PARIS

Healthy air, healthier children

Further action to reduce traffic is needed for healthy schools





The dangers of air pollution

In the EU, each year air pollution causes ± 400,000 premature deaths and hundreds of billions of euros in health costs Air pollution from energy production, transport, industry, agriculture and households is the number one environmental threat to health in Europe and globally¹. The World Health Organization (WHO) recognises air pollution as a leading risk factor for major chronic diseases in adults, including heart and lung disease as well as cancer. It also states that no level of air pollution can be considered safe². Each year, air pollution causes around 400,000 premature deaths and hundreds of billions of euros in health costs in the EU alone³.

Breathing in air pollutants - particulate matter, for example, which are tiny particles much thinner than a human hair - can lead to changes in the body that damage health. Poor air quality is linked to chronic and acute respiratory diseases, such as bronchitis and the aggravation of asthma, heart disease and stroke. People already suffering from disease, those living in cities or who are economically deprived are particularly at risk from the harmful effects of polluted air⁴.

In cities, emissions from cars, buses and lorries are a major contributor to poor air quality, in particular emissions of nitrogen dioxide (NO₂). NO₂ contributes to the formation of particulate matter with related health impacts, and is often considered an indicator for traffic-related air pollution. Studies have shown that NO₂ can lead to asthma and make health problems of asthmatic people worse. Researchers are also investigating a possible link between NO₂ and heart disease and diabetes⁵.

Children and air pollution



Even more worrying is evidence of the toll it takes on children⁶. Children are exposed to air pollution in different ways to adults such as being closer to a vehicle exhaust. Exposure to air pollutants can increase the risk of a child developing asthma and the number and severity of asthma attacks, affect their learning abilities, as well as a child's heart, brain and nervous system development. Effects even affect the unborn child: pregnant women breathing unhealthy air can lead to children being born earlier, or with a lower birth weight, which increases the risk of disease decades later^{7,4}.

HEAL's project



▶ NO, monitoring tubes outside a Berlin school | © HEAL |

To raise awareness of air pollution in school environments and how it affects children's health, **HEAL developed a citizen science initiative to monitor indoor and outdoor air pollutants around primary schools in six capitals of the European Union – Berlin, London, Paris, Madrid, Sofia and Warsaw**. These cities and also the countries that they are located in currently fail to meet EU air quality standards. Berlin, Paris, London and Madrid have breached limits for nitrogen dioxide (NO₂); Spain is breaching both NO₂ and PM EU air standards; and Bulgaria and Poland have been found to breach EU air quality legislation for PM by the EU Court of Justice⁸.

School environments have received less attention in both research and policy-making, which has largely focused on regulating outdoor air quality. At EU level, a comprehensive set of laws is in place to ensure good outdoor air quality and to cut emissions from the main pollution sources. The quality of indoor air is significantly affected by outside air, as well as indoor factors⁴. People spend the majority of their time indoors, with children spending up to a third of their day at school, and yet no comparable framework exists for indoor environments.

During March, April and May 2019, 50 schools in these six cities participated in the initiative using low-cost monitoring devices to collect data on common air pollutants. NO₂ was monitored continuously for a period of three to four weeks and local partners visited each school to take a 20 minute measurement of the PM concentration in and around the schools and the CO₂ levels inside the classrooms.

Air quality monitoring



- Particulate Matter (PM) is the pollutant of greatest concern to health as tiny particles can enter the bloodstream. This project looked at both PM_{2.5} and PM₁₀' the number indicating the size of the particles.
- Nitrogen Dioxide (NO₂). NO₂ is a pollutant often used to indicate air pollution from traffic, and it contributes to the formation of particulate matter. Studies also show it causes and aggravates asthma.
- Carbon Dioxide (CO₂) measured inside the classroom. CO₂ acts as an indicator of indoor air quality and ventilation. Inside CO₂ levels can rise high enough to cause drowsiness, affecting concentration and productivity⁹.

This report uses a limit value of 1,000 parts per million (ppm) for CO_2 as the threshold for healthy indoor air. The European Union has set legally binding standards and the WHO has set guidelines for the maximum average concentration of PM and NO₂:

		EU Air Quality Directive	WHO Guidelines	
Pollutant	Period	Concentration (limit value µg/m³)	Concentration (limit value µg/m³)	
PM _{2.5}	24 Hours	-	25*	
PM _{2.5}	Annual	25	10	
PM ₁₀	24 Hours	50**	50*	
PM ₁₀	Annual	40	20	
NO ₂	Hourly	200***	200	
NO ₂	Annual	40	40	

* 99th percentile - 3 days/year

** not to be exceeded more than 35 days a year

*** not to be exceeded on more than 18 times a year

In response to the public health threat that air pollution brings to those living in cities, more and more grassroots organisations and individuals are using low-cost devices to raise awareness of the need for clean air and to improve the knowledge of the exposure and vulnerability of different population groups. This local data can be useful to compare with official monitoring stations and other collected data to stress the need for pollution reduction measures in communities. This HEAL initiative is a contribution to this growing movement, providing a snapshot of air quality in and around schools in different cities, as well as recommendations for local authorities and school communities to discuss further. With the active participation of schools and children, this pilot initiative is one of the largest of its kind to use a coordinated, citizen science approach to measure both indoor and outdoor pollutants to date in Europe.

Findings of the HEAL snapshot – Indoor and outdoor monitoring at schools in six capital cities in Europe

HEAL's citizen science monitoring found various unhealthy air quality concentrations in and outside classrooms where children spend the majority of their day. A detailed analysis of the results in Paris can be found further in this report.

Common findings

- At all participating schools, NO₂ was detected inside the classrooms. As there were no sources of NO₂ in classrooms, these NO₂ levels can only come from outdoor air pollution, notably traffic.
- Concentrations of particulate matter varied, and for some schools were higher than what the World Health Organization recommends to protect health.
- The majority of the classrooms had CO₂ values above the recommended level of 1,000 parts per million (ppm), indicating an overall need for more ventilation.

Participating schools and number of represented students across Europe



The results show that there were varying concentrations of unhealthy pollutants inside and outside classrooms.

The variation in the results can be explained by many factors, including proximity to busy roads, the season and characteristics of the building. Understanding how these interact is complex. However, the results do clearly demonstrate that outdoor pollutants enter school buildings and influence indoor air quality. Since there are no indoor sources of NO_2 , the concentrations detected indicate the contamination of indoor air by traffic-related emissions.

It is important to highlight that the concentrations shared in this report do not remain steady throughout the day, or over the year, but vary as PM and NO₂ concentrations are influenced by traffic, the weather, use of heating, or ventilation. In order to determine the health risk to children, longer and continuous monitoring is needed.

The indoor environment cannot be separated from the outside world. The high values of CO_2 observed in a majority of the classrooms underlines the need for ventilation. To prevent drowsiness, loss of concentration, and decreased productivity, it is important to ventilate regularly. Renovations for energy



 Hitherfield Primary School and Children's Centre, London, pupils engaged in the project in the school playground. |© Sustrans |

efficiency are an opportunity to address these ventilation challenges, leading to healthier learning conditions. More attention is needed to link health and energy efficiency considerations so that schools and buildings generally can be climate and health friendly at the same time. Yet, as long as the outdoor air is polluted, schools will struggle to achieve good indoor air quality. The outdoor air needs to be cleaned up, so that children can learn well and develop healthily.



Citizen science monitoring - children help to set up monitoring tubes for nitrogen dioxide (NO₂) in the classroom | © HEAL |

PARIS

Further action to reduce traffic is needed for healthy schools

One of Europe's largest cities, Paris exceeds the EU limit for both NO₂ and PM. Long-term exposure to poor air quality has been associated with around 55,000 premature deaths in France annually¹⁰. Road transport accounts for the majority of primary emissions of both NO₂ and PM (73% NOx and 42% PM₁₀) in Paris¹⁰. The mayor of Paris has made clean air a priority, and plans to reduce the number of cars in the city by half, and pedestrianisation of the capital is planned in addition to a ban of diesel vehicles by 2024. All vehicles in Paris are required to display an anti-pollution sticker under the Crit'Air scheme in an effort to improve air quality in the city¹¹. Emergency measures are put in place during pollution episodes including a reduced price for public transport, speed restrictions and the ban of heavy duty vehicles.

A recent study led by the French association Respire created an inventory of the air pollution near schools in Île-de-France, the Paris region, at crèches, schools, colleges and high schools. Of the 12,520 schools analysed, 682 were exposed to air pollution levels exceeding annual NO₂ standard guidelines.¹² Additionally, studies in French schools across six French cities found that poor air quality in classrooms, predominantly PM_{2.5} and NO₂, was linked to an increased prevalence in asthma in children in the past year¹³.

Summary

Geographical location of the schools across Paris

- Six nursery and primary schools
- School population represented: ± 975 children
- Most children are not dropped off by car but come to school by foot, bike, metro or bus
- Schools located in the centre of Paris
- Measurements taken in May 2019.



NO, monitoring in a school in Paris

Results

Six schools participated in the monitoring initiative in Paris. The NO₂ concentration at the school entrance of Paris school 2 was exceptionally high at 52 μ g/m³. The annual EU and WHO air quality standard is 40 μ g/m³. The values measured are averages and the NO₂ concentration will probably have been higher during certain periods of the monitoring, increasing the risk of negative health effects. Indoors the NO₂ concentrations ranged from 17 to 27 μ g/m³. At Paris school 3 the NO₂ concentration at the school entrance was 32 µg/m³ which is a relatively high value because the school is located near a park and surrounded by pedestrianised and calm streets.

The highest concentrations of particulate matter were measured at Paris school 5 and Paris school 6. Close to these two schools construction works took place, which might have influenced the higher PM values.

Schools	NO ₂ outdoors (µg/m³) Measured over a four- week period	NO ₂ indoors (µg/m ³) Measured over a four- week period	PM _{2.5} outdoors (µg/m³) Measured over a single 20-minute period	PM _{2.5} indoors (µg/m³) Measured over a single 20-minute period	PM ₁₀ outdoors (µg/m³) Measured over a single 20-minute period	PM ₁₀ indoors (µg/m³) Measured over a single 20-minute period	CO2 (ppm) Maximum value measured over a single 20-minute period
Paris school 1	33	21	12	7	17	9	584
Paris school 2	52	27	8	2	10	5	1525
Paris school 3	32	17	20	9	28	13	1075
Paris school 4	26	20	4	3	5	5	1785
Paris school 5	30	19	25	10	35	15	686
Paris school 6	36	24	23	7	37	10	1062

Conclusions and Recommendations for Paris

The air quality at Paris school 2 was very poor during the period that the NO₂ concentrations were measured. It is likely that a big boulevard next to the school entrance impacted this result. Even at Paris school 3 the air pollution was relatively high, even though it was less affected by busy roads. It is essential to increase monitoring of air pollution in order to raise awareness of the problem and improve the understanding of children's exposure, while at the same time implementing measures to tackle it.

The majority of the pupils in the participating schools were not brought to school by car. It is extremely difficult for schools and parents to address air pollution themselves. Air pollution should be tackled as a whole in order to protect the health of the most vulnerable.

The key recommendations for Paris are:

1	Support the expansion of regulatory and citizen science air quality monitoring in schools.
2	The Paris arrondissements' mayor and school authorities could put measures in place to discourage and restrict traffic and car idling around schools such as ensuring schools are part of low emission zones or congestion charge areas, creating more pedestrian streets around schools, and promoting free public transport for children and their parents.
3	Ensure better control and stricter fines regarding the non-respect of the Crit'Air vignette.
4	Create educational campaigns which promote the health gains to Parisians through measures to curb air pollution, which in turn can contribute to more awareness on the benefits of cleaner air and climate action for greater public health gains.
5	Increase knowledge and raise awareness about the impact of construction works on air quality and its health effects in and around schools, and enforce strict mitigation measures to reduce air pollution from construction sites.

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Disclaimer:

The report 'Healthy Air, Healthier Children - 50 schools across the EU monitor air quality' is a snapshot in indoor air quality in 50 schools in six capitals in the EU, based on citizens' science, with schools participating on the basis of interest. Therefore, this report is not a representative analysis of schools' indoor environments, nor did HEAL investigate actual health impacts of children in participating schools. Given the differences in each city (location, geographical conditions, state of the school buildings etc.) and differences in the intervals of measurement it is not possible to make comparisons between schools or cities. However, HEAL's citizen science monitoring demonstrates that providing for clean air schools environments should be a priority for policy-makers, and that further monitoring should be undertaken.

The full methodology can be found on the website of HEAL.



The Health and Environment Alliance (HEAL) is the leading not-for-profit organisation addressing how the environment affects human health in the European Union (EU) and beyond. HEAL works to shape laws and policies that promote planetary and human health and protect those most affected by pollution, and raise awareness on the benefits of environmental action for health.

HEAL's over 70 member organisations include international, European, national and local groups of health professionals, not-for-profit health insurers, patients, citizens, women, youth, and environmental experts representing over 200 million people across the 53 countries of the WHO European Region.

As an alliance, HEAL brings independent and expert evidence from the health community to EU and global decision-making processes to inspire disease prevention and to promote a toxicfree, low-carbon, fair and healthy future.

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