

Filtration		Synopsis
Title	Cardiovascular Mortality and Long-Term Exposure to Particulate Air Pollution	It was found that long term exposure to particulate matter increased the mortality of ischemic heart disease, dysrhythmias, heart failure, and cardiac arrest. An 8-18% increase in mortality rates were seen with a 10ug/m3 increase in PM2.5. These health complications posed more risk to smokers compared to nonsmokers.
Author(s)	Circulation	
AA Location	4-4	
Web address		
Title	Fine Particulate Air Pollution and Hospital Admission for Cardiovascular and Respiratory Diseases	Fine particulate matter (PM2.5) was analyzed in association to hospital admissions for cardiovascular and respiratory diseases. It was found that with an increase in fine particulate matter, the risk for hospital admission for these diseases increased. Most notable was a 1.28% increase of heart failure in same day exposure to fine particulate matter. These values tended to be higher in the Eastern US.
Author(s)	Journal of American Medical Association	
AA Location	4-3	
Title	Socioeconomic status in the association between air pollution and cardiovascular disease	Long term exposure to fine particulate matter (PM2.5) is associated with cardiovascular disease. There was a 13% increased risk of cardiovascular disease associated with a 5ug/m3 increase in fine particulate matter (PM2.5). This is also positively associated with low socioeconomic status at both the individual and neighborhood level as these areas experience the most pollution in comparison to other locations of higher socioeconomic status. Of the low neighborhood socioeconomic levels, women were observed to be the most susceptible to air pollution and its ill effects.
Author(s)	Env. Health Perspectives	
AA Location	4-5	
Web address		
Title	Age-specific associations of ozone and fine particulate matter with respiratory emergency department visits in the United States	Increases in ozone and fine particulate matter (PM2.5) were associated with increased respiratory emergency department visits in the 17 states monitored. These respiratory illnesses included asthma, COPD, pneumonia, and acute respiratory infections including bronchitis and bronchiolitis. This study monitored all age groups.
Author(s)	American Journal of Respiratory and Critical Care Medicine	
AA Location	Physician Form	
Web address	https://www.atsjournals.org/doi/10.1164/rccm.2019.09.1677	

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Title	Building Air Treatment Systems Will Be Common by 2030	Developers predict that air purifying systems will be commonplace in residential housing by the year 2030. Technologies such as "energy recovery ventilators" and disinfecting using ultraviolet light are becoming more popular. Using purified fresh air is a main target, as well as indoor sensors that provide more filtration/ventilation when it detects that air quality is low.
Author(s)	Florida Realtors	
AA Location		
Web address	https://www.floridarealtors.org/ne	
Title	Effects of the PremierOne Air Filter on Airborne Particles in a Recirculating Air Duct	A study that determines the effectiveness of the PremierOne Electronic Air Filter. It works by giving polar ionic charges to the particles that pass through the filter, and after multiple passes through the filter, the particles agglomerate and are removed. Tobacco smoke was introduced into the room and it was found that there was a 97.8% decrease in 0.3 µm particles after five minutes when compared to no filter . There was a 99.7% decrease in 1.0 µm particles after four minutes when compared to no filter .
Author(s)	Kerby Fannin, MPH, PhD	
AA Location	7-14	
Web address		
Title	Unhealthy Homes	Contains a collection of summary findings from various studies: In a study from Cincinnati Children's Hospital there was a ten-fold decrease in ER visits of homes that were cleaned from mold compared to those who were not. 65% decrease in ER visits were found in a similar study. Homes that had a high ERMI value with children at 1 year of age had twice the risk of developing asthma before age 7 . After addressing IAQ in schools, there was an 80% decrease in need of emergency asthma intervention, and decreased it absenteeism by half . Particulate matter has been linked to chronic respiratory illnesses like asthma and coughing, wheezing, and chest tightness . Chemical pollution indoors is 2-5 (and at times 100) times higher than outdoor pollution. High filtration systems have shown to reduce 30-35% cat allergen levels and 90-99% tobacco smoke . It is known that 10-30% of disease from PM is caused by indoor exposure .
Author(s)		
AA Location	4-30	
Web address		

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Title	EPA Plans to Get Thousands of Pollution Deaths Off the Books by Changing Its Math	<p>Most experts agree that there are no safe levels of fine particulate matter exposure caused by the burning of fossil fuels. It has been linked to heart attacks, strokes, and respiratory disease. The EPA plans on changing this math though to take off 1400 pre-mature deaths from the lists caused by PM 2.5 exposure, likely to be used by the Trump administration.</p> <p>One expert notes that reducing fine PM below the current set standard of 12 ug/m3 would save around \$40 billion per year. There is some disagreement among experts on when to start calculating the health risks caused by fine PM, as there are associated health risks at any amount of exposure.</p>
Author(s)	Lisa Friedman	
AA Location	7-16	
Web address	https://www.nytimes.com/2019/09/18/health/epa-pollution-deaths.html	
Title	EPA Air Trends: Particulate Matter	<p>A nationwide monitoring of particulate matter was done over a ten year period from 2000-2010. It was found that across the country there has been an overall decrease in outdoor particular matter levels. PM 10 levels were below the national standard, though PM2.5 levels were above the national standard from 2000-2007. The national standard has since changed from 15 up/m3 to 12 ug/m3.</p>
Author(s)	EPA	
AA Location		
Web address	https://www.epa.gov/air-trends	
Title	Trial of Air Cleaners and Hlth Coach to Improve IAQ for Inner-City Children w/ Asthma and SHS	<p>This study focused on inner-city children with asthma that lived with a smoker. It was found that the use of air cleaners in homes of at least one smoker significantly reduced fine particulate matter levels and increased the number of symptom-free days (cough, wheeze, chest tightness). However, the air cleaners were less effective in removing nicotine gas vapors, which indicates that the improvement of symptoms was linked to lower PM levels. Using 2 HEPA air cleaners that cost between \$200-400 is as effective as using leukotriene modifiers, which cost between \$1200-1500. Though PM levels were significantly reduced, they were still not low enough to reach outdoor standards (for homes with a smoker). Health coaches were proven to be ineffective.</p>
Author(s)	American Medical Association	
AA Location	7-18	
Web address		

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Title	Involuntary Exposure to Tobacco Smoke	As of 2000, 126 million people aged 3 and older are exposed to secondhand smoke. SHS kills more than 3000 people per year from lung cancer (20-30% risk increase compared to no exposure to SHS), 46,000 from coronary heart disease (25-30% increased risk), and 430 newborns from sudden infant death syndrome. Major conclusions: SHS can cause premature death and disease in children such as sudden infant death syndrome, respiratory infections, ear infections, and more severe asthma. Adults have immediate adverse effects to the cardiovascular system, and causes coronary heart disease and lung cancer. There has also been sufficient evidence of SHS causing small birth weight and children developing asthma. There has been suggestive yet not sufficient evidence in several cases of childhood cancer, leukemias, lymphomas, and brain tumors, and the development of chronic obstructive pulmonary disease (COPD). It lists that stopping SHS altogether is more effective than filtration or ventilation of rooms with smokers present.
Author(s)	US Dept of Health & Human Services	
AA Location	7-19	
Web address		
Title	CDC: Cigarette Smoking Among Adults -- United States, 2006	As of 2006, 20.8% of the US population were current smokers. 36.9% had a related chronic disease, 38.8% had smoking-related cancers (excluding lung cancer), 29.3% had coronary heart disease, 30.1% had a stroke, 49.1% had emphysema, and 41.1% had chronic bronchitis. The economic costs from smoking were estimated at \$92 billion in productivity losses from premature death and \$75.5 billion in related health-care costs. Updated: As of 2013, 19.0% of U.S. adults smoke cigarettes and account for 440,000 deaths per year, or one in every five deaths.
Author(s)	CDC	
AA Location	7-31	
Web address	https://www.cdc.gov/mmwr/previ	
Title	Lung Cancer and Cardiovascular Disease Mortality With ambient air pollution and cigarette smoke	It was found through a study of 1.2 million American adults (obtained data from the American Cancer Society) that there was a direct linear relationship between long-term heavy smokers and lung cancer risk. There is an exponential relationship between cardiovascular disease and smoking, with low exposure levels seeing the most exponential increase in risk and leveling off at higher exposures.
Author(s)	Env. Health Perspectives	
AA Location	7-32	
Web address		

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Title	Potentially Harmful Chemicals Widespread in Household Dust	Ten harmful chemicals known to cause adverse health effects were found in 90% of dust samples across multiple studies. They could be found everywhere in the home, from the carpet to the furniture to the household appliances used daily. Some of these chemicals included phthalates (interferes with hormones, linked to declining IQ, respiratory problems in children), and high fluorinated chemicals (linked to health problems in the immune, digestive, developmental, and endocrine systems) . Many of the chemicals are also linked to cancer, and have developmental and reproductive toxicity. One way to reduce exposure to these chemicals is using a strong HEPA filter vacuum and avoiding products with these chemicals.
Author(s)	GWU Public Health	
AA Location	7-33	
Web address	https://publichealth.gwu.edu/content	
Title	Question for Radio Interview: Filtration	A radio interview that goes over the asthma coalition and its goals. To prevent asthma and reduce the prevalence of it, it is recommended to have a filter with a rating of at least MERV 8, good housekeeping practices such as using a HEPA filter vacuum, humidity control by use of a dehumidifier, and education and access to appropriate medication and healthcare.
Author(s)	Richard Johnson	
AA Location	7-34	
Web address		
Title	Env. Tobacco Smoke Exposure in Children w/ and w/o Asthma	Environmental tobacco smoke, also known as secondhand smoke, has been linked to higher risk of middle ear infections, bronchitis and pneumonia, coughing, wheezing, worse lung function, and asthma development in children . It is also known to worsen asthma symptoms and cause more frequent attacks . From 2007-2010, children with asthma were exposed to ETS more than children without asthma.
Author(s)	Nat'l Center for Health Statistics	
AA Location	7-35	
Web address		

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Title	Indoor Air Pollution: Children's Health and the Environment	Indoor air pollutants are potentially more harmful to children than adults because children have higher respiration rates, their lungs are still developing, and they spend more time indoors. Some examples of indoor air pollutants are volatile organic compounds from common household items (i.e. formaldehyde), radon, asbestos, secondhand tobacco smoke, mold, and more. To reduce indoor air pollution, it is recommended to have regular maintenance of HVAC systems, choose non-volatile and non-toxic building materials, venting for cooking, maintaining dry environments, proper ventilation with outdoor air, and air cleaning by means of air filters and gas absorbing materials.
Author(s)	WHO	
AA Location	7-36	
Web address	https://www.who.int/ceh/capacity	
Title	Air filters and air cleaners: Rptstrum by the American Academy of Allergy, Asthma, and Immunology indoor allergen committee	Provides guidance to allergists on the topic of air filtration within the home. One study has identified ducted heating and air conditioning as 2 out of 5 things associated with asthma and bronchial responsiveness. High capacity and high efficiency filters and electronic air cleaners not only keep HVAC systems clean but also rid the air of small particulates, allergens, and fungal spores. The American Lung Association recommends a MERV 11 filter or higher. A variety of different filters are efficient in filtration and air cleaning, like HEPA HVAC filters (by far the most effective), and powered electronic filters, washable/disposable filters, and ionizers (much like electronic filters). Several studies have shown a decrease in asthma/rhinitis symptoms as well as reductions in bronchial hyperresponsiveness. HEPA filters have also been shown to reduce mold and fine PM levels in hospital units. Filtration should not be seen as a treatment for allergic respiratory diseases but rather to be used as a reduction in its prevalence. Air filtration has shown to reduce levels of particulates that may trigger the respiratory diseases, but source control and ventilation are of most importance.
Author(s)	Journal of Allergy and Clinical Immunology	
AA Location	7-37	
Web address		

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Title	The 3 Phases of Indoor Air Pollution	It categorizes indoor air pollutants into 3 categories: Germs, Chemical Gases and Odors, and Particles and Allergens. It then summarizes the different types of filters and air cleaners that can be used to filter out certain particulates like visible dust, pet dander and large spores, mold and plant spores, and dust mite feces and respirable suspended particles. Air cleaners are the most efficient to filter out all of these, as it contains polarized media, and an electronic & HEPA air cleaner. Ultraviolet lights are used to disinfect from germs and filter chemical gasses naturally.
Author(s)	Environmental Dynamics Group	
AA Location	7-38	
Web address		
Title	Air Quality in the Indoor Environment	In the indoors where we spend 90% of our time, there were high counts of mold spores found in comparison to outdoor samples. In several studies, homes that had asthmatic inhabitants and had high ERMI ratings were cleaned. Of these homes, there was a significant decrease in ER visits for asthma patients when compared to the homes that were not cleaned. Out of 72 different mold spore types, 25 were connected to allergies, 27 connected to other respiratory issues, 20 were connected to headaches, for a sum of 62 out of 72 causing some type of health issue. Particulate air pollution is associated with several health concerns like acute and chronic respiratory illness, asthma aggravation, and premature deaths, and account for a total of 10-30% of disease caused by PM inhalation. Out of 40 homes, 9 exceeded the nat'l PM2.5 limit and 19 exceeded the nat'l PM10 limit. 10 toxic chemicals were found in 90% of the homes sampled. Some easy solutions for all of these problems is the use of better and higher MERV rating filters, better housekeeping, and dehumidifiers. This would cause a significant decrease in healthcare costs across the US, as 5-10 million ER visits for asthma alone is attributed to PM2.5.
Author(s)	Air Allergen and Mold Testing	
AA Location	7-39	
Web address		

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Title	Household dust is laced with toxic chemicals	An analysis of over two dozen studies was done on the chemicals present in household dust. Ten known harmful chemicals were found in 90% of the samples taken, including chemicals such as phthalates, flame retardants, and PFOA and PFOS. These chemicals are linked to cancer, respiratory problems, developmental problems, as well as issues with the immune, digestive, and endocrine systems. Children are at particular risk as they often crawl or play on the floor where dust settles.
Author(s)	CBS News	
AA Location	8-D	
Web address	https://www.cbsnews.com/news/h	
Title	Air Pollution and PM2.5	Particulate matter pollution is mostly human caused from things like smokestacks, car engines, construction, and more. It is a leading cause behind heart disease, stroke, lung cancer, and respiratory infection. PM2.5 exposure costs 4 million lives per year. In the US alone, air pollution accounts for 200,000 deaths per year. Studies have shown that household PM2.5 levels often exceed outdoor levels, though there is no law or guideline defining what quality the indoor air environment should be.
Author(s)	Undark	
AA Location	8-L	
Web address	https://undark.org/breathtaking/	
Title	Control of asthma triggers in indoor air with air cleaners	An indoor air quality modelling system was created in order to evaluate the indoor air over the course of a year in terms of natural ventilation, portable air cleaners, and forced air ventilation with high efficiency filters. It was found that forced air systems with high efficiency filtration was the best control and reduced 30-55% of cat allergen levels, 90-99% lower risk of respiratory infection (by inhalation exposure), 90-98% lower secondhand smoke levels, and 50-75% lower mold spore levels when compared to systems with no high efficiency filters.
Author(s)	Environmental Health	
AA Location	9-22	
Web address		
Title	Is your home making you sick?	Only 9% of Americans consider indoor air quality a threat to their health and 70% do not consider it a threat at all. Nearly 40% of Americans do not clean their humidifier or kitchen range hood and use air fresheners or candles at least once a week. Nearly 20% of Americans also smoke at home or let others do so.
Author(s)	Consumer Reports	
AA Location	9-22	
Web address	https://www.consumerreports.org/	

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Title	Identifying Problems in the Indoor Environments	Some health effects can be attributed to the indoor air quality in a home or place of work. When noticing symptoms, it is important to discuss them with your doctor, identify and remove potential sources of indoor air pollution, and assess if ventilation in the home is adequate . Weatherizing the home is popular for energy savings, though it can lead to inadequate ventilation. Signs of this include stuffy air or moisture condensation build up, and mold or mildew growth. Measuring radon levels in the home is also important and remediation typically requires a skilled contractor.
Author(s)	EPA	
AA Location	9-24	
Web address	https://www.epa.gov/indoor-air-qu	
Title	Improving Indoor Air Quality	Source control, improved ventilation, and air cleaners are three ways to improve indoor air quality. Source control is the most cost effective approach. Ventilation in the home is one way to dilute and/or remove indoor pollutants. Air cleaners are also effective in improving indoor air quality if it has a high percentage efficiency rate and filtering element.
Author(s)	EPA	
AA Location		
Web address	https://www.epa.gov/indoor-air-qu	
Title	Particulate Matter Air Pollution Test	Sources of particulate matter include motor vehicles, woods stoves, and industrial emissions. A large amount of studies have attributed adverse health effects to particulate matter levels below the federal standard. 1 in every 8 ER visits for asthma in Seattle is linked to particulate matter pollution. 1,400 people die prematurely every year from PM exposure and it also accounts for \$340 million in medical costs every year in Washington. PM is linked to respiratory illnesses, asthma aggravation, increased hospital admissions, and premature death. Ozone air pollution also contributes to lung disease and one recent study linked cardio-pulmonary ER visits were twice as high on days with high ozone levels.
Author(s)	American Lung Association	
AA Location	1-13	
Web address		
Title	Particulate Matter	Outdoor particulate matter exposure (PM10 and PM2.5) has been associated with increased hospitalizations for asthma and lung and heart related respiratory illnesses. Exposure also increases the risk of premature death, especially if you have cardiopulmonary disease. It has also been associated with reduced lung function and adverse respiratory symptoms in children.
Author(s)	American Petroleum Institute	
AA Location	1-23	
Web address	https://www.api.org/oil-and-natural-gas	

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Title	Indoor Air Particles Affect Vascular Function in the Aged An Air Filtration-based Intervention study	A study evaluating the health of elderly patients was done after installing HEPA filters for 48 hours into their homes. Particulate matter levels decreased significantly and was associated with improvement in microvascular function (MVF) and thus reducing the risk of cardiovascular disease.
Author(s)	American Journal of Respiratory and Critical Care Medicine	
AA Location	2-6	
Web address		
Title	Outdoor Air Pollution and COPD-Related ED Visits, Hospital Admissions, and Mortality: A Meta-Analysis	A study of particulate matter, nitrogen dioxide, and sulfur dioxide levels were compared against COPD-related emergency department and hospital admissions as well as mortality. It was found that increases in outdoor concentrations of these substances were positively and significantly associated with COPD related ED visits, hospital admissions, and mortality.
Author(s)	Journal of Chronic Obstructive Pulmonary Disease	
AA Location	2-7	
Web address		
Title	Air Pollution is the greatest human health risk	Particulate matter levels over the WHO guidelines is causing an average of 1.8 years loss of life expectancy for the average person around the world. This increased from 1.0 in 1998 to 1.8 in 2016.
Author(s)	Niall McCarthy	
AA Location	2-11	
Web address	https://www.manufacturing.net/og	
Title	Health Benefits of Particle Filtration	This study analyzed publication prior to 2000 regarding particle filtration and 16 more recent studies (as of 2013). A 7-25% improvement of general health outcomes was observed. Generally, it was found that particle filtration moderately improved allergy and asthma symptoms, particularly in homes with pets. Providing filtered air to the breathing zone of an asthmatic or allergic person was shown to be more effective than whole-house filtration systems. There does not seem to be much improvement in health outcomes for people without allergies or asthma. However, filtration has shown to reduce future coronary events. Overall, particle filtration reduces the morbidity and mortality of indoor exposure to outdoor air/pollution.
Author(s)	Indoor Air	
AA Location	2-23	
Web address		

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Title	Dose-response relationship to inhaled endotoxin in normal subjects	This study establishes the dose-response level of the endotoxin derivative lipopolysaccharide (LPS). Inhalation of the endotoxin is associated with multiple pulmonary diseases and severe asthma and inhalation of pure LPS causes a blood and lung inflammatory reaction. Fever and shaking chills are the immediate symptoms. This study established that the no-response threshold for LPS was lower than 0.5ug.
Author(s)	American Journal of Respiratory and Critical Care Medicine	
AA Location	2-18	
Web address		
Title	Clean Air Act	The Clean Air Act addressed air pollution and its regulation. The six main pollutants: ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. After the act was in place, it prevented (As of 2020) upwards of 2.4 million asthma exacerbations, 17 million missed school days, 5.4 million missed work days, 230,000 adult mortalities from particulate, 280 infant mortalities from particulate, 75,000 chronic bronchitis cases, 200,000 heart disease cases, and more.
Author(s)	EPA	
AA Location	2-24	
Web address		
Title	Independent and Joint Contributions of Fine Particulate Matter Exposure and Population Vulnerability to Mortality in the Detroit metropolitan Area	A study performed in the Detroit area found that in areas with population vulnerability (i.e. low-income, 2/5 of the population is of color, renters, less than high school education, linguistically isolated) and high PM2.5 levels there were high cases of cardiopulmonary mortality. These high levels were below the current U.S. standards and reducing PM2.5 levels would reduce cases of cardiopulmonary mortality by 18%.
Author(s)	International Journal of Environmental Research and Public Health	
AA Location	4-17	
Web address		

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Title	Acute Effects of Ambient Particulate Matter on Mortality in Europe and North America: Results from the APHENA Study	PM10 was studied across many cities located in the United States, Europe, and Canada. A 10ug/m3 increase in PM10 was associated with a range of 0.2-0.6% increase in daily mortality rate. The increase in mortality affected all age and groups but affected people older than 75 the most. Cities in Europe and US had similar daily mortality percentages, though Canada differed greatly and had mortality rates as great as 1.4% per 10ug/m3 PM10 increase.
Author(s)	Env. Health Perspectives	
AA Location	4-18	
Web address		
Title	Associations of particulate matter and its components with emergency room visits for cardiovascular and respiratory diseases	A study evaluated the association between ER visits for cardiovascular and respiratory diseases to increases in PM2.5 (i.e. organic and elemental carbon, ammonium, and more). It was found that all pollutants analyzed contributed to cardiovascular ER visits, the most influential being ammonium. Lagged SO2 was also associated with respiratory ER visits. There was a significant association with organic carbon and cardiovascular ER visits for women and the elderly, implying they are the more vulnerable population.
Author(s)	PLOS One	
AA Location	4-22	
Web address		
Title	7 million deaths annually linked to air pollution	The WHO reported that in 2012, 7 million deaths were due to air pollution, both indoor and outdoor. That is about 1 in every 8 deaths globally. There was also a link discovered between air pollution and cardiovascular disease, strokes, ischemic heart disease, and cancer.
Author(s)		
AA Location	5-4	
Web address	https://www.who.int/mediacentre	
Title	Reducing Global Health Risks	It is estimated that 3.7 million deaths per year are due to exposure to fine particulate matter (PM2.5) in the outdoors, while 4.3 million deaths are due to indoor combustion sources. Exposure to PM2.5 causes disease such as stroke, ischemic heart disease, acute lower respiratory disease, COPD, and lung cancer. It is estimated that 2.4 million lives could be saved from mitigating short-lived climate pollutants such as fine particulate matter.
Author(s)	WHO	
AA Location	3-5	
Web address	https://www.who.int/phe/publicat	

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Title	Can the AC filter in your home, office, or local mall protect you from Covid-19?	Joseph Allen is the director of the Healthy Buildings Program at the Harvard T.H. Chan School of Public Health. He recommends the use of a HEPA filter in buildings to help prevent the airborne transmission of the coronavirus. The highest MERV rating HEPA filter has the possibility of filtering out 99.97% of particles in the air when it is at its worse performance. However, not all HVAC systems can handle this high amount of filtration. MERV 13 filters are recommended for typical home and building use. It can filter out pollen, dust, mold, bacteria, and viruses. Ventilation is also important, as well as keeping the humidity between 40-60% to help control airborne transmission.
Author(s)	CNN	
AA Location	10-3	
Web address	https://www.cnn.com/2020/07/07/	
Title	Air pollution not only affects health, but also cognition	A study was performed that evaluated the performance of chess players at a tournament while also monitoring indoor air quality levels. It was found that when fine particulate matter (PM2.5) was the highest, the chances of a player making an error increased by 26.3%. Older individuals were the most affected by this change in indoor air quality. The chances of making an error also increased when under a time limit. Several other studies in Australia have also linked air pollution to cognitive decline and it is suspected that there is a significant link between air pollution in childhood and developing a mental disorder.
Author(s)	Air Quality News	
AA Location	10-9	
Web address	https://airqualitynews.com/2019/1/	
Title	Consumer Product Chemicals in Indoor Dust: A Quantitative Meta-analysis	Indoor dust is known to carry harmful chemicals such as phthalates, replacement flame retardants (RFRs), perfluoroalkyl substances (PFASs), synthetic fragrances, and environmental phenols. Of the household dust samples collected, phthalates were found to be in the highest concentrations. Phenols, RFRs, fragrance, and PFASs were shortly followed. These chemicals are known to cause reproductive and endocrine system harm. Environmental exposure can be from air, dust, or dermal pathways. Children are most vulnerable to indoor exposure of contaminated dust because they frequently crawl on the floor and put things in their mouths and have faster breathing rates. The specific health effects include "reproductive toxicity, endocrine disruption, cognitive and behavioral impairment in children, cancer, asthma, immune dysfunction, and chronic disease."
Author(s)	Env. Science & Technology	
AA Location	10-14	
Web address		

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Title	Effect on environmental air pollution on type 2 diabetes mellitus	A meta-analysis of 102 published studies was done evaluating the connection between air pollution and type 2 diabetes. It was found that there is a significant risk of insulin resistance and type 2 diabetes with exposure to air pollution. Pollutants most influential were traffic related pollutants, NO ₂ , tobacco smoke, and particulate matter.
Author(s)	European Review for Medical and Pharmacological Sciences	
AA Location	11-1	
Web address		
Title	IAQ and energy implications of high efficiency filters in residential buildings: A review (RP-1649)	A review of published studies was done evaluating the effectiveness of high efficiency filters in residences and the impact on energy use of high efficiency filters. 90% of our time is spent indoors and 2/3 of that 90% is spent at home. It was found that using high efficiency filters provided health benefits, particularly those with asthma and allergies . It was also found that using high efficiency filters in the home reduces premature mortality by 2.5% and increases life expectancy by 1.6 months. The benefits of this ranged from \$1 to \$1348 per person. There is a significant net benefit in upgrading filters in commercial spaces, for example upgrading from a MERV 6 to a MERV 16. However, in regards to residential environments, it is important to have high run times in order to make these economic and health benefits apparent. Using high efficiency filters in the home is successful in reducing indoor contaminants, but less effective in filtering outdoor air due to decreased infiltration of outdoor air in homes (as opposed to commercial buildings, who have higher ventilation rates). Overall, it can be determined that using high efficiency filters in the home is effective in reducing indoor contaminants such as particulate matter when paired with high run-times. The economic benefits also outweigh the costs due to little change in energy consumption from using upgraded filters.
Author(s)	Science and Technology for the Built Environment	
AA Location	11-2	
Web address	https://www.tandfonline.com/doi/	

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Title	Framework for estimating the US mortality burden of fine particulate matter exposure attributable to indoor and outdoor microenvironments	PM2.5 has long been associated with increased mortality. In 2012, ~230,000 to ~300,000 deaths in the US were due to PM2.5 exposure when focusing only on non-smoking homes. Of all PM2.5 exposure, 40-60% of it was from indoor exposure, primarily in residential environments. Outdoor exposure accounted for 12% of PM2.5 exposure. When accounting for smoking homes as well, one can expect the mortality burden to increase significantly.
Author(s)	Journal of Exposure Science & Environmental Epidemiology	
AA Location	11-3	
Web address		
Title	Effectiveness and Cost of Reducing Particle-Related Mortality with particle filtration	The economic benefit of using high efficiency filtration is over \$1000 per person per year. This estimate took into account prevented healthcare costs, filtration costs, energy costs, and maintenance. This adds up to be \$0.32 trillion in potential economic savings in the US. It was found that a MERV 8 filter costed \$7.33/person/year, a MERV 11 filter costed \$8.93/person/year, and MERV 13 filter costed \$13.05/person/year in residential homes. The energy cost from using upgraded filters is estimated to be a 2-4% increase, a somewhat negligible cost. The benefit to cost ratio ranged from 3.9 to 133. This has shown that there is great economic benefit from implementing higher efficiency filtration in the home, as well as overall preventing particle related premature mortality.
Author(s)	Indoor Air	
AA Location	econ-4	
Web address		
Title	Georgia: Falling Behind on Smokefree Protections	91% of Georgia's population is still exposed to secondhand smoke, even after implementing smoke-free policies in all restaurants, bars, and workplaces. Tobacco use in Georgia costs \$3.18 billion in healthcare. Exposure to secondhand smoke is known to cause heart disease, SIDS, ear infections, respiratory disease, slowed lung growth in children, and the worsening of asthma. 11,690 people in Georgia die every year from smoking or secondhand smoking.
Author(s)	American Nonsmokers' Rights Foundation	
AA Location	11-7	
Web address		

Filtration		Synopsis
Title	Costs of COPD exacerbations in the emergency department and inpatient setting	In 2008, the average cost of an ER visit for COPD was \$647 for simple inpatient visits and upwards of \$20,757 for complex admissions. The highest costs were for intensive care or intubations, costing \$44,909 dollars per admission.
Author(s)	Respiratory Medicine	
AA Location	econ-8	
Web address		
Title	Georgia's approach to cardiovascular disease	Cardiovascular diseases include heart disease, stroke, hypertension, atherosclerosis, and other heart conditions. Heart disease is the leading cause of death in Georgia, accounting for 29% of all deaths per year. Stroke is the 5th leading cause of death in Georgia. Atherosclerosis affects every one in four people in the United States. Smoking causes 1 in every five deaths. 17.4% of adults in Georgia smoke tobacco. Diabetes is the 7th leading cause of death in the US. CVD cost Georgia \$6.1 billion in hospital charges. The cost of diabetes in Georgia in 2013 was \$5.1 billion and smoking costed \$1.8 billion per year.
Author(s)		
AA Location		
Web address		

Filtration		Synopsis
Title	Indoor aerosols: from personal exposure to risk assessment	<p>There are several sources of indoor ultrafine particulate matter, including smoking, cooking, stoves, candle & incense burning, photocopiers, cosmetic products, cleaning products, and more. Larger particulate matter (PM10 and PM2.5) sources include several human activities throughout the indoor space (i.e. walking, vacuuming). In this study it was found that PM10 levels were higher than outdoor levels, while PM2.5 levels were about the same as outdoor levels but with larger variation. PM10 levels were also seen in significantly higher numbers in schools and PM2.5 levels higher when close to roads, a concern as children are more susceptible to air pollution and its adverse health effects. PM2.5, PM10, ultrafine particulates, PAH compounds, and heavy metals are all known to be hazardous to human health and are all present in the indoor environment. PM2.5 is associated with cardiopulmonary mortality, total nonviolent mortality, chronic bronchitis, and restricted activity days. PM10 causes adverse health effects like new diagnosis of chronic bronchitis and other respiratory symptoms. Particle mass rather than composition is the primary factor in its toxicity, and ultrafine particulate is most extreme in its health effects. According to the WHO metric DALY, 1000-3000 healthy life years are lost per million people per year due to particulate matter exposure, or 10-30% of the total burden of disease. Particulate matter inhalation plays a significant role in human health globally, with the dominant source of particulate matter being where we spend most of our time - indoors. Despite these findings, risk assessment and personal exposure analysis (including exposure control) methods need to be improved to further understanding of the topic.</p>
Author(s)	Indoor Air	
AA Location	7-50	
Web address		

Filtration		Synopsis
Title	Review of the National Ambient Air Quality Standards for Particulate Matter - Long-term PM2.5	<p>The EPA reviewed many peer reviewed publications to determine whether the current national air quality standards should be updated and more stringent in regards to the human health effects of particulate matter. The ISA (Integrated Science Assessment) concluded that the evidence is sufficient to state that there is a causal relationship between long term exposure to PM2.5 and total mortality, and in particular cardiovascular mortality. Increased cardiovascular mortality and morbidity by PM2.5 exposure is confirmed in all scientific disciplines (animal toxicology, controlled human exposure studies, and epidemiological). It has also been proven that there is a linear relationship between long-term PM2.5 exposure and mortality, with no threshold present in which mortality or morbidity does not occur. With each 10ug/m3 decrease in PM2.5, there is a 0.61-year increase in life expectancy. Long-term exposure to PM2.5 is also associated with negative respiratory effects. There has also been significant associations with long-term exposure and increased risk and incidence of cancer, primarily lung cancer mortality. Exposure to PM2.5 has known mutagenic, genotoxic, and carcinogenic effects, all of which contribute to cancer development. It has also been significantly associated with decreased neurologic function, Alzheimer's disease, autism spectrum disorder, and other nervous system effects.</p>
Author(s)	EPA	
AA Location		
Web address		
Title	Short-term PM2.5	<p>Short term exposure to PM2.5 has a known positive association with increased mortality, ranging from a 0.19% to 2.80% increase. There is a direct linear relationship between PM2.5 and mortality with no threshold. Overall, there has been sufficient evidence to conclude that there is a causal relationship between short term exposure to PM2.5 and total mortality, including cardiovascular effects. Not only does short-term exposure lead to increased mortality, but also an increase in hospital admission and emergency department visits, ischemic heart disease, and heart failure by endothelial dysfunction, arterial thrombosis, and/or arrhythmia. There has also been sufficient evidence to support that there are negative respiratory effects such as asthma and COPD exacerbation caused by short-term exposure to PM2.5.</p>
Author(s)	EPA	
AA Location		
Web address		

