discover, however, that very few schools were near enough to a networked air quality monitor - too few to draw any conclusions about the safety of our school children at school. Many of these schools are on busy streets and, as noted above, levels are augmented by the 'school run' and idling engines at school drop off.

Recommendation: The Royal College of Physicians of Edinburgh would like to recommend to the Net-Zero Committee that air quality monitors should be placed at all Scottish city primary schools for a period of at least one year (to avoid confounding by the significant seasonal variation in pollution). Once complete the same proposal should be rolled out to all city secondary schools.

We understand that the Scottish Government has provided funding for a national teaching resource that includes 5 Air Quality sensors, held by SEPA, which can be loaned to schools. However, these are insufficient in number, cannot be borrowed for the full year, and will not give us the full Scotland-wide perspective that is required to ensure a safe air quality environment for our children.

Local authorities are well set up to support this initiative, as all the major cities have Air Quality Management Areas (AQMAs) which they monitor already. The monitoring is standardised, and quality controlled. The finding would then be reported in their annual reports on their AQMAs to the Scottish Government and the public. School pupils can be involved in this process as part of their education through projects on the environment and health.

It is imperative to establish these levels, as often the introduction of small changes can effect improvement in air pollution levels and thus health. Although LEZ or Ultra LEZs could have the biggest influence in removing pollutants from vehicles exhaust, they operate in a confined area of the city. Beyond this, additional interventions are essential. The removal of diesel school buses, the introduction of low pollution vehicles and retrofitting bus engines can substantially reduce exposure

(20). Staggered low traffic areas round school have been shown to reduce pollution(21) as has enforcing no-idling zones around schools (8) and traffic free zones during drop-off and pick up times. While avoiding busy roads is advised, walking to school still has a lower exposure to pollutants than within vehicular transport (22) in most cases. Future neighbourhoods should be designed to maximise the number of children who are able to walk between home and school (21), avoding the need for vehicles including buses.

Within classrooms, air purifiers can be used to reduce particles where levels are persistently high, although these only remove some pollutants and we suggest thast efforts should be directed at reducing the sources of pollution in the first instance (26, 27). Governments should consider a wider-range of measures to reduce pollution from a wider range of sources, including construction, domestic sources of pollution, energy generation, agriculture and industry. Only a combined approach of multiple interventions will be successful in significantly reducing pollution, however, in doing so, it will help realise the lower levels of pollution that is recommended by the WHO.

In conclusion, there is overwhelming evidence that air pollution harms the health of school children. What is missing in Scotland is robust data on air pollutant levels around schools and whether pollutants are present at levels above those recommended, in both the short and long-term. As mitigation can produce significant health benefits where air pollutants are high, we ask the Net Zero Committee to promote the introduction of air quality monitors around all city schools as a matter of priority. We suggest that this should be targeted to the most vulnerable primary school children first, then expanded until the risk to all Scottish school children of air pollution is nationally evaluated, in order to inform policy and direct interventions to improve health and wider outcomes.

Authors are Members of Royal College of Physicians of Edinburgh's Air Pollution Short-term Working Committee

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