



Iron-Bearing Particles in Coal Fly Ash: Unrecognized Risk Factor for Gastrointestinal Disease and Cancers

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Abstract: We provide evidence that coal fly ash, the globally abundant waste product of coal burning, including its undisclosed use in geoengineering aerosol operations, is an unrecognized risk factor for the development of inflammatory bowel disease (IBD) and certain gastrointestinal (GI) cancers. We review world-wide interdisciplinary scientific, medical, and public health literature focusing on the key role of ultrafine air pollution from combustion sources including coal burning in the development of IBD like Crohn's disease and GI cancers like colorectal cancer (CRC). Extensive and expanding evidence indicates that ultrafine air pollution particles from combustion sources, especially reactive iron-bearing particles like those found in coal fly ash, contribute to disease in the human gut by various means including inflammation, altered gut biome, redox reactions favoring oxidation, and genotoxicity. We show that the exogenous particles in gut-associated lymphoid tissue (GALT) match those in coal fly ash. We present new data showing the relationship between certain toxic volatile elements in coal fly ash aerosols to those in wildfire smoke with an associated threat to human and gastrointestinal health. Steps must be taken to both monitor and limit ultrafine air pollution from combustion sources to combat a growing public health emergency that includes increasingly frequent and severe gastrointestinal disease in young people. These steps must include recognizing and halting intentionally undisclosed geoengineering operations that utilize aerosolized coal fly ash.

Keywords: ultrafine air pollution, iron-bearing particles, coal fly ash, inflammatory bowel disease, gastrointestinal malignancy, colorectal cancer, geoengineering

INTRODUCTION

Gastrointestinal cancers, including colorectal cancer (CRC), are among the world's most important public health challenges, accounting for over 25% of global cancer cases and over 35% of all cancer deaths (Figure 1). Among esophageal, gastric, biliary tract, and colon cancer, only gastric cancer has declined in certain geographical areas. Colon cancer is now the third most common cancer in the world [1].

The incidence of early-onset gastrointestinal cancers (cancer in persons less than 50 years old) is rising at alarming rates globally and increased by more than 15% in the U.S. between 2010 and 2020 [2]. Inflammatory bowel disease (IBD) including ulcerative colitis and regional enteritis (Crohn's Disease) are among the most important chronic GI diseases affecting young people throughout the world, with the highest rates in the U.S. and Europe [3]. The rapid rise of GI cancer and IBD throughout the world is driven primarily by changing environmental conditions and lifestyle issues rather than genetics. Key environmental factors and lifestyle factors have included highly processed foods, gut microbial biome shifts, obesity and inactivity, and certain chemical exposures and pollutants [4]. Robust

global data now confirms that particle pollution plays a central role in driving both non-malignant gastrointestinal disease and digestive tract malignancies.

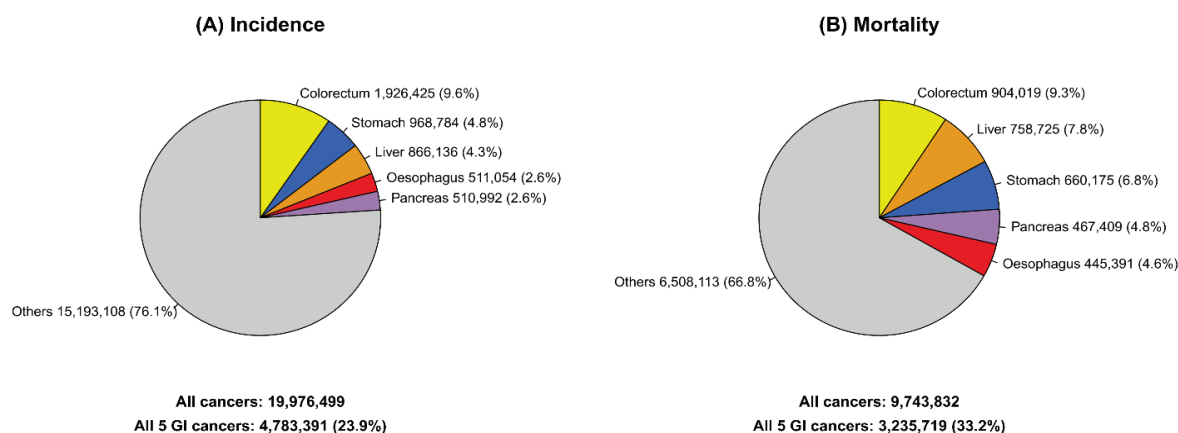


Figure 1: From [1]. Incidence and mortality of gastrointestinal cancers in 2022.

Despite increasing appreciation of the role pollution particles play in human diseases, nevertheless there is a gross misunderstanding of the severity of particulate pollution. The cause of said gross misunderstanding is deliberate. Scientists, physicians and the general public have been deceived into underestimating the extent and causes of aerosolization of coal fly ash, the toxic waste product of coal-burning. In Western nations we are told that coal fly ash is electrostatically trapped and sequestered. Some small amount might still exhaust through smokestacks. Some amounts also might be windblown from inadequately protected sequester-sites, but those amounts are small compared to the often-non-trapped coal fly ash exiting smokestacks in India and China.

For the past three decades, in ever increasing frequency and geographic range, pollution particles, evidenced as coal fly ash [5-9], have been covertly jet-emplaced in the upper troposphere and lower stratosphere (Figure 2). All the while, citizenry internationally have been lied to about the existence of such an activity [10-12].



Figure 2: From [13]. Deliberate jet-emplaced particulate trails, clockwise from top left San Diego, California, USA; Karnack, Egypt; London, England; Danby, Vermont, USA; Luxembourg; Jaipur, India.

Historically viewed as a respiratory hazard, fine particulate matter (PM_{2.5}) and environmental particles are now implicated in accelerating rates of colorectal cancer (CRC), gastric, and liver cancer, as well as chronic inflammatory gut diseases [14].

RISK FACTOR FOR GASTROENTESTINAL DISEASE AND CANCERS

Air pollution is the second leading risk factor for death globally, and non-communicable diseases (NCD's) account for roughly 85-90% of those pollution related deaths [15]. Ultrafine pollution particles (< 1 micron) produced by fossil fuel and combustion sources are ubiquitous in polluted air. These ultrafine particles (UFP's) have a small mass but very large exposure surface area, can bypass respiratory defenses, and translocate to the brain and bloodstream [16]. The most important ultrafine iron-bearing particles in coal fly ash include particles of magnetite (Fe₃O₄), nanoparticulate hematite (Fe₂O₃), ferro-spheres, and iron incorporated into aluminosilicate particles. Ferro-spheres from coal fly ash can be classified into several groups based on their iron content relative to their associated aluminosilicate component [17].

Spherical carbonaceous particles are particles created by high temperature combustion of fossil fuels like coal (Figure 3). These particles have no natural source and are a primary stratigraphic marker for anthropogenic industrial and combustion activities [23]. Ultrafine spherical carbonaceous particles can reach the intestine by multiple pathways including mucociliary clearance after deposition in the airways and lungs, ingestion of contaminated food and water, and by entering the blood stream directly from the lungs and then deposited in the gut.

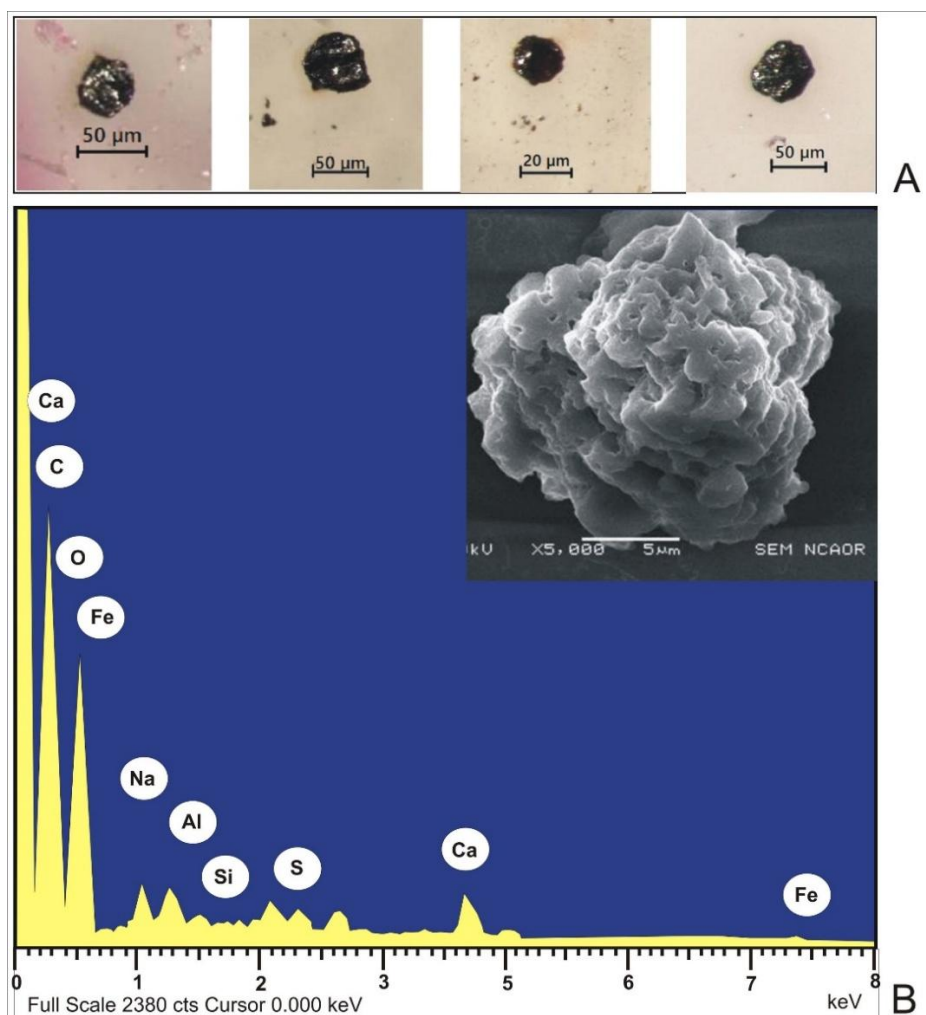


Figure 3 A and B: Light Microscopy and Scanning electron microscopy photomicrographs of Spheroidal Carbonaceous Particles. Courtesy of Singh et al. [18].

Spherical carbonaceous particles (SCP's) often contain surface iron spinels. Aside from primary or secondary iron particles, the most abundant ultrafine particles in coal fly ash are aluminosilicate particles, spherical carbonaceous particles, and separate titanium nanoparticles [19]. The iron contained in aluminosilicate glass is the primary source of soluble, bioavailable iron from coal fly ash [20]. The way that different airborne particles distribute themselves throughout the human body depends heavily on their size, chemistry, and entry pathway. Spherical ultrafine/nano-sized magnetite particles can bypass the blood-brain barrier and travel via the olfactory nerve directly into the brain, where they are implicated in neurodegenerative disease including Alzheimer's disease [21]. Combustion and friction-derived magnetic particles like magnetite travel in the blood to the heart,

where they are associated with cardiovascular disease, often beginning at a very young age [22].

Insoluble aluminosilicate particles bearing iron in coal fly ash are significantly more likely to enter the body via the respiratory-to-gastrointestinal system rather than the direct translocation by blood as described for magnetite nanoparticles. Aluminosilicate particles are often slightly larger than ultrafine or nano-particulates, ranging in size from an average of 100 to 400 nanometers up to a few microns. They are more likely to be trapped by airway mucociliary clearance mechanisms involving coughing and then swallowing secretions. Swallowed particles containing aluminum tend to persist in the gut with low clearance rates [23].

Exogenous ultrafine carbonaceous particles are found in all three layers of the intestine: mucosa, submucosa, and the muscularis propria of individuals diagnosed with colon cancer [24]. Atmospheric processing (*e.g.*, acquiring sulfate coatings) fundamentally alters both aluminosilicate particles and carbon (soot and unburned carbon) particles in coal fly ash, significantly increasing both their solubility and bioavailability of their iron content [25]. It has been shown that iron associated with coal fly ash particles remains chemically active in biological systems, acting as a source of oxidative stress within cells and the surrounding environment [26].

Kaolin clay containing aluminosilicates with crystalline iron can be ingested, but it acts as a mineral sponge, pulling iron out of the body and human gut. Iron-bearing coal fly ash particles like aluminosilicate particles react differently, releasing bioavailable iron and often other heavy metals when exposed to acidic conditions in the stomach. Iron-bearing particles from coal fly ash can release active iron ions into the gut lumen to react with tissue or be utilized by microbiota [27].

Aluminosilicate particles from coal fly ash are otherwise resistant to digestive enzymes and instead of being broken down and digested they are taken up by gut-associated lymphoid tissue (GALT), the specialized immune system of the small intestine [28]. Once inside the lamina propria, the tissue layer lying under the gut lining, the aluminosilicate particles with any remaining iron are ingested by intestinal macrophages via phagocytosis. Because macrophages cannot digest these inorganic particles, they permanently accumulate inside these specialized immune cells. The physical presence of the sharp, non-degradable crystalline structures inside of the macrophages triggers a high level of high pro-inflammatory signals. The process of chronic immune activation eventually compromises the mechanical integrity of the lining of the gut, leading to a “leaky gut” [29].

The particles inside the cells are not immunologically inert but act as potent immune adjuvants when taken up by macrophages in GALT. By absorbing luminal molecules like bacterial endotoxins, these microparticles cause an increase of pro-inflammatory cytokines that triggers and sustains the chronic granulomatous reaction characteristic of Crohn's Disease [30].

Peyer's Patches are aggregated lymphoid follicles that belong to GALT which contain macrophages that have phagocytosed environmental pollution particles including particulate matter. Specialized M-Cells (Microfold Cells) overlying the Peyer's Patches sample luminal contents and bring them into the Peyer's Patches, where they are engulfed by resident macrophages and presented to immune responding T-Cell and B-cells. Peyer's

Patches are distributed through the small and large intestine, but they are concentrated in the ileum, where the gut epithelium is thinner [31].

In a landmark 1996 study led by J. J. Powell, researchers characterized the dark pigment found in Peyer's Patches macrophages as the accumulation of inert, submicron inorganic particles derived from dietary or environmental sources. Using X-ray microanalysis and electron energy loss spectroscopy, these particles were categorized into three distinct types: 1) Titanium nanoparticles in size range 100-200 nm, 2) Aluminosilicate particles 100-400 nm with adsorbed iron resembling kaolinite clay, and 3) Mixed silicate particles lacking aluminum. It was pointed out that the same kind of particles are found in the chronic granulomatous tissue characteristic of Crohn's Disease [32].

It has been shown in animal studies that both ultrafine carbon and iron oxide particles can be taken up and deposited in Peyer's Patches [33]. Analytic chemistry (e.g. energy-dispersive x-ray spectroscopy) demonstrates that inert submicron particles containing iron-bearing aluminosilicates and titanium nanoparticles that are in these patches are identical to particles within the matrix of coal fly ash [34]. These foreign particles and immune cells within Peyer's Patches are also highly biologically active (1). Therefore, the most abundant and biologically active ultrafine particles in coal fly ash, *i.e.*, iron bearing aluminosilicates, carbon, and titanium nanoparticles are better able to explain the inorganic contents of the macrophages in Peyer's patches than are kaolinite clay or separate food additives containing aluminum, iron, or titanium nanoparticles.

Iron in the human gut is like a double-edged sword. It is essential for many physiological processes including oxygen transport and energy production. On the other hand, excess or unabsorbed iron can disrupt homeostasis in the gut, fuel harmful bacteria leading to dysbiosis, and promote intestinal inflammation. The challenge is finding a balance that ensures adequate iron absorption while minimizing its harmful effects [35]. Exogenous iron-bearing particles that gradually release reactive iron create a major pathway for intestinal inflammation, tissue damage, and microbial imbalance. When unabsorbed, reactive and bioavailable ferrous iron (Fe^{2+}) within the lumen of the gut reacts with naturally produced hydrogen peroxide, it triggers the Fenton and Haber-Weiss reactions. This iron chemistry produces highly reactive oxygen species like the hydroxyl radical ($-\text{OH}$) which produce lipid peroxidation, mucosal damage, mitochondrial dysfunction, and chronic inflammation [36].

Gut inflammation causes the body to release interleukin-6 (IL-6) that tells the liver to make more hepcidin, a hormone that controls iron in the body. High hepcidin has the action of shutting down ferroportin, a protein that acts like a door to export iron out of intestinal cells into the bloodstream. When this door is shut iron builds up in cells (like macrophages) in the gut and leads to a shortage of iron in the blood. This process can result in iron-deficiency anemia which is common in people with inflammatory bowel disease and GI malignancy.

People with these gut diseases may have functional iron deficiency (iron stuck in intestinal cells) and/or absolute iron deficiency associated with inflammation and blood loss [37]. Dysregulation of intestinal iron transport produces a build-up of iron in colorectal cancers which in turn leads to tumor-associated inflammation and tumor growth [38]. Both iron and aluminum are found in colon cancer tissue, where these elements influence tumor growth, cell survival, and disease progression [39]. In a recent study aluminum was found in

100% of the tissues from colon cancer patients which correlated with tumor mutation burden [40].

Spherical carbonaceous particles (SCP's) constitute a major fraction of the ultrafine particles in coal fly ash and are among the most toxic. Iron rich spinels containing magnetic iron oxides like magnetite (Fe_3O_4) on carbonaceous and glassy particles from coal fly ash cause human toxicity by generating reactive oxygen species and apoptosis (programmed cell death) [27]. Co-exposure to carbon black and Fe_2O_3 causes a synergistic oxidative effect that is significantly greater than the additive effects of either particle alone. Carbon surfaces on fly ash can act as reducing agents, converting stable ferric Fe^{3+} iron to the more reactive ferrous Fe^{2+} which accelerates radical production [41]. Titanium and iron nanoparticles make up an extremely small percentage of coal fly ash, but they dominate in terms of the total number of particles where they are found in the hundreds of millions of particles per milligram. Because of their tiny size, they can escape standard filtration, remain airborne for longer periods, and reach the alveoli of human lungs, where a high percentage of these particles are taken up by interstitial lung fluid and become bioavailable [42].

By extension, it can be inferred that countless titanium nanoparticles can enter the gut by mucociliary clearance followed by swallowing secretions. Titanium dioxide (TiO_2) nanoparticles from air pollution are considered more dangerous than food additives because the primary route of exposure, i.e.; inhalation drastically changes how the body absorbs and reacts to these particles [43]. The effects of ingestion of titanium nanoparticles in the human gut include mucosal damage, alteration of microbiota, and disruption of metabolism [44].

The magnetic fraction of coal fly ash is the iron-rich portion that can be separated by magnetic fields and is sometimes repurposed for industrial uses. This magnetic fraction makes up about 2-20% of the weight of coal fly ash, depending on the coal source and the combustion conditions. Coal fly ash contains an abundant unbound population of magnetic magnetite (Fe_3O_4) nanoparticles (average size 200 nm) which allows them to penetrate through human nasal, lung, and gastrointestinal portals of entry [45]. In addition to spherical magnetite/maghemite nanoparticles, coal fly ash contains ultrafine magnetic ferro-spheres and aluminosilicate particles with surface and internalized iron which show magnetic activity [46] (Figure 4). It has been shown that the human intestinal system can acquire diverse magnetic ultrafine particles from environmental sources that include air pollution. Most of the anthropogenic pollution particles found in the gut have a spherical morphology like those from combustion.

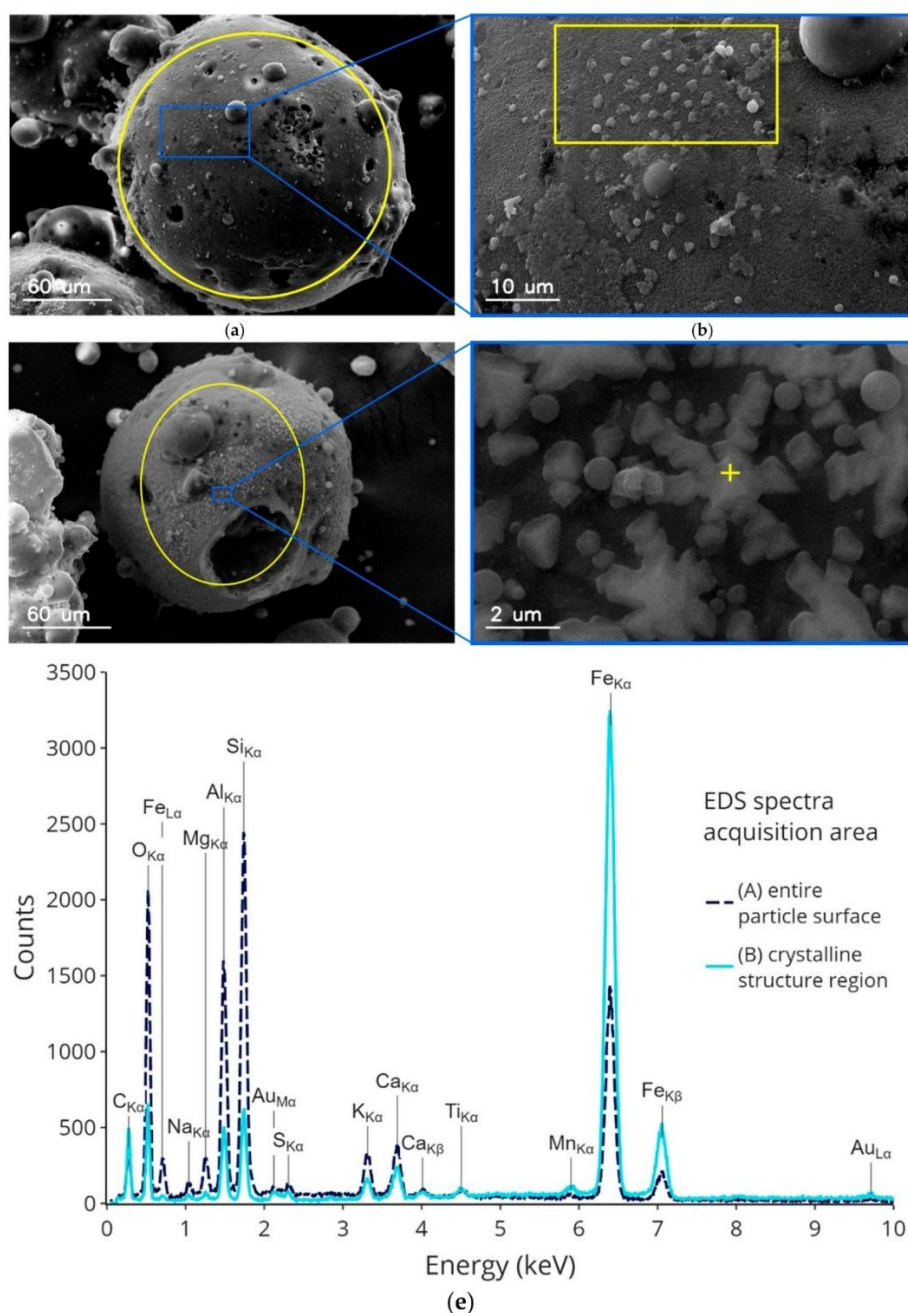


Figure 4: SEM micrographs of magnetic fly ash particles and its EDS spectra: (a,c) General views of selected particles with marked area of EDS spectrum acquisition; (b,d) detailed views of crystalline structures visible on the (a,c) particles, respectively; EDS spectra of particles shown in (a,b). Courtesy of Tadeusz Czech [46].

The magnetic particles in the gut can be measured non-invasively by fecal magnetometry and transmission electron microscopy. These types of analyses can distinguish between particles from combustion sources and natural magnetic particles that are produced by bacteria. The TEM-EDS examination of spherical particles reveals these elements: aluminum, silicon, iron, and carbon [47]. The co-occurrence of microplastic particles and magnetic fly ash particles in the human gut is an extremely important emerging area of environmental toxicological research. Both types of particles are ubiquitous

environmental pollutants and together they have a high probability of producing synergistic toxicity in the gut. Like magnetic fly ash particles, microplastic particles lead to dysbiosis, metabolic and immune disruption, and chronic inflammation in the human gut [48]. Microplastics are likely to be introduced into the gut by magnetic fly ash particles since they adhere to these particles by electrostatic and/or molecular forces in atmospheric and aquatic conditions [49].

Epidemiological studies and toxicological data strongly link coal combustion products, including coal fly ash (CFA) and indoor coal smoke, to an increased risk of gastrointestinal disease and cancers [50]. While historically viewed as primarily a respiratory threat, research now shows that aerosolized coal fly ash grossly contaminates the environment and is frequently ingested, either directly by food or water, or indirectly when inhaled particles are inhaled and then cleared by the respiratory tract and swallowed [51].

A recent study showed that nationwide and global geographical populations living near coal fly ash impoundments or exposed to coal operations have a significantly higher risk of gastrointestinal malignancies, driven largely by heavy metal and chemical contamination [52]. Using a variety of analyses, another study found consistent evidence that U.S. counties containing or adjacent to coal fly ash impoundments exhibited higher cancer rates compared to more distant counties, even after adjusting for confounding risk factors like smoking or heavy alcohol usage. In this study, both lung and GI cancers were related to particulate matter (PM_{2.5}) air pollution [53]. A strong and growing body of epidemiological and toxicological research links the core elements in coal fly ash ultrafine particles to increased risk of inflammatory bowel disease - both Crohn's Disease and Ulcerative Colitis [54]. Lead (Pb), chromium (Cr), cadmium (Cd), aluminum (Al), iron (Fe), arsenic (As), and mercury (Hg) are all elements that can be leached from coal fly ash and become bioavailable. The bioaccumulation of these elements can lead to a cascade of events that contribute to the development and progression of colorectal cancer [55].

There are multiple toxic metals and metalloids in coal fly ash aerosols that can disrupt, inflame, and injure the human gastrointestinal tract and gut lining. For example, chronic ingestion of inorganic arsenic (As) can cause irritation of mucus membranes, destroy intestinal microvilli, and impair gut integrity. Acute exposure to arsenic causes nausea, vomiting and diarrhea. There is evidence that inflammatory changes produced by arsenic in the gut can predispose to hepatocellular carcinoma [56]. Cadmium (Cd) can damage the human gut and cause oxidative stress, compromise intestinal barriers, and lead to severe disruption of the gut microbiome [57]. Mercury (Hg) disrupts beneficial gut bacteria and compromises tight junctions of intestinal epithelium leading to increased permeability and inflammation [58]. Antimony (Sb) is associated with severe toxicity to the human gut. When antimony is given by injection for treatment of certain parasitic diseases like leishmaniasis, it causes nausea, vomiting, diarrhea, ulcerative disease and it has been shown to cause programmed cell death (apoptosis) in human intestinal epithelial cells [59].

Toxic metals and metalloids are not distributed evenly in the ultrafine and nano-scale fraction of coal fly ash, but they usually partition into specific host matrices based on their volatility, chemical affinities, and combustion conditions. Arsenic and mercury are strongly captured by the nano-carbon graphitic phase. Iron oxides tend to absorb arsenic, while aluminosilicates tend to absorb antimony, and iron-bearing aluminosilicates may

enhance the overall mobilization of both elements compared to isolated mineral phases [60].

We have shown, not unexpectedly, that wildfires re-aerosolize coal fly ash that had settled on their canopy, surrounding soil and vegetation [61]. Figure 4 shows that wildfires tend to concentrate volatile toxic elements (mercury, arsenic, and cadmium) in their ash relative to coal fly ash. On the basis of limited available data, the same can be said for antimony [62].

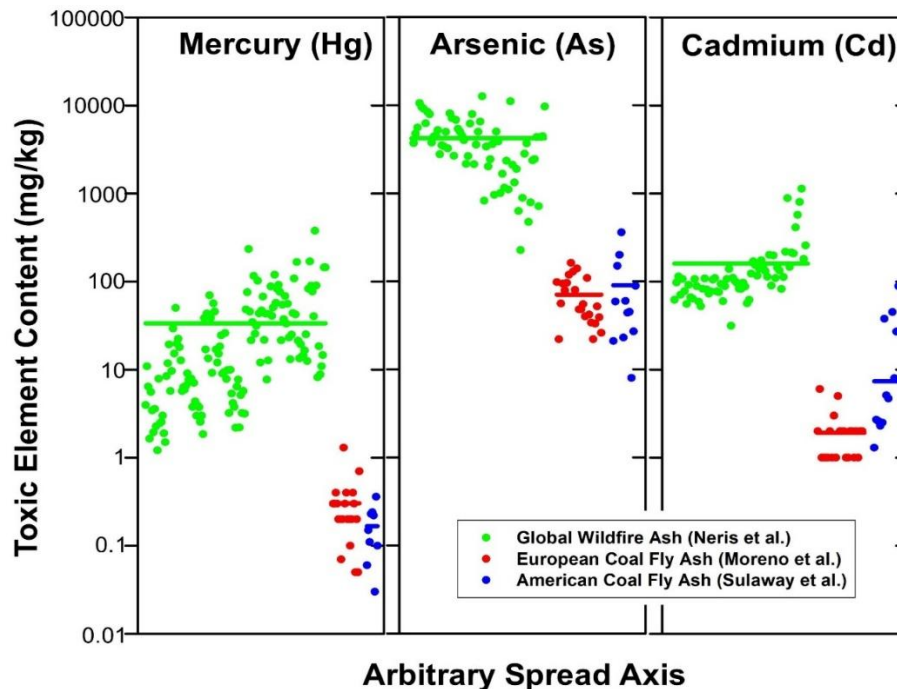


Figure 5: Showing wildfire data [63] for mercury, arsenic and cadmium compared to coal fly ash data [64, 65]. Solid lines signify mean values.

The primary global sources of ultrafine combustion particles less than 0.1 micrometers (PM 0.1) that can bypass lung barriers and enter the bloodstream are from fossil fuel burning for transportation, industry, and power generation. These sources of PM 0.1 are supplemented by domestic biomass burning of wood and coal products in developing countries. A typical concentration of ultrafine pollution particles in rural areas might be in the range of 2500 particles per cubic centimeter (cm^3) whereas in urban roadsides it might be 10,000 to 50,000 particles per cm^3 , with a mean global concentration around 10,000 particles per cm^3 . The respiratory system is often the first line of entry of ultrafine pollution particles into humans, but gastrointestinal exposure is nearly universal, with millions of these particles swallowed by individuals every day. There are known adverse health effects of these particles on human respiratory, central nervous system, cardiovascular, and metabolic systems [66]. Over the past decade the authors have collaborated and published several toxicological and forensic investigations documenting the existence of major global scale geoengineering or climate intervention aerial spraying operations that emplaces fine to ultrafine particulate matter into the upper troposphere. We have identified the base material for these undisclosed “hidden in plain sight” operations as being consistent with coal fly ash, the globally abundant waste product of coal burning [6]. We have shown in separate published articles how this aerosolized coal fly ash is a risk factor for lung cancer

[67], neurodegenerative disease [68], COPD and other lung diseases [69], and cardiovascular disease [70]. We reference investigators who have documented myriad (millions per gram) of spherical, exogenous ultrafine magnetite (Fe_3O_4) particles found in human brain and heart tissue that are identical to particles in coal fly ash [68, 70].

By extension of the information presented in this article, we suggest it is very likely that tropospheric geoengineering operations employing aerosolized coal fly ash are a significant risk factor for GI inflammatory disease and GI cancers, and a possible explanation for the rapidly rising rates of severe gastrointestinal disease and cancers in young people.

By extension of the information presented in this article, we suggest it is very likely that tropospheric geoengineering operations employing aerosolized coal fly ash are a significant risk factor for GI inflammatory disease and GI cancers, and a possible explanation for the rapidly rising rates of severe gastrointestinal disease and cancers in young people. We previously published an article showing how coal fly ash aerosols employed in climate intervention operations are a primary factor in the extent and severity of global forest fires [71]. Recently we demonstrated that both the elemental composition and water leach data for coal fly ash and wildfire data sets are consistent. We found that global wildfire differs from ash produced from burning wood in the laboratory primarily by incorporating a more iron-rich composition. We concluded that it is highly likely that wildfires remobilize and re-aerosolize coal fly ash deposited on trees and underlying vegetation and soil [61]. Both coal fly ash aerosols and wildfire smoke contain a dangerous cocktail of iron-bearing particles, toxic metals, metalloids, and polycyclic aromatic hydrocarbons (PAH's) that pose a severe risk to human health and the gastrointestinal tract. Here we show that concentrations of three of the most toxic elements in coal fly: arsenic, cadmium, and mercury, display a very similar pattern but one that is significantly magnified in wildfire smoke - See Figure 3. This data is consistent with recent study showing increased urinary excretion and/or abnormal pulmonary function in persons exposed to the same elements from wildfire smoke [72]. A recent study confirms that fine iron-containing particles often mixed with other toxic metals in coal fly ash account for the large majority of coal combustion fine particle toxicity [73]. Given their close relationship, the same may be true for the particles in wildfire smoke [61].

There is currently no effective monitoring or regulation of ultrafine particle pollution. A recently published study by Lelieveld, et al., says that establishing an air quality program that measures the numeric concentration (vs. mass) of ultrafine particles and sets limits for these particles is essential for improving global public health. This study estimates that reducing the concentration of ultrafine pollution particles to less than 5,000 per cubic centimeter could reduce excess mortality from these particles by 45% and thus save millions of lives. This can only be accomplished by significantly reducing emissions from fossil fuel combustion sources that include traffic, industry, and power production. Non-fossil fuels sources of energy must be developed and utilized [16]. Advanced filtration systems, e.g., wet electrostatic precipitators and hybrid baghouses, can supplement traditional electrostatic precipitators used in coal-burning power plants to capture more fine particulate matter, acid mists, and other hazardous air pollutants [74]. Indoor air pollution from using solid fuels like biomass (e.g. wood) or coal affects nearly half of the world's population, primarily in developing countries. Indoor air pollution is linked to multiple health risks, especially in women and children, including multi-system cancers and adverse pregnancy outcomes. Changing or upgrading to cleaner, vented, and more efficient stoves can greatly reduce indoor air pollution and diseases associated with it [75]. Indoor cooking

with solid fuel, especially coal, increases the risk of upper gastrointestinal cancers by mechanisms of both direct swallowing and systemic blood circulation. Indoor coal burning releases a toxic mix of fine particulate matter including iron-bearing magnetic particles and polycyclic aromatic hydrocarbons known to cause significant pathology in the GI tract [50].

To protect the GI tract from particulate matter in air pollution the average person needs to address both inhalation, oral ingestion, and the combined mechanism of mucociliary clearance from airways with mucous production which is swallowed. One should stay well hydrated to keep secretions mobile, practice good pulmonary hygiene, and spit out thick mucus rather than swallowing it. To decrease inhalation of pollution particles one can upgrade indoor air filters like HEPA and ultrafine air purifiers. People can check local air quality and use N95-type masks when heavy air pollution or smoke is reported or evident. One should practice smart commuting, avoid heavy traffic when possible, and recirculate air in the car in high emission settings. One should wash fruits and vegetables and cover fresh food. Exercising outdoors in poor air conditions can drive pollution particles deeper into the lungs [76]. Inhaled material cleared from the lungs by mucociliary clearance can disrupt the gut microbiome and trigger inflammation.

Long-term and early life exposure poses significant health risks, especially for children who still have developing respiratory and immune systems [77]. One should avoid highly processed foods containing many food additives which can act as emerging disruptors of gut health. Emulsifiers used to blend and texture processed foods can erode gut lining and promote inflammation. Food additives often contain titanium nanoparticles like titanium dioxide (TiO_2) [78].

Gut dysbiosis is not only related to inflammatory bowel disease, but also irritable syndrome, celiac disease and possibly metabolic diseases like obesity. Strategies to rebuild a healthier gut biome include probiotics (like yogurt or lactobacilli), prebiotics (like certain fiber supplements) and syn-biotics (combinations of pro and syn-biotics) [79]. Curcumin (turmeric) is one of the only supplements for which there is solid scientific evidence of its effectiveness of binding with iron ions to reduce active iron uptake into the gut without interfering with iron supplements in persons who require it [80].

CONCLUSIONS

Recent findings of exogenous magnetic particles matching those from combustion sources like aerosolized coal fly ash in the human brain and heart represent a “smoking gun” etiological factor associated with neurodegenerative and cardiovascular disease. Similarly, analytic chemistry (such as energy-dispersive x-ray spectroscopy) demonstrates that inert, submicron particles containing aluminum silicates, iron, and titanium within Peyer’s Patches are identical to particles within the matrix of coal fly ash and strongly suggests this substance is an etiological factor. Peyer’s Patches loaded with macrophages containing this material are a hallmark of inflammatory bowel disease like Crohn’s. Aluminum as explained in this article is an emerging risk factor for the development and progression of colorectal cancer. Iron bearing aluminosilicate particles are primary components of coal fly ash and they create synergistic toxicity of reactive iron and aluminum. There is growing evidence that ultrafine air pollution particles like those found in coal fly ash are significant risk factors for human gastrointestinal inflammatory disease and cancers. We have published several independent lines of evidence that coal fly ash is utilized in global scale atmospheric aerosol

climate intervention operations. Currently there are no monitoring of the hazardous ultrafine pollution particles or the principal elements i.e., aluminum, silicon, and iron or many other toxic elements in coal fly ash. Throughout history, emissions from biomass and coal burning have been associated with human non-communicable disease. It appears that is the case for human gastrointestinal diseases. Complacency over the dangers of ultrafine air pollution and the deadly code of silence concerning the subject of “covert” climate engineering must be broken if we are to have any realistic chances of reducing what is rapidly becoming a public health emergency. We have previously shown that these activities have devastating effects on human and environmental health. In addition to the measures described for reducing exposure to air pollution, first and foremost these “hidden in plain sight” tropospheric aerosol spraying operations utilizing coal fly ash must be exposed and halted.

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