

## Recent research on the health impacts of emissions from waste incinerators

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Overall, findings based on scientific research into toxic emissions from municipal waste incinerators (MWIs) indicate that waste incineration has contributed significantly to air pollution and continues to do so, worsening the toxicity of the air we breathe and the food we eat, while increasing the burdens to society in terms of chronic ill health and premature death. The research also underscores that current uncertainties reflect a dearth of evidence, highlighting the need to apply the precautionary principle.

Note that a group of 70 doctors has called on the Prime Minister to stop the construction of the North London Heat and Power Plant in Edmonton. See Emma Bartholomew. 2020. 'Doctors call on PM to "save lives" and halt plan for £1.2bn incinerator to burn north London's waste.' *Hackney Gazette*. 28 September. <https://www.hackneygazette.co.uk/news/environment/doctors-call-on-pm-to-pull-plug-on-north-london-incinerator-1-6858982>

Focus	Findings	Citation	Notes
Birth defects	'small excess risks associated with congenital heart defects and genital anomalies in proximity to MWIs'; 'small increased risks (2–7%) with proximity to the nearest MWI were observed for <b>all congenital anomalies combined</b> , congenital heart defects and genital anomalies, specifically hypospadias'; as the study <b>considers only PM<sub>10</sub> emissions</b> , and no other emissions, such as dioxins, ' <b>further monitoring of exposures and health outcomes near MWIs appears warranted</b> '	Brandon Parkes, Anna L. Hansell, Rebecca E. Gosh, Philippa Douglas, Daniela Fecht, Diana Wellesley, Jennifer J. Kurinczuk, Judith Rankin, Keesde Hoogh, Gary W. Fuller, Paul Elliott, and Mirelle B. Tolledano. 2020. 'Risk of congenital anomalies near municipal waste incinerators in England and Scotland: Retrospective population-based cohort study.' <i>Environmental International</i> , 134. <a href="https://www.sciencedirect.com/science/article/pii/S0160412019308104">https://www.sciencedirect.com/science/article/pii/S0160412019308104</a> .	Research led by a team at Imperial College London and funded by Public Health England and the Scottish Government. Study of MWI emissions at 22 sites across the UK between 2003 and 2010.
Accumulation of metals in the body	'Results [show] an <b>increased body burden of specific metals in children free-living in an urban area and exposed to emissions from waste incinerators</b> , as compared with controls'; 'percentage of children having toenail metal concentrations above the limit of detection was <b>higher in exposed children than in controls for Al, Ba, Mn, Cu, and V (aluminium, barium, manganese, copper and vanadium)</b> . Exposed children had <b>higher absolute concentrations of Ba, Mn, Cu, and V</b> , as compared with those living in the reference area'; ' <b>metals should be considered an indicator of exposure to a complex combination of pollutants generated from waste combustion</b> , including gaseous pollutants, persistent organic pollutants, and a number of other toxic chemicals vehiculated by particulate matter'; 'cumulative exposure to complex mixtures of chemicals of industrial origin may generate synergistic effects on health'	Agostino Di Ciaula, Patrizia Gentilini, Giusy Diella, Marco Lopuzzo, and Ruggero Ridolfi. 2020. 'Biomonitoring of Metals in Children Living in an Urban Area and Close to Waste Incinerators.' <i>International Journal of Environmental Research and Public Health</i> , 17(6). <a href="https://www.mdpi.com/1660-4601/17/6/1919">https://www.mdpi.com/1660-4601/17/6/1919</a> .	The study area is defined as the 3.5-km radius around two incinerators in an urban area in Italy. The researchers assess the concentration of 23 metals in children's toenails.
Toxicity and damage to living cells	' <b>Fine particles (PM<sub>2.5</sub>) emitted from municipal solid waste incineration (MSWI) contain high amounts of toxic compounds and pose a serious threat to environment and human health</b> '; MSWI PM <sub>2.5</sub> had <b>higher contents of heavy metals (including Pb, Zn, and Cu) and dioxins (PCDD/Fs)</b> than did BMI PM <sub>2.5</sub> ; MSWI PM <sub>2.5</sub> caused <b>more serious cell injuries</b> , as indicated by the lower viability, higher ROS [reactive oxygen species] generation, and <b>DNA damage</b> '	Yu Shang, Meiyong Wu, Jizhi Zhou, Xing Zhang, Yufang Zhong, Jing An, and Guangren Qian. 2019. 'Cytotoxicity comparison between fine particles emitted from the combustion of municipal solid waste and biomass.' <i>Journal of Hazardous Materials</i> , 367, 316–24. <a href="https://doi.org/10.1016/j.jhazmat.2018.12.065">https://doi.org/10.1016/j.jhazmat.2018.12.065</a> .	The study compares PM <sub>2.5</sub> collected from municipal solid waste incineration (MSWI) and biomass incineration (BMI).

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Deaths, respiratory and cardiovascular conditions	'In total, <b>15 deaths of London residents per year are calculated to be attributable to emissions of nitrogen oxides and particulate matter from the five EfW facilities. For hospital admissions, less than one per year for both respiratory and cardiovascular conditions is calculated to be attributable to particulate matter emission from the five EfW facilities</b> '; 'Emissions from the five EfW facilities within Greater London are predicted to be associated with <b>15 deaths of London residents per year, as well as 0.9 respiratory hospital admissions and 0.8 cardiovascular hospital admissions per year</b> '; 'the contribution of the facilities to annual mean <b>concentrations of nitrogen dioxide and particulate matter is greatest close to the facilities</b> '	Ben Marner, Tom Richardson, and Duncan Laxen. 2020. <i>Health Effects due to Emissions from Energy from Waste Plant in London</i> . Air Quality Consultants Ltd. Commissioned by the Greater London Authority. May. <a href="https://www.london.gov.uk/sites/default/files/gla_efw_study_final_may2020.pdf">https://www.london.gov.uk/sites/default/files/gla_efw_study_final_may2020.pdf</a>	A study of the impacts of five London energy-from-waste incinerators on air quality and human health. It considers solely emissions of nitrogen oxides and particulates.
Undetected carcinogenic chemicals (due to loopholes in measurement protocols)	This study demonstrates that limits on emissions of carcinogenic chemicals are commonly exceeded but that breaches often go undetected; the study finds <b>high levels of dioxins in eggs of free-range chickens in areas close to incinerators</b> ; 'pattern of elevated UPOPs [unintentionally produced persistent organic pollutants] during start-up or shutdown events'; 'measurement of a much broader spectrum of POPs in flue gases is strongly advised to meet the need for the elimination of all POPs in the environment, which is the major objective of the Stockholm Convention'	Abel Arkenbout and Jindrich Petrlik. 2019. 'Hidden emissions of UPOPs: Case study of a waste incinerator in the Netherlands.' Project: Dioxins and incineration. <a href="https://www.researchgate.net/publication/336650688">https://www.researchgate.net/publication/336650688</a> .	This study challenges claims that state-of-the-art incinerators keep emissions of dioxins and other carcinogenic chemicals below legally permitted levels. See also <a href="https://www.researchgate.net/search/publication?q=High+levels+of+PCDD%2FFs+around+sites+with+waste+containing+POPs+demonstrate+the+need+to+review+current+standards">https://www.researchgate.net/search/publication?q=High+levels+of+PCDD%2FFs+around+sites+with+waste+containing+POPs+demonstrate+the+need+to+review+current+standards</a>
Literature review: health impacts of waste incineration	'A range of adverse health effects were identified, including <b>significant associations with some neoplasia [cancer], congenital anomalies, infant deaths and miscarriage</b> '; 'older incinerator technology and infrequent maintenance schedules have been strongly linked with adverse health effects. More recent incinerators have fewer reported ill effects, perhaps because of inadequate time for adverse effects to emerge. A <b>precautionary approach is required</b> . Waste minimisation is essential.'	Peter W. Tait, James Brew, Angelina Che, Adam Costanzo, Meg Davies, Ahmed Khalaf, Kathryn McMahon, Alastair Watson, Kirsten Rowcliff, and Devin Bowles. 2020. 'The health impacts of waste incineration: a systematic review.' <i>Australian and New Zealand Journal of Public Health</i> , 44(1), 40–48. <a href="https://onlinelibrary.wiley.com/doi/full/10.1111/1753-6405.12939">https://onlinelibrary.wiley.com/doi/full/10.1111/1753-6405.12939</a>	Analysis of a large number of studies published in the last 30 years.
Literature review: cancer rates near waste incinerators	The study finds that the literature focuses on specific toxic pollutants—dioxins, furans, and heavy metals (the best-known carcinogenic chemicals)—but that it does not cover a host of other chemicals emitted from incinerators and their possible interactions. The study calls for more complete epidemiological studies and points to a <b>lack of evidence for current dioxin limits</b> .	Jose L. Domingo, Montse Marquès, Montse Mari, and Marta Schumacher. 2020. 'Adverse health effects for populations living near waste incinerators with special attention to hazardous waste incinerators: A review of the scientific literature.' <i>Environmental Research</i> , 187. <a href="https://doi.org/10.1016/j.envres.2020.109631">https://doi.org/10.1016/j.envres.2020.109631</a>	Analysis of studies on the incidence of cancer and cancer mortality in areas near incinerators.
Fine and ultra-fine particulate matter (PM)	'To date, <b>no threshold level of PM<sub>2.5</sub> is advised as safe for the general population</b> .'	Bing Zhao, Fay H. Johnston, Farhad Salimi, Masahiko Kurabayashi, and Kazuaki Negishi. 'Short-term exposure to ambient fine particulate matter and out-of-hospital cardiac arrest: a nationwide case-crossover study in Japan.' <i>The Lancet</i> . 2020. 4(1), e15-e23. <a href="https://www.thelancet.com/journals/lanplh/article/PIIS2">https://www.thelancet.com/journals/lanplh/article/PIIS2</a>	

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		<a href="https://uk-air.defra.gov.uk/networks/network-info?view=particle">542-5196(19)30262-1/fulltext</a>	
	<b>'Exposure to airborne PM is associated with a range of adverse effects on human health including effects on the respiratory and cardiovascular systems, leading to hospital admissions and mortality. There is increasing evidence that fine (PM<sub>2.5</sub>) and ultrafine particulate matter (&lt;100nm) plays a more significant role than previously thought, although as yet the precise toxicological mechanisms are not clearly understood.'</b>	Department for Environment Food & Rural Affairs (DEFRA). n.d. 'UK AIR: Particle Numbers and Concentrations Network.' <a href="https://uk-air.defra.gov.uk/networks/network-info?view=particle">https://uk-air.defra.gov.uk/networks/network-info?view=particle</a>	
	'There is a very real health concern associated with the inhalation of toxic gases and aerosols produced during the incineration/combustion of municipal solid waste'; measurements 'indicate that over 90% of the emitted particles are ultra-fine particles (UFPs) <0.1 micron in size', implying that <b>'the bag filters used for the removal of particles produced in the incineration process have a very low efficiency for the removal of UFPs</b> , contradicting assertions that these filters have a high removal efficiency for UFPs'; analysis of fibre filter retention revealed <b>'filter efficiency as low as 5%'</b> for UFPs	UK Without Incineration Network (UKWIN). 2019. 'The Particulate Research Group (PRG).'	Mike Reeks, Professor Emeritus of Fluid Dynamics, Newcastle University, studied filtration of emissions from incinerators.
	'Scientific evidence has shown that the real dangerous impact of incineration comes from the smallest particles, PM <sub>0.1</sub> and PM <sub>1</sub> , because they are absorbed into the bloodstream through the lungs. These <b>particles are too small to be filtered and are therefore emitted directly into the air that we breathe.'</b>	<a href="https://ukwin.org.uk/particulates/">https://ukwin.org.uk/particulates/</a>	Former MP Dr David Drew chairs the Particulate Research Group. Mentioned in: Circular. 2019. "Important caveats" omitted from incinerator health dangers, group claims.' 10 December. <a href="https://www.circularonline.co.uk/news/important-caveats-omitted-from-incinerator-health-dangers-group-claims/">https://www.circularonline.co.uk/news/important-caveats-omitted-from-incinerator-health-dangers-group-claims/</a>
	'epidemiological studies worldwide have consistently demonstrated links between ambient particulate matter exposure and adverse health outcomes, including increased rates of respiratory and cardiovascular illness, hospitalisations, and premature mortality. Studies have shown that <b>ultrafine particles are more toxic than larger particles'</b> ; <b>'bag filter systems on municipal waste incinerators cut out the larger particles and produce an aerosol of the smallest particles, which are precisely those that are most hazardous to health. This is likely to have long-term health impacts on communities in the vicinities of waste incinerators'</b>	2019. 'New incinerator pollution report released.' Press release. 9 December. <a href="https://ukwin.org.uk/files/particulates/PRG-Particulates-Matter-December-2019-Press-Release.pdf">https://ukwin.org.uk/files/particulates/PRG-Particulates-Matter-December-2019-Press-Release.pdf</a>	Vyvyan Howard is Emeritus Professor of Nano Systems Biology at the Centre for Molecular Bioscience, University of Ulster.
	'Recent authoritative reviews [...] have noted that <b>few epidemiological studies investigating concentration-effect relationships for UFP are available, because of insufficient measurements of UFP metrics such as particle number concentration.</b> The World Health Organization [...] concluded that the epidemiological <b>data are currently too scarce to evaluate or to use as the basis for recommending an air quality guideline for UFP.'</b>	Air Quality Expert Group. 2018. <i>Ultrafine Particles (UFP) in the UK</i> . Prepared for Department for Environment, Food and Rural Affairs; Scottish Government; Welsh Government; and Department of the Environment in Northern Ireland. <a href="https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1807261113_180703_UFP_Report_FINAL_for_publication.pdf">https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1807261113_180703_UFP_Report_FINAL_for_publication.pdf</a>	

## AIR POLLUTION AND COVID-19

Recent studies confirm links between air pollution and Covid-19 deaths (see the table below). Poor air quality has also been linked to depression, reductions in intelligence, and other health impacts (see, for example, <https://www.theguardian.com/environment/2019/jan/30/children-exposed-to-air-pollution-more-likely-to-develop-depression>; <https://www.theguardian.com/environment/2018/aug/27/air-pollution-causes-huge-reduction-in-intelligence-study-reveals>).

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Air pollution and Covid-19 deaths	'long-term exposure to this pollutant [Nitrogen dioxide (NO <sub>2</sub> )] may be <b>one of the most important contributors to fatality caused by the COVID-19 virus</b> '	Yaron Ogen. 2020. 'Assessing nitrogen dioxide (NO <sub>2</sub> ) levels as a contributing factor to the coronavirus (COVID-19) fatality.' <i>Science of the Total Environment</i> , 726. <a href="https://doi.org/10.1016/j.scitotenv.2020.138605">https://doi.org/10.1016/j.scitotenv.2020.138605</a>	Both articles are mentioned in: Damian Carrington. 2020. 'Air pollution may be "key contributor" to Covid-19 deaths—study: Research shows almost 80% of deaths across four countries were in most polluted regions.' <i>Guardian</i> . 20 April. <a href="https://www.theguardian.com/environment/2020/apr/20/air-pollution-may-be-key-contributor-to-covid-19-deaths-study?CMP=Share_AndroidApp_Gmail">https://www.theguardian.com/environment/2020/apr/20/air-pollution-may-be-key-contributor-to-covid-19-deaths-study?CMP=Share_AndroidApp_Gmail</a>
	' <b>higher historical PM<sub>2.5</sub> exposures are positively associated with higher county-level COVID-19 mortality rates</b> after accounting for many area-level confounders'	X. Wu, R.C. Nethery, M.B. Sabath, D. Braun, and F. Dominici. 2020. 'Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis.' <i>Science Advances</i> , 6(45). <a href="https://advances.sciencemag.org/content/6/45/eabd4049">https://advances.sciencemag.org/content/6/45/eabd4049</a> .	
	'compelling evidence of a <b>positive relationship between air pollution, and particularly PM<sub>2.5</sub> concentrations, and Covid-19 cases, hospital admissions and deaths</b> . This relationship persists even after controlling for a wide range of explanatory variables'; 'a municipality with 1 µg/m <sup>3</sup> more PM <sub>2.5</sub> concentrations will have <b>9.4 more Covid-19 cases, 3.0 more hospital admissions, and 2.3 more deaths</b> . This relationship between Covid-19 and air pollution withstands a number of sensitivity and robustness exercises'; 'It is well known that long term exposure to pollutants such as nitrogen dioxide (NO <sub>2</sub> ), sulphur dioxide (SO <sub>2</sub> ), and fine particulate matter (PM <sub>2.5</sub> ) contributes to cardiovascular disease, reduces lung function, and causes respiratory illness'; 'These pollutants have been shown to cause a <b>persistent inflammatory response</b> even in the relatively young, and to <b>increase the risk of infection by viruses that target the respiratory tract</b> '	Matthew A. Cole, Ceren Ozgen, and Eric Strobl. 2020. 'Air Pollution Exposure and Covid-19 in Dutch Municipalities.' <i>Environmental and Resource Economics</i> , 76, 581–610. <a href="https://link.springer.com/article/10.1007/s10640-020-00491-4">https://link.springer.com/article/10.1007/s10640-020-00491-4</a> .	