Environmental pollution is a 'work in progress' incorporating new information whenever time permits.

Environmental pollution

The following have been classified by the World Health Organisation as a) carcinogenic to humans b) probably carcinogenic and c) possibly carcinogenic;-

a) Air pollution, notably from vehicle exhausts; pesticides & solvents in childhood and during pregnancy; including occupational paternal pre-conceptional exposure; background ionising radiation including radon gas;

b) Excessive exposure to Light at Night

c) Magnetic fields associated with the electricity supply; radiofrequency fields from mobile phones and modern communication devices

General

Solvents, traffic, pesticides and tobacco smoke have consistently demonstrated positive associations with the risk of developing childhood leukaemia (Metayer 2016).

All forms of air pollution in 60 studies (Killin 2016), including particulate matter, nitric oxides, ozone or carbon monoxide – all were linked to dementia. There was also a clear link with vitamin D deficiency and a weaker association with passive smoking and occupational exposure to pesticides. The team also found a link between dementia and living close to power lines.

Agricultural pesticides

The increased leukaemia risk among children residing close to arable crops indicates the need to further investigate the involvement in disease aetiology of passive exposure to herbicides and pyrethroids, though such exposure is unlikely to play a role in the vast majority of cases, possibly excepting children under 5 (Malagoli 2016).

Other pesticides and herbicides

Polycyclic aromatic hydrocarbons (PAHs) in urban soils may pose a serious threat to human health via oral ingestion, dermal absorption, and particulate inhalation, especially in public parks and playgrounds, with children and senior citizens showing the highest susceptibility. Total cancer risk (TCR) analysis found that 22 urban parks in Guangzhou (accounting for 78.57% total parks) designed for children's use and general-use park areas presented a potentially high risk for all users (Ke 2017).

Air pollutants

In an unprecedented court case in Paris in June 2017, Michel Aubier, an eminent French lung specialist was fined €50,000 and given a six-month suspended jail sentence because he didn't disclose his ties to the oil industry during a Senate air-pollution inquiry. Aubier has long been accused of downplaying the impact of small particles in urban pollution on disease, despite the World Health Organization's cancer agency, IARC, saying since 2013 that outdoor air pollution in general is carcinogenic (Nature).

Early life exposure to 1,3-butadiene (found in urban air samples and used in the production of synthetic rubber) rather than benzene or POM (polycyclic organic matter) appears to increase early childhood risk of acute lymphocytic leukaemia (Symanski 2016).

The risk of neuroblastoma, the most common cancer in infancy, was increased with higher maternal exposure to carbon tetrachloride and polycyclic aromatic hydrocarbons particularly indeno(1,2,3-cd)pyrene and dibenz(a,h)anthracene (Heck 2013).

Incremental lifetime cancer risk (ILCR) estimation of levels of polycyclic aromatic hydrocarbons (PAHs) in road dust and agricultural soils from industrial sites in Shanghai showed that the PAHs in the dusts and soils had potential cancer risk for both children and adults only by direct ingestion exposure (Jia 2017). The total incremental lifetime cancer risk from urban street dust, including dermal contact, ingestion and inhalation exposure pathways, was estimated to be 4.12×10^{-6} and 3.98×10^{-6} for children and adults, respectively (XS Wang 2018).

Children with higher exposures to benzene, toluene, ethylbenzene and xylenes (BTEX) compounds were more likely to receive academic support services later in childhood. Urban air pollution may affect children's neurodevelopment and educational trajectories (Stingone 2017).

Brockmeyer & D'Angiulli's review (2016) reports that several samples of children populations living in large cities around the world suffer to some degree neural, behavioural and cognitive changes associated with air pollution exposure. The breakdown of natural protective barriers facilitates the passage of airborne pollutants into the body of young urban residents. Extensive neuroinflammation contributes to cell loss within the central nervous system, and likely is a crucial mechanism by which cognitive deficits may arise. Although subtle, neurocognitive effects of air pollution are substantial, apparent across all populations, and potentially clinically relevant as early evidence of evolving neurodegenerative changes.

In the UK, air pollution is believed to be responsible for upwards of 40,000 premature deaths per year. In 2017, it only took London 5 days to breach its annual air pollution limit and legal limits were easily surpassed in the vast majority of local authorities. The effects are particularly pernicious for children whose lungs are still developing. Much (though by no means all) of the problem comes down to emissions from diesel vehicles. 97% of modern diesel cars exceed the official limit for NOx pollution (Guardian April 2017).

Current day concentrations of ambient air pollution have been associated with a range of adverse health effects, particularly mortality and morbidity due to cardiovascular and respiratory diseases. In this review, we summarize the evidence from epidemiological studies on long-term exposure to fine and coarse particles, nitrogen dioxide (NO2) and elemental carbon on mortality from all-causes, cardiovascular disease and respiratory disease. We also summarize the findings on potentially susceptible subgroups across studies (Hoek 2013).

Klocke (2017) found that vulnerability of the brain to air pollution extends to gestation and produces features of several neurodevelopmental disorders in both sexes.

Airborne particulate matter exposure promotes pathological brain aging in older women and may contribute to the development of Alzheimer's disease (Cacciottolo 2017). Jørgensen (2016) found weak evidence for association between risk of brain tumours and long-term exposure to air pollution in women older than 44 years. They also found that obese women may be susceptible, as well as having a positive tendency towards elevated risk for meninges and benign tumours, which require further investigation.

Arsenic

Data from a study by Naujokas (2013) call for heightened awareness of arsenic-related pathologies in broader contexts than previously perceived. Testing foods and drinking water for

arsenic, including individual private wells, should be a top priority to reduce exposure, particularly for pregnant women and children, given the potential for life-long effects of developmental exposure.

Changes in buildings

Ubiquitous pollutants that exceed the concentration recommendations, including particulate matter, formaldehyde, benzene and other VOCs, moisture/mould, inorganic gases and radon, were found, indicating a common indoor air quality (IAQ) issue in Chinese dwellings. With very little prevention, oral, inhalation and dermal exposure to those pollutants at unhealthy concentration levels is almost inevitable. Two directional ventilation modes would have profound impacts on improving IAQ for Chinese residences are: 1) natural (or window) ventilation with an air cleaner and 2) mechanical ventilation with an air filtration unit. Mode 1 is more applicable due to its low cost and low energy consumption (W Ye 2017).

Endocrine disruptors

Endocrine disruptors (EDs) are pollutants that alter the endocrine system and are involved in carcinogenesis. When ED exposure happens at critical periods of life, from embryo to puberty, they can act at doses considered safe for an adult. Furthermore, their epigenetic effects can also influence the cancer risk of future generations. There are thousands of newly introduced substances whose potential endocrine-disrupting and cancer effects are completely unknown. Although there are still gaps in our knowledge, these data support the urgent need for health and environmental policies aimed at protecting the public and in particular, the developing fetus and women of reproductive age (Del Pup 2016).

Fracking (hydraulic fracturing)

Elliott (2017) provides some support for the hypothesis that exposure to unconventional oil and gas development could increase the risk of leukaemia.

In a study by McKenzie (2017) there were more cases of ALL in children and young people of 0-24 years old who lived in an area with the highest number of gas and oil wells within 16 kilometres. Oil and gas development has potential to expose a large population to known haematologic carcinogens. There are a lot of problems in the USA of drinking water pollution in areas with gas and oil wells. This problem has greatly increased since fracking started.

Gas Pipelines & EMFs

A natural gas pipeline has been associated with ocular melanoma, a rare cancer, in a nearby high school and those living and working nearby. The authors suggested that this was due to the practice of using the earth as a conduit for return currents (Milham & Stetzer 2017).

Light pollutants

In towns and cities across the world, the colour of night is changing. Traditional yellow sodium street lights are steadily being replaced by white LED lamps. The new lights use less energy, dramatically cutting carbon emissions and saving money. The bright light disturbs many people's sleep, and for many produces a significantly worse feeling than the natural light of the moon (BBC news March 2017). Protestors point to a report by the American Medical Association (AMA), which warns that the blue light emitted by first generation high-intensity LEDs, used in many cities around the world, can adversely affect circadian sleep rhythms, leading to reduced duration and quality of sleep, "impaired daytime functioning" and obesity. The AMA report calls on cities to use the lowest-intensity LEDs possible and shade them better to reduce glare, which it warns can also harm wildlife.

Moulds

Moulds in water-damaged buildings

Over the past 20 years, exposure to mycotoxin producing mould has been recognized as a significant health risk. Scientific literature has demonstrated mycotoxins as possible causes of human disease in water-damaged buildings (WDB) (Brewer 2013). Almost 30% of people diagnosed with chronic fatigue syndrome had more than one mycotoxin present in their urine samples. Ochratoxin A (OTA) was the most prevalent mycotoxin detected (83%) and macrocyclic trichothecenes (MT) was the next most common (44%).

Traffic pollutants

Significant elevations in the risk of childhood leukaemia have been associated with environmental exposure to gasoline; aromatic hydrocarbons from refinery pollution, petroleum waste sites, and mobile sources (automobile exhaust). The author suggested that children might represent a subpopulation in which a higher risk of leukaemia is associated with very low level exposure to environmental benzene (Infante 2017, Steinmaus & Smith 2017). Other environmental chemical and familial exposures may also play a part, but benzene seems a significant risk factor (Jiang 2016). In one of the largest studies of its kind (Danysh 2015), results suggest positive associations between hazardous air pollutants and incidence of astrocytoma (1,3-butadiene and DPM) and medulloblastoma (DPM).

The combustion of fuels such as diesel, gasoline, and bio-blends triggers biochemical and immunological changes in exposed people. A study by Manzetti & Andersen (2016) provides evidence for the need to reduce emissions in urban centres, with an emphasis on the prevention of exposure of groups such as children, the elderly, and other vulnerable people, and shows how the exposure to exhaust emissions induces mechanisms of pathogenesis related to cardiopulmonary pathologies and long-term diseases such as asthma, allergies, and cancer. Scientists from MIT estimated that the excess emissions generated by diesel vehicles that were over the European limit could cause approximately 60 premature deaths across the US. The researchers estimate that 1,200 people in Europe will die early, each losing as much as a decade of their life, as a result of excess emissions generated between 2008 and 2015 by affected cars sold in Germany (Chossière 2017).

NO2 concentrations at roadside locations in Inner London have remained largely static since the early 2000s, and remain well above the legal limit of 40 µg/m3. The VW Polo was reported in March 2017 as emitting as much N02 emissions as a heavy duty lorry (International Business Times), more than 13 times higher than EU regulations allow. Scientists at Leeds University's Institute for Transport Studies said that the Polo was one of the worst polluters on Britain's roads. Other high polluters included a Vauxhall Astra, Ford Focus and BMW 318d, according to the research. The bigger VW Passat was found to be one of the lowest-emitting diesel of the cars studied.

The problem is that modern cars with catalytic converters emit ultrafine aerosol particles of size order 2 nm to 200 nm (0.02 to 0.2 microns) which travel long distances from the roadside, so roadside measurements are always likely to underestimate exposure levels. So, all that has been achieved is the reduction of pollution at the roadside, affecting those very close to roads, to be replaced by exposure to a much wider population, away from the roadside.......... and official measures of pollution still concentrate on NOx by the roadside rather than the real nasty carcinogenic aerosols (Sunday Times January 2017).

Mostafavi (2017) assessed the association between exposure to ambient air pollution and genome-wide gene-expression levels in peripheral blood mononuclear cells collected from 550 healthy subjects. The study provided evidence of subtle changes in gene expression related to exposure to long-term NOx which they suggested may indicate similarities between air pollution and tobacco induced changes in the transcriptome.

Chen and colleagues provide new knowledge showing direct evidence that residing in close proximity to a high traffic road will increase the risk of developing dementia (Calderón-Garcidueñas & Villareal-Ríos (2017).

Woodward (2017) proposed that traffic-related air pollution-associated human cognitive and white matter changes involve hippocampal responses that begin at younger ages, potentially affecting those who may have a vulnerability to dementias.

Ambient air pollution exposure, especially from traffic-related pollutants increases the risk of Parkinson's disease (PC Lee 2016, Ritz 2016, C Chen 2017).

In-pram babies are susceptible to air pollution effects. A study by Kumar (2017) reported that babies in prams on school runs are exposed to high levels of pollution from vehicles at traffic intersections and bus stops, especially in the mornings but also in the afternoons. Parents and carers may want to bear this in mind for planning their route to schools when taking a baby along. A recent WHO report states that 570,000 children under the age of 5 die every year from respiratory infections, such as pneumonia, attributable to indoor and outdoor air pollution, and second-hand smoke.

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