

ISSUE 2

# CURAM

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## ENVIRONMENTAL HEALTH

### IMPACTS OF INDUSTRIALIZATION

Pollution, pesticides, nuclear power,  
and plastics

### ENVIRONMENTAL JUSTICE

How different communities are  
disproportionately affected by  
environmental issues

### EXPERT INTERVIEWS

Read about conversations with  
professionals in environmental  
health

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ISSUE II: ENVIRONMENTAL HEALTH

# PREFACE

Scientific innovation has given us countless discoveries that have led to a massive shift in medical treatments and procedures. From the synthesis of aspirin in 1838 to penicillin as the first antibiotic in 1928 to PreP as the first HIV prevention medication in 2013, science has given us the gift of longer, healthier lives. These life-altering discoveries are all backed by research and data, created by scientists who justly spent more time in their own detailed manuscripts than compartmentalizing their work for the public. Detailed diagrams may simplify new data but without years of previous research and interest, these unsuccessfully attempt to bridge a wider audience. With our form of writing, we are able to communicate established theories and newer discoveries into digestible paragraphs with everyday diction.

Our goal at CURAM Magazine is to provide a bridge between the meticulous work and thinking of scientists, and the larger-picture science and application for the public. Our vision is to present this important information in a way that's easy to understand and engaging.

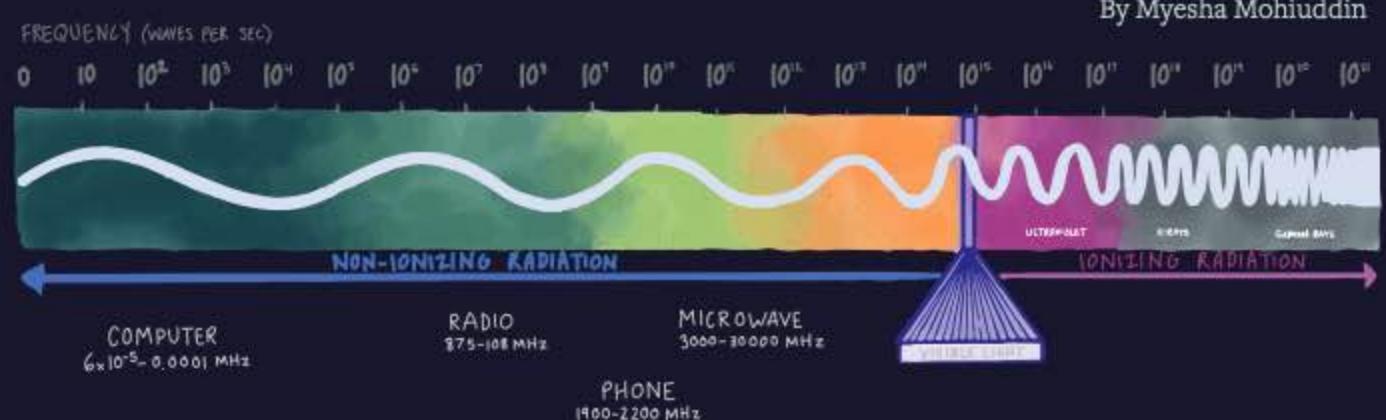
The magazine consists of three parts:

1. Current medical research: Summaries and interviews with researchers, professionals, and overviews of novel, cutting-edge research.
2. Art inspired by medicine: Personal poems, essays, and visual pieces.
3. Education: Important resources and facts.

We explore Environmental Health in this issue. Understanding the interaction between ourselves within and as part of the environment is important for our own physical and mental health, but also for the health and longevity of the organisms around us. More, environmental issues and potential solutions expand outward, literally and ideologically. The changes we make in our neighborhoods accumulate and expand, into the surrounding air and conversation, exponentially making the change you want to see in the world.

*Disclaimer: CURAM Magazine is not affiliated with any particular political ideology. All information in this magazine is for educational purposes only and should not be used as a substitute for professional medical advice.*

# RADIATION EFFECTS ON HUMANS



As essential as our electronic devices are to our lives, many individuals do not understand the negative effects that they can have on our neurological system. Radiation is defined as energy derived from a source that travels through space at the speed of light with an electric and magnetic field (CDC, 2022). Even though the electromagnetic field is not visible to the human eye, it is still surrounding us. When radiation is emitted from technology, this displays negative correlations between technology use and our neurological functions. Surprisingly, there are positive and negative effects of radiation. Due to the latest innovations in medicine and therapeutics, radiation can be used to target cancerous cells. Radiation with positive effects can be classified as the energy that fuels our everyday lives, such as solar panel energy. However, ionizing radiation imposes health risks, where too much exposure can lead to fatal consequences. If a patient is exposed to X-rays—a type of ionizing radiation—in continuous, extreme conditions, it could impose many health risks (IAEA, 2023). Overall, there are many pros and cons to radiation in our day to day lives, however, few are aware of the potential consequences to one's health secondary to increased radiation due to more prevalent technology use.

Cell phones provide great health risks through the close proximity between our cell phone and our brain. Shown in recent studies, there has been no

direct correlation between radiation emitted by cell phones to specifically cancer in humans; however, our neurological functions are still affected by radiation. When we call someone, we raise our cell phones close to the ear, which is in close proximity to the brain. Many individuals also sleep with their cell phone under their pillow showcasing a continuous cycle of emitted radiation in direct contact with the brain. The brain is one of the most affected parts of our body when it comes to radiation (NCI, 2022).

As cell phones release radiation, this travels to our brain in the form of radiofrequency electromagnetic radiation (RF-EMR) emitted from our cell phones. RF-EMR exposure impacts those neurological and behavioral functions of adolescents and young adults (Hasan et al., 2022). A recent study looked into the effect of 2400 MHz mobile phone radiation exposure on behavior and hippocampus morphology in a Swiss mouse model. MHz, also known as megahertz, is the standard measure for electromagnetic radiation (TechTarget, 2023). A typical frequency range of RF-EMR of cell phones ranges between 900-2600 MHz, where radiation is present and can worsen with the increase of MHz. The correlation between the study and effects on humans provided information that the exposed mice seemed to behave differently after exposure. Radiation exposure causes an irregular arrangement of the neurons in the brain. Prior to exposure to radiation, the mice were able to move freely in

their cage and behaved normally; however, after exposure, it was found that the mice were not as open to exploration as before—indicating decrease in curiosity. Within the brain-stained images of the mice, it was found that there were dark stained neurons and pyknosis was present which is a shrunken cell nucleus (Hasan et al., 2022). Based on the results of this mouse-model study, it is implied that significant use of our phones directly correlates with harmful effects on our nervous systems, creating a concern from health professionals on what this might lead to for humans in the future (Hasan et al., 2022).

Short wave radiation is used throughout manufacturing and radio transmission. With many devices and tools that use short wave radiation, this constant exposure promotes damage to our biological functions. Compared to the mice who were exposed to 2400 MHz, short wave radiation has a frequency range which is varied from 3 MHz to 30 MHz—a lower frequency than a mobile device. However, even with lower MHz, this is still classified under a high frequency band—where health hazards can be prevalent when there is a rapid electromagnetic field (EMF). This concludes that no matter the frequency range of a device—it is found as a potential threat to human health (Yu et al., 2017).

Tablet devices demonstrate a similar concern with regards to radiation and effects on health. Even when a tablet is not engaging in internet use, there is persistent background radiation emitted from the device. iPads and other tablets release the same radiation at the same speed of a microwave—an average of every four seconds or even more than 900 times an hour (Environmental Health Trust, "iPads and Tablets"). Due to this statistic, The American Academy of Pediatrics has issued a warning on children's use of technology. "If you plan to watch a movie on your device, download it first, then switch to airplane mode while you watch in order to avoid unnecessary radiation exposure," was one of the tips shared by this organization. (Environmental Health Trust, "Recommendations to Reduce Exposure to Cell Phones").

With the increased use of technology and background radiation in our day to day lives, much is still to be discovered regarding radiation effects on health. Confusion if radiation is harmful or not is seen through the different results between two organizations—National Cancer Institute and the International Agency for Research on Cancer of the World Health Organization. The findings from the National Cancer Institute stated there was no direct link between radiation and cancer; however, The International Agency for Research on Cancer of the World Health Organization found the opposite. Due to their findings, they established radiofrequency as a "Class 2B Possible Carcinogen in 2011." (Environmental Health Trust, "iPads and Tablets").

The increase in technology since that has urged this organization to ask for a reclassification from class 2b carcinogen to class 1 human carcinogen. Both of these organizations found different results concluding there is still no scientific consensus on many of these topics and further research must be conducted in order to obtain solid information. Overall, it is found that increased radiation dose does seem to correlate with health effects. Humans who use their cell phone daily should limit their time around the device in order to prevent any long lasting problems.



# NANOPARTICLE POLLUTION

By Baishali Chaudhuri

Reviewed by  
Rima Habre, ScD

## WHAT ARE NANOPARTICLES?

As research and technology continue to expand frontiers, nanoparticles have quickly arisen to be the star player of many innovative applications. Referred to as being “zero-dimensional,” nanoparticles are materials that range from 1 to 100 nanometers in size, a scale invisible to the human eye (Murthy, 2007). Nanoparticles can be found in nature, but are mainly synthesized by manufacturing companies from various elements, such as carbon, titanium, and aluminum.

Before nanotechnology, larger bulk materials would be used in several technologies spanning the fields of chemical energy, computer science, and biomedicine. However, the discovery of nanoparticles soon led to the revolution of such technologies; due to their uniquely submicroscopic size, nanoparticles have special physical and chemical properties that make them more flexible and better-suited to carry out certain roles their visible materials cannot, providing cheaper and more efficient solutions in many different fields. For example, nanotechnology has enabled us to shrink computers that were once the size of entire rooms to portable laptops we use today (Bayda et al., 2020). In medicine, nanoparticles are being developed to help transport chemotherapy drugs directly to tumors (Yuan et al., 2019). Nanoparticles can also revolutionize agriculture, as nanoparticles containing nutrients can improve plant growth and the effectiveness of fertilizers (Ahmad et al., 2022).

## NANOPARTICLE POLLUTION

However, as the development and commercial use of nanoparticles are on the rise, so is the threat of their pollution and health effects. Nanoparticles can be unintentionally released into the air through combustion and other processes. They can also end up in large amounts as nanowaste and be disposed of similarly as conventional trash, which is usually done without any precautions or treatments. Some global estimates claim that over 300,000 tons of engineered nanomaterials are released each year, with about 85% ending up in landfills (Schwab et al., 2023).

This prospect is concerning, as nanoparticles can be fatal to the environment if they are not taken care of correctly. Nanoparticles can invade aquatic ecosystems via wastewater or surface runoff and dissolve, creating a hazard for

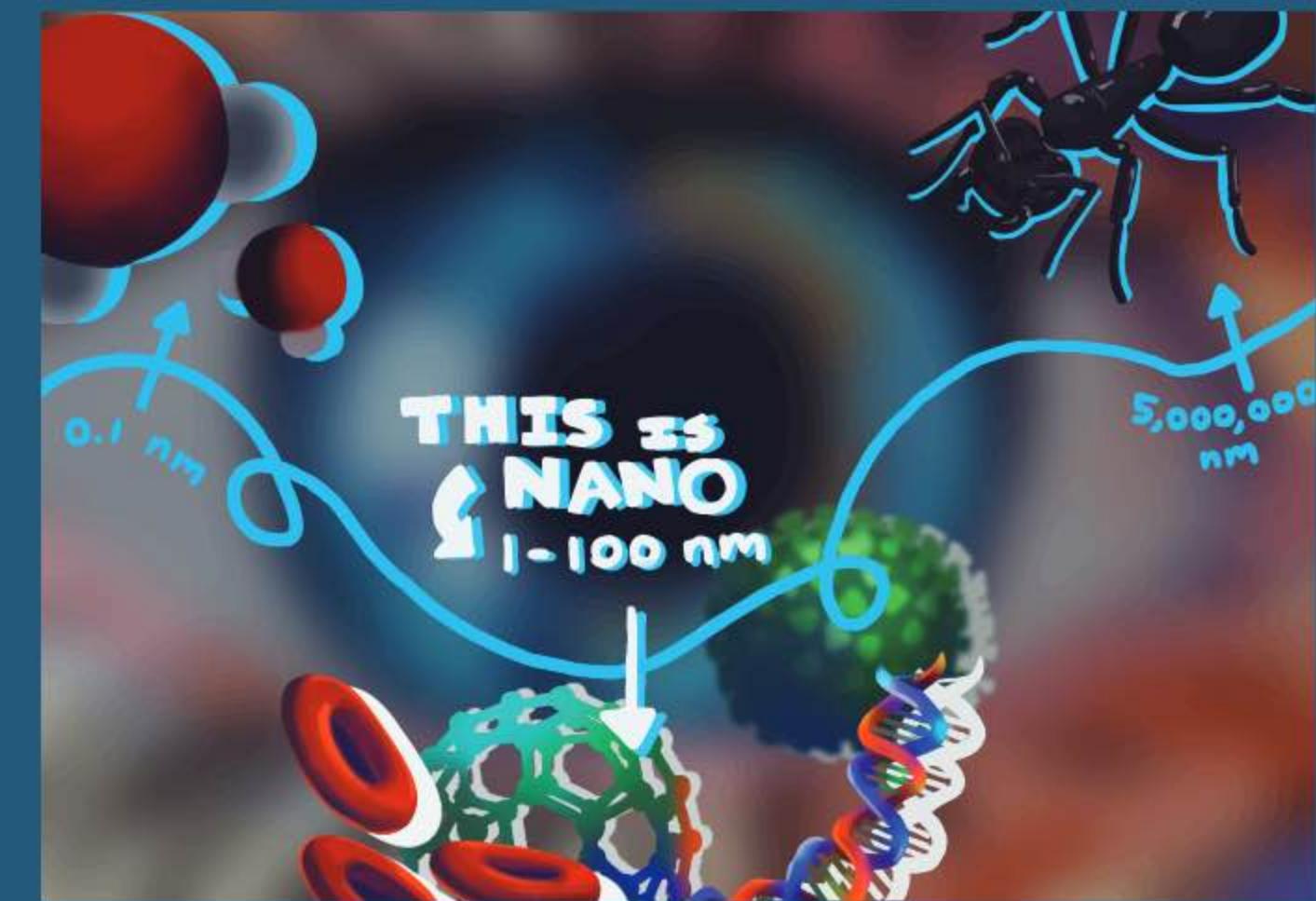
aquatic animal and plant life as they can absorb these dissolved particles that are toxic to them (Gupta and Xie, 2018). In addition, nanoparticles also present a threat to terrestrial life, as they can enter the soil through the use of fertilizers and land treatment products and accumulate, causing toxic effects on organisms in the soil, including fungi and other bacteria. Though nanoparticles cannot be seen, they present a very real threat through “invisible pollution,” raising concern for environmental health, especially as the toxicity that nanowaste presents on flora and fauna may accumulate, increasing up the food chain from plants to humans.

## POTENTIAL HEALTH HAZARD?

So far, the technology is too new for scientists to describe potential adverse effects on humans in the short and long term. However, emerging evidence suggests exposure to specific nanomaterials may be harmful. Some researchers are concerned that after inhalation, airborne nanoparticles could become stuck in the lungs. If this happens, nanoparticles could eventually enter the bloodstream, reaching and affecting other organs (Gupta and Xie, 2018). Some animal toxicology studies investigated this and found that the mice models experienced negative pulmonary and cardiovascular effects, and the development of tumors (Fischman et al., 2019).

A more recent study has found that effects expand beyond the lungs. In mice, it was found that nanoparticles made from microplastics had been digested by gut enzymes and accumulated in the liver, intestine, and brain, later causing intestinal inflammation and damage (Wang et al., 2023). Consumption of a certain food additive containing titanium dioxide nanoparticles was also found to lead to gut health issues, as the nanoparticles could have played a role in changing gut microbiota and contribute to inflammatory bowel disease.

Commercial products have also been a concern. Cosmetics containing titanium dioxide, gold, or silver nanoparticles increase the risk of these slipping into our daily lives and causing health issues, leading to an ongoing effort to address these concerns (Katz et al., 2015). A study tested the toxic effects of zinc oxide nanoparticles, which are prevalent in pigments and sunscreens, in different animal models and cell lines, finding them to be potentially damaging to cells if there is too much exposure (Gupta



and Xie, 2018). At the same time, however, silica nanoparticles, which are commonly employed in the food industry to prevent clumping in powders and thicken pastes, were evaluated and determined to be a safe additive (Yang et al., 2014). Still, further studies need to be conducted to confirm the safety of long-term exposure.

## CAUSE FOR CONCERN?

Despite these findings, it is important to note that these results may not be entirely applicable to humans. Further research must be done to fully evaluate the safety and health effects of nanoparticles, specifically in humans, as their toxicity depends on many factors, such as dose, which depends on the route of exposure and can be different from studies using mice. In short, we don't know the whole story yet. Therefore, while studies suggest the hazards of nanoparticles, further investigation is needed to fully assess nanoparticles' implications on human health, as the toxicity of nanoparticles is highly variable and dependent on many factors.

In the meantime, efforts should be made to establish more concrete safety and disposal measures in order to mitigate potential risks of nanoparticles. Redirecting focus towards minimizing nanoparticles released into the environment via combustion, whether it is implementing more secure ventilation and filtration measures, should be considered. Additionally, when addressing how to dispose of nanoparticles, there should be an establishment of more comprehensive guidelines for managing nanowaste so that its pollution into the environment is limited, and therefore presents less of a risk to plants and animals, including us.

Nanotechnology is continuously proving to be a significant advancement in science as we continue to explore how to break new frontiers. However, as much as we are still discovering all of the possibilities of nanotechnology, we must also be mindful of the potential concerns it may present.

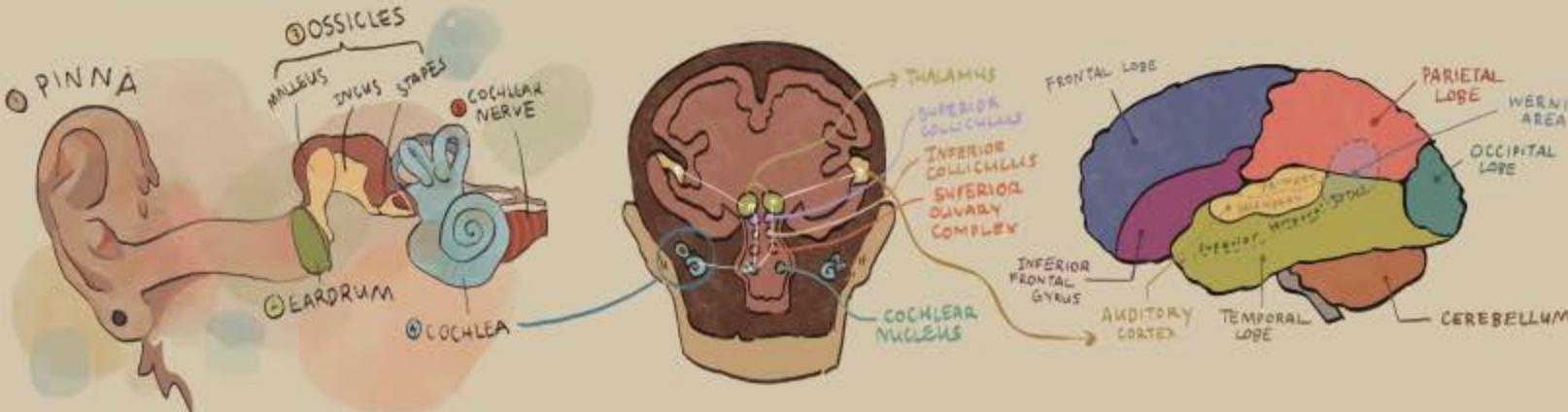
# HOW WE INTERACT WITH OUR ENVIRONMENT: SOUND, LANGUAGE, AND CONVERSATION FROM SOUND TO MEANING

By Ryan Wisniewski

The science of speech and language is complex, involving sound recognition, language processing, and speech production. We might not give these everyday phenomena much thought, but just having a conversation requires us know that sound is going on, we identify who is making the noise, we recognize that noise is speech, we process the words and emotions of their speech, considering their filler words, gestures, and body language, and prepare our own response with the muscles in our throat and lungs. Sound is just one way we, like all species, interact with our environment, involving everything around us. Before setting sound waves to meaning, we accurately detect minor differences in the source of sound's time and space, up to differences in vibrations as small in diameter as an atom and a thousand times faster than the visual system (Purves, Augustine, Fitzpatrick et al., 1997). Understanding sound and all its interactions starts with the physical processing of incoming sound in the ear.

## ANATOMY OF THE EAR:

First, the sound enters the ear through the pinna—the visible portion of the outer ear—and continues down the ear canal to strike the eardrum. As the eardrum vibrates, it moves three tiny bones. Attached in order are the malleus (hammer), incus (anvil) and stapes (stirrup). These bones are housed in the segment of the ear called the middle ear cavity. The stapes vibrates the oval window that opens to the inner ear—the cochlea. This snail-shaped organ, a series of fluid-filled tubes, is the first stage of neural processing. Here, there are sensory hair cells that transform the mechanical fluid energy to neural signals. The cochlear nerve fibers contact hair cells so that as waves of sound pass, fluid moves, the cells are triggered and the cochlear nerve fibers are activated.



The hair cells of the cochlea are bounded by a gelatinous tectorial membrane on top and a stiffer basilar membrane below (Dallos, 1992). As the basilar membrane is stimulated by sound, fluid waves travel along it and it acts something like a trampoline at each point. Also, the basilar membrane is narrower at the base and wider at the apex. Longer wavelengths (lower frequencies) will cause deformation toward the apex of the cochlea (the wider end of the basilar membrane) while shorter wave lengths (higher frequencies) will cause deformations at the base (the narrow end of the basilar membrane). This anatomical structure provides the basis for early frequency analysis. The tonotopicity of the cochlea is a frequency-place map, where the coding of a complex sound is decomposed into frequencies mapped from high (at the base) to low (at the top or apex) (Kiang, 1984; Knudsen and Konishe, 1978). The detector part of the hair cells, tiny stereocilia (or hairs), are loosely embedded into the tectorial membrane. So when the basilar membrane moves, it causes a shearing motion that deflects the hairs, opening tiny ion channels embedded in the stereocilia. When this occurs, an action potential is triggered in the nerve and sent to the brain. The anatomy of the inner ear allows not only for specificity in the coding of frequency of sound (i.e., pitch), but also precise coding of timing and intensity.

The signal travels down the auditory nerve deep in the brainstem, into a nucleus called the cochlear nucleus (Purves et al., 1997; Kandel, Schwartz, Jessell, Siegelbaum, and Hudspeth, 2013). These nuclei are also organized tonotopically (i.e. frequency is mapped by place). This means the same “map” coded in the cochlea is retained in the central auditory system (Kiang, 1984; Knudsen and Konishe, 1978). Within the brainstem, the cochlear

nucleus transmits its signals to the next “waystation”, the superior olfactory complex. Here, the differences in timing and intensity (the size of the signal) from sound stimulation to the left and right ear help us localize sound, to know where it is coming from (Knudsen, 1999).

From here, the auditory information is aligned (in an area called the inferior colliculus) with a visual map and integrated (in the superior colliculus) in order to identify where exactly the sound is coming from. Sorting out what is important versus irrelevant information occurs in the thalamus, which then transmits stimulation to the primary auditory cortex (of the temporal lobe) (Cohen and Knudsen, 1999; Kandel et al., 2013). The primary auditory cortex, specifically the temporal lobe of the brain, processes the complex auditory information that has been initially encoded in the cochlea and integrates it with other sensory information.

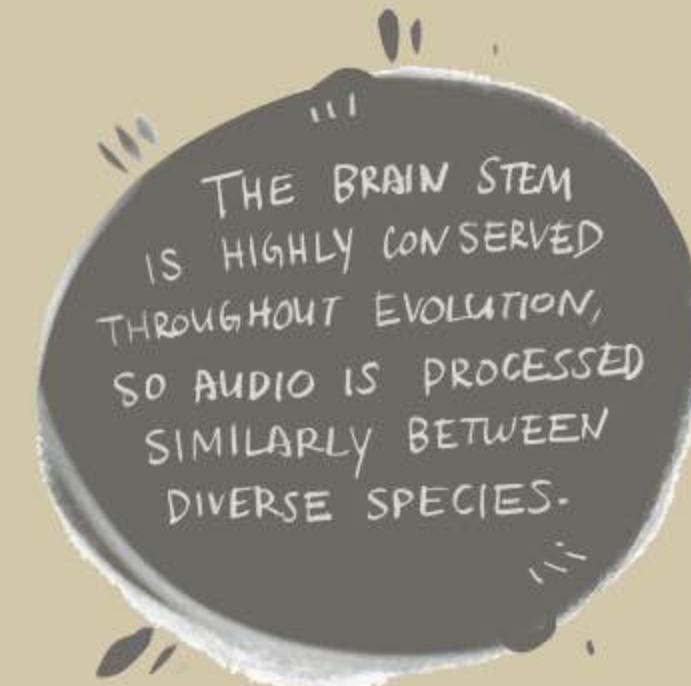
From here, it is not so clear how sound, specially speech, translate to the rest of the brain and create behaviors and reactions. However, we will outline a few of the known areas and their role in transforming audio waves into meaningful and emotional perceptions.

## HOW DO WE UNDERSTAND, OR DON'T— ONE MODEL OF COMPREHENSION

People speak, hear, and understand speech at around 120-200 words per minute, about 2-3 words per second. It makes sense that the physical machinery of speaking has co-evolved with the neural circuitry of listening and understanding. This neural circuitry includes recognizing the same meaning in different acoustic conditions—accents, context of speech segment, intonation, stress, and rhythm. But how do we comprehend speech?

The dual-stream model for speech comprehension is one theory. It balances two ideas that a) the input must be wired with a conceptual semantic representation—aka. understood—and b) the audio system is linked with the motor system, so we can physically reproduce the noise.

The left and right auditory cortex, comprising the primary and secondary auditory cortex, have different processing capacities of temporal (time) and spectral (space) resolution, and temporal integration windows (Boemio et al., 2005; Obleser et al., 2008; Zatorre et al., 2002; Poeppel, 2003). The left side processes phonology (sounds of speech), lexicon (vocabulary), and rapidly changing acoustic cues, and the right side processes for tone and pitch processing. We'll explore relevant brain structures specific to our left sides that include Wernicke's area, the PT, IFG, ITG, and MTGPT, IFG, ITG, and MTG.



We have an auditory cortex, also known as Heschl's gyrus. In this general area, there is a primary and secondary auditory cortex, both with different roles. These have different processing capacities with different temporal and spectral resolutions (Boemio et al., 2005; Obleser et al., 2008; Zatorre et al., 2002), and with different temporal integration windows. In other words, these areas are different in their accuracy and resolution to detect small, sudden changes in time and space, and in creating discrete “snapshots” from continuous sound input. The left hemisphere processes rapidly changing acoustic cues, and the right hemisphere processes tone and pitch.

Another small brain region called the superior temporal gyrus (STS) is key. The STS is structurally symmetrical, but the sides have functional differences. The STS on the left hemisphere is more responsible for phonological information—identifying words—and the right STS is more for identifying voices and processing emotions (Hickok and Poeppel, 2007; Price, 2012, 2010; Turkeltaub and Coslett, 2010; Belin and Zatorre, 2000; Latinus and Belin, 2011; Jäncke et al., 1999; Jäncke et al., 2002; Price, 2012). Studies showed that the more intelligible the sound is, the greater the left STS response was, with no difference with music or white noise (Osnes et al., 2011b; Specht et al., 2009b). Interestingly, both sides are also involved face perception, voice identification, theory of mind, and audio-visual integration (Hein and Knight, 2008).

The left anterior temporal lobe is responsible for semantic (speech) comprehension of meaningful sentences (Binder and Desai, 2011; Hickok and Poeppel, 2007, 2004; Humphries et al., 2007, 2006; Patterson, 2007; Patterson et al., 2007; Poeppel et al., 2012; Price, 2012). It maps sound to meaning, arranged by sentences. Damage to the left anterior temporal lobe is associated with semantic dementia—the loss of memory for words (Adlam et al., 2006; Mesulam et al., 2009; Mummery et al., 2000; Galantucci et al., 2011). The left and right sides both contribute to pictures and environmental sounds (Visser and Lambon Ralph, 2011).

Speech comprehension is a complex task that requires attention, working memory, and the ability to recognize, understand, and respond to words and sentences with many variations in phrasing, intonation, and speed. One theory for how we make sense of speech is the dual-stream model. This model frames comprehension with a dorsal stream for the auditory-motor interaction, and a ventral stream for extracting meaning and processing sentences and narratives.

The ventral stream is more left-sided, with lexical, semantic, and syntactical processing (Hickok, 2012; Hickok and Poeppel, 2007). The gradient from the left to right side is associated with the processing of more complex speech, although there are many intra-region connections and higher-order processes including attention. Aside from those mentioned, other brain regions are involved. One called the posterior temporal area is specifically associated with narrative comprehension. Another called the supramarginal gyrus processes categorical perception of speech (Turkeltaub and Coslett, 2010). Another, the angular gyrus, is a hub involved in many different literary tasks including word tasks, word retrieval, tasks based on word retrieval, understand

higher-order tasks, global understanding, as well as finger counting number processing, reading aloud, and writing (Binder et al., 2009; Chao et al., 1999; Golestani et al., 2013; Price, 2012; Golestani et al., 2013; Martín-Lloechs et al., 2008; Catani et al., 2004; Rusconi et al., 2005; Raichle et al., 2001; Roux et al., 2003; Roux et al., 2004). The basal ganglia (BG) and cerebellum is tied to emotional processing (Schröder et al., 2010; Paulmann et al., 2009; Kotz and Schwartze, 2010).

While the ventral stream functions for speech perception and comprehension, the dorsal stream is involved in linking, producing, and reproducing speech sounds with the motor system. It is the network in understanding repetition of sublexicon (syllables) and pseudowords. With (pseudo) words like plock, crig, pate, and druf, we have some idea of how to pronounce them, some idea of what they mean, or how we might use them. This process, called predictive coding, includes performed action and perceived action (Friston et al., 2010; Hickok, 2012; Kilner et al., 2007; Kotz and Schwartze, 2010). It works both through a feedback loop and on the cellular level of the mirror neuron system, where neurons respond to observations and predict outcomes of actions (Iacoboni and Dapretto, 2006; Rizzolatti and Craighero, 2004; Rizzolatti and Sinigaglia, 2010). Studies have found that a disturbed motor cortex has little to no effect on the ability to perceive and comprehend speech, meaning speech comprehension does not rely on the motor system (Hickok, 2012, 2009; Hickok et al., 2009; Lotto et al., 2009; Rogalsky et al., 2011). However, more recent work has led to question motor and pre-motor areas for speech perception and whether or not they process speech and categorical perception, “mirror” the articulatory process, or are simply byproducts of low conceptual importance.

The ventral stream is the neural network that translates sound to meaning. So while the dorsal stream processes articulation and consonants, the ventral stream processes overall meaning.

### SOUNDSCAPE ECOLOGY & ACOUSTIC BIODIVERSITY:

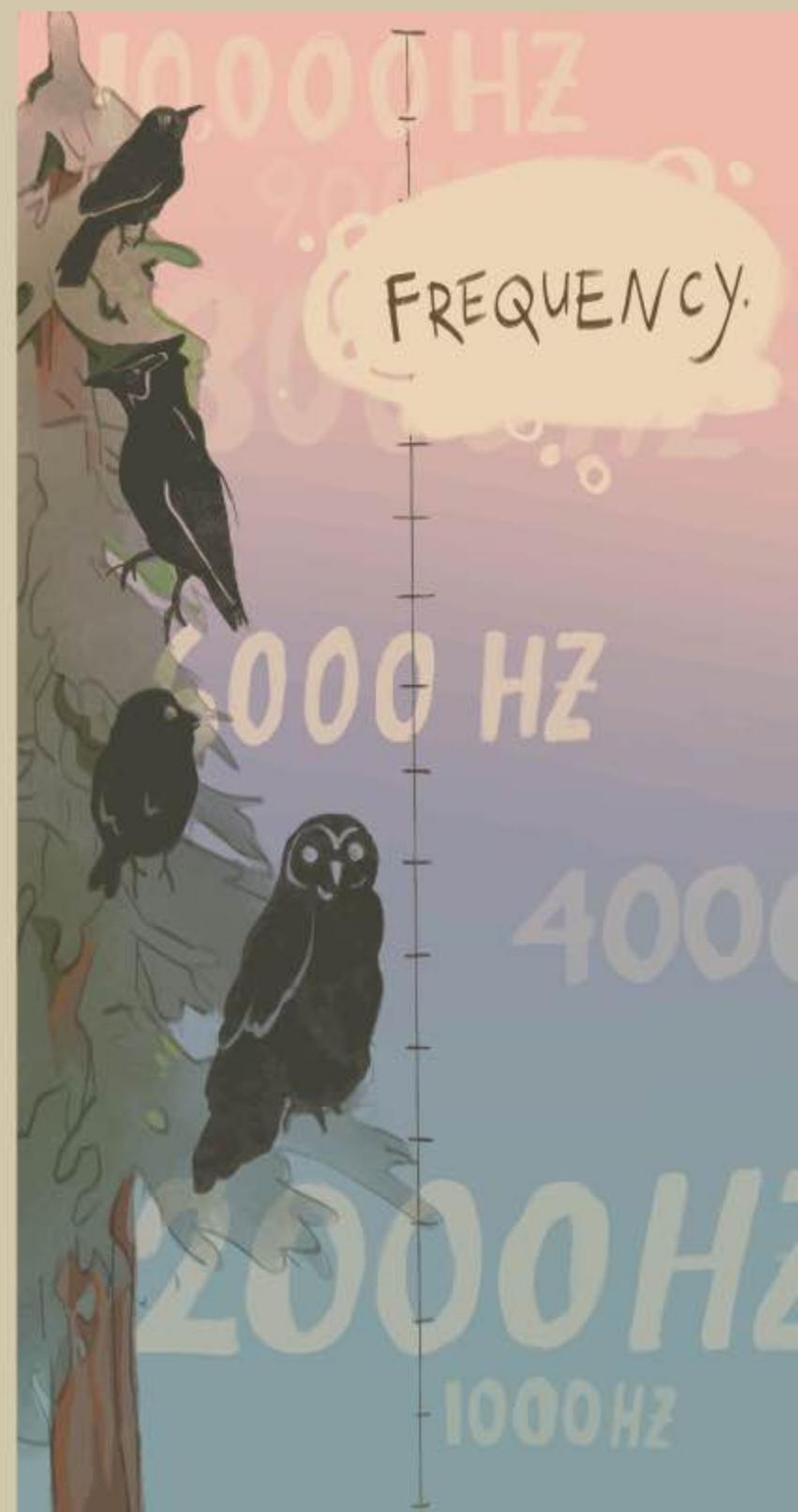
Biodiversity is not only the animals and plants we see or don't see. Animals take up niches in different ways—parts of trees, waking at night or day, sonic frequencies, etc. The ways that evolution explains new species being made—geographic barrier formation, entering an isolated niche, entering an adjacent niche, or a genetic polymorphism (new gene)—is the way that the sounds are orchestrated. An underappreciated part of biodiversity is sound and the communication between animals. Each

either intentionally or involuntarily, produces some noise for movement, navigating, communicating, and even from the wind, rain, and internal processes. The broad realm of acoustic biodiversity can be organized into ecosystems, landscapes, and individuals, each with different functions and behaviors producing different sounds. Animals in healthy habitats have evolved partitioned vocal ranges. Generally, insects tend to settle on ranges in the upper frequencies or they vocalize at times when bandwidth is clear of other organisms' voices. Birds will tend to find acoustic turf mid-range, amphibians in the low-mid ranges, and large mammals, except some smaller whale species and manatees, generally vocalize in lower-ranging bandwidth. Birds in America, including American robins, song sparrows, white- and orange-crowned sparrows, towhees, mockingbirds, and house finches, and great horned owls take up different registers. Indigenous tribes describe the complex network of associations as a “large animal orchestra” where the acoustic locating system, taught from childhood, with permanent and evolving voices. Our own classrooms, dining rooms, and break rooms are similar; we could tell who is who by the sound of their voice, but also their laughs, sighs, speed of their walk, or sound of their shoes.

Birds have “sing” with different notes, structured by syllables, phrases, and patterns. Skylarks have suites up to 500 syllables, differing with individual traits, personalities, and individual history. Their songs even differ by social contexts. The humpback whale also “sings”. The song is done by males to attract females and repel other males, and also allows pods to recognize each other. The song is made up of single notes that form repetitive phrases called themes, and different themes form a song. Noise pollution, from human industries and cities, can reshape communities according to the noise tolerance between prey and predators. For birds, noise pollution can cause direct stress, masking predatory menace, and interfere with communication in general (Brumm, 2013). Even urban great tits sing with higher frequencies in cities, above traffic noise (Slabberkoorn and den Boer-Visser, 2006; Slabberkoorn and Peet, 2003). For whales, noise from engines can directly cause whales’ hearing loss, which mask songs between individuals and species (Hatch and Wright, 2007; Southall, Schusterman, and Kastak, 2001). This involves general and sexual calls that enable individuals to meet and mate, feeding calls that facilitate food resource utilization, and mother and calf calls that enable maintenance of proximity. Thus, the potential of noise to impair survival, reproduction, and population growth demands attention. Along with humpback whales, this also affects right whales, dolphins,

coral reefs, fishes, and mammals (Farina, 2014). Right whales call less often with human noise, dolphins change their frequency around boats, and sperm whales reduce clicking around tones, even hundreds of miles away (Parks, Clark, and Tyack, 2007).

Reviewed by Carolina Abdala, PhD & Mark Swanson, MD



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# INDUSTRIALIZATION, THE TSIMANE POPULATION, AND DEMENTIA

Reviewed by/  
Meredith Bruskin, PhD

By Shaakhini Satchi

## INTRODUCTION:

How often do you think about dementia? It usually stays at the edges of peoples' minds, a vague looming thought that we only consider after it is too late. After all, there is already plenty of stress to draw from—rush hour traffic, tough habits to beat, etc. At a certain point, ignoring a disease that will likely only hit far in the future seems necessary for our sanity. The problem is, when we don't think about the disease as adults, we don't take any steps towards preventing it, making it a bigger issue for our future selves. The first step we can take is understanding just what dementia means. Dementia is a term that encompasses multiple diseases, each of which impacts intellectual function, impairing our memory and cognition (Centers for Disease Control and Prevention, 2019). Though it mainly affects older people, you don't necessarily need to be an older adult to get the disorder. Moreover, while there are treatments that people can take to slow the progression of symptoms, there is no current cure for the disease. So, how exactly do we think about a disease that appears so elusive and puzzling? For starters, we can develop a better understanding of it.

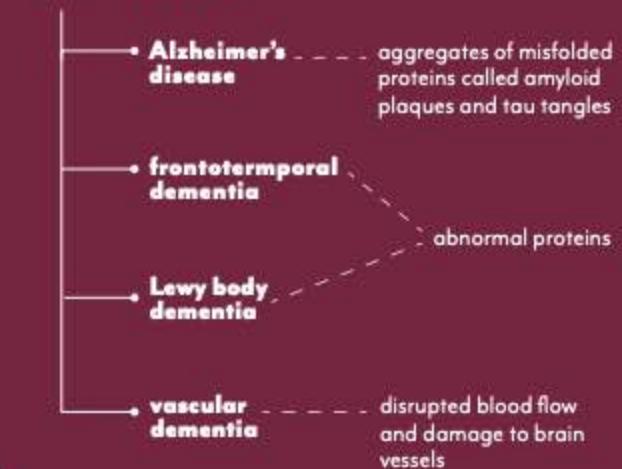
## THE BASICS:

The term dementia encompasses several diseases, each of which affect a person's cognition and daily life. The four major types of dementia are Alzheimer's disease, frontotemporal dementia, Lewy body dementia, and vascular dementia (National Institute on Aging, n.d.). We have different understandings of the cause of each of these disorders. With the most infamous of these conditions, Alzheimer's disease, there are aggregates of misfolded proteins called amyloid plaques and tau tangles found in the brain that are associated with the symptoms ("What Happens to the Brain in Alzheimer's Disease?"). Both frontotemporal dementia and Lewy body dementia are also associated with abnormal proteins, though the specific proteins are distinct between the diseases (National Institute on Aging, n.d.). Finally, vascular dementia is caused by disrupted blood flow and damage to vessels in the brain, making it harder for blood to flow normally ("Vascular Dementia"). Ultimately, each of these pathologies leads to a collection of cognitive and behavioral symptoms that interrupt the ability of the patient to live independently.

Although you may not be constantly thinking of dementia and Alzheimer's, they have a widespread impact on our population. In fact, there are currently more than 6 million Americans with Alzheimer's, an estimate that is predicted to grow to 13 million by 2050 (Alzheimer's Association, n.d.). So not only are millions of people struggling with this disease but this number is expected to multiply scarily soon. Though dementia is primarily associated with memory loss, it has a much greater range

of symptoms, gradually taking over cognitive and physical functioning (Alzheimer's Los Angeles, n.d.). In the beginning stages of the disease, patients may seem overall healthy but have impaired judgment, loss of direction, and mood swings. This could mean trouble managing bills, difficulty with once-simple tasks, and losing concentration. Moreover, as the disease advances, the impact becomes more ranging and severe, with symptoms including weight loss, seizures, skin infections, difficulty swallowing, and loss of bowel and bladder control. Although dementia itself is not deadly, it causes

## DEMENIA



symptoms that grow to be deadly. One of the most common causes of death for people with dementia is aspiration pneumonia, a condition that impairs your ability to swallow, so food gets into the lungs instead of down the throat.

### CARETAKING BURDEN OF DEMENTIA

From all the scary diseases, what makes this different? Dementia is unique because it doesn't just deteriorate the health of its victims, but also the lives of the people charged with taking care of them. As much as the disease seems like a far-off outcome, it may not just burden your life as a patient, but as a caregiver for a loved one. In fact, "more than 11 million Americans provide unpaid care for people with Alzheimer's or other dementias" (Alzheimer's Association, n.d.). These people are responsible for providing care that they haven't been given the necessary time or training for. Because of this caregivers are at increased risk for not only the psychological burdens of stress and depression, but with that, many health problems including cardiovascular problems, lower immunity, poorer immune response to vaccines, slower wound healing, higher levels of chronic conditions, such as diabetes, arthritis, ulcers, and anemia (Brodaty & Donkin, 2009). The threat to health that the disease poses is not just to the people suffering from dementia, but also to the loved ones around them. Anyone from your parents, your grandparents, or your partner could have the disease currently or in the future. The implications of dementia are far-reaching, becoming a financial, emotional, and physical worry for both the people who get the disease and the people close to those involved.

### THE TSIMANE POPULATION:

Now that we have a greater understanding of the disease, let's explore the effects of industrialism by comparing the communities of Los Angeles and the Tsimane tribe. The Tsimane are a group of people in Bolivia who use small-scale planting and foraging to sustain themselves (National Institute on Aging, n.d.). This group's health is compelling because they exhibit lower levels of cardiovascular disease, but higher levels of infection (Irimia et al., 2021). Specifically, the Tsimane have the lowest rate of coronary atherosclerosis—a disease that disrupts blood flow to the heart—and higher levels of inflammation. This unique combination allowed scientists to investigate whether inflammation or heart health is more impactful to brain aging. In order to examine this idea, scientists from the Tsimane Health and Life History Project gathered a group of 746 Tsimane people in different age groups and compared their brain volume decline with groups of industrialized populations from Germany,

United States, and the Netherlands. The idea was that since brain volume loss is associated with higher levels of cognitive decline, the scientists could infer brain health through this measurement. Ultimately, this study found that the Tsimane population had less brain volume decline, indicating better brain health with age for this less industrialized group. Specifically, it was indicated that more developed industrialization is associated with a 70% increase in brain volume decline with age. This suggests that cardiovascular health is a better predictive factor for brain health than inflammation and therefore, modern industrialized living poses a greater threat to the brain with aging.

### HEART AND BRAIN HEALTH:

So, if the data demonstrates that cardiovascular health is associated with brain aging, how exactly are they biologically connected? While the brain itself is responsible for memory, decision-making, motor skills, and more, it is composed of cells which require oxygen. The body's system of transporting this oxygen to neurons is with blood that carries oxygen molecules. The heart pumps this blood throughout the body, allowing oxygen to be exchanged with these cells. This blood has an even greater role, in regulating temperature, carrying immune cells, and transporting nutrients. So, if there is reduced flow of blood to the brain, the neurons can be damaged and even die. Because the brain and heart are so interconnected, it's important to look at both organs when thinking about dementia. By maintaining our heart health, we can help prevent the risk of dementia.

### THE TSIMANE LIFESTYLE:

There are a few ways the Tsimane lifestyle contributes to less cognitive decline. For instance, the Tsimane lifestyle is largely dependent on physical activity. Rather than driving to buy groceries, they actively seek out the food they eat, engaging in "slash-and-burn horticulture (mainly plantains, rice, sweet manioc, and corn); fishing in rivers, streams and lagoons; hunting a large array of neotropical mammals; and seasonal gathering of fruits and other foods, such as honey and nuts" (Gurven et al., 2017). Because they have to contribute to their community and their family through these activities, most people in the population perform considerable exercise on a day to day basis. This high physical activity could be beneficial for heart health as it is associated with a decreased risk for pathologies like coronary heart disease and high blood pressure. This is especially concerning when we consider

the current state of fitness for the LA community. According to the Los Angeles County Department of Health Services (2000), "61% of adults did not get enough weekly physical activity to meet the recommended guidelines" and only 35% of adults participated in "activities that strengthen and tone muscles" such as push-ups and weight lifting. Many people in cities like LA do not engage in the recommended level of physical activity, which could pose a great threat to our heart health. Also, because there are associations between heart and brain health, our lack of fitness participation could present even greater challenges to our health later in life with age-related brain illness. When we consider their physical activity, their preindustrial style of living can work to protect their heart and brain health.

### SLEEP AND DEMENTIA:

Another major aspect of health to consider in relation to dementia is sleep. Around one-third of adults do not get enough sleep each day (Centers for Disease Control and Prevention, 2022). For many people, the priority of sleep is left on the back burner, neglected for the sake of staying up to do work or be online or because your mind can't stop running. While you may be familiar with the short-term effects of this behavior, the grogginess, slow reaction time, etc, you might never have considered the long-term impact of lack of sleep. A study conducted by the Harvard Medical School suggests that people who get less than five hours of sleep a night are at twice the risk of getting dementia in comparison to people who get 6-8 hours of sleep at night (Harvard Pilgrim Health Care, n.d.). While we can't assume that lack of sleep is a direct cause of dementia, we can see that dementia is associated with poor sleep patterns, suggesting that it is an important health habit to focus on. Though sleep is a significant aspect of health, there are many barriers to achieving the recommended 7 or more hours of sleep at night (National Heart, Lung, and Blood Institute, 2022). For instance, some people have trouble immediately falling asleep, making it so that a lot of their time is taken up lying in bed awake, rather than asleep. One reason this could happen is the amount of blue light we are exposed to throughout the day (UC Davis Health, 2022). Blue light is a type of light emitted by digital sources like phones, TV, and computer screens. Evolutionarily, we are alert to the blue sky and slow down as that color goes away. With screens on all day, this doesn't happen. When we perceive blue light before bed, it can impact the production of melatonin, a hormone that regulates sleep. Because of this impact, our sleep schedule can be disrupted when we use digital devices before bed. Thus, it could be helpful to shut down these devices an hour or two before bed. Another habit

that could disrupt your sleep is using the bed for other activities besides sleeping (Suni and Vyas, 2023). Often, people find it easier to lay in bed and do work or scroll on their phones. However, this habit leads you to associate your bed with these activities rather than sleep, making it harder to fall asleep at night. Conditioning yourself to work in bed makes it harder to relax in that environment. Thus, creating a distinction for your bed as a place of only sleep can help aid your sleep schedule. Finally, it could be helpful to practice other health habits like exercise, avoiding caffeine, and reducing alcohol intake, all of which are associated with helping sleep.

### PRACTICAL APPLICATIONS:

While it is all good and well to understand that increasing physical activity can help us prevent cognitive decline and dementia in the future, many people find it hard to get started. The CDC cites some of the barriers to elevating fitness to be a lack of time, lack of energy, and high costs of participation. The first of these barriers, lack of time, some people may not realize that we don't need to exercise for a huge amount of time each day. Instead, it is only recommended that adults perform moderate physical activity for around half an hour each day (Los Angeles County Department of Health Services, 2000). While this may at first seem like a lot, they assert that "walking 1.5 to 2 miles in half an hour" is enough to meet this requirement, meaning that the physical activity involved in walking to a grocery store or walking around the neighborhood would be enough. Thus, people with a lack of time in their day could find ways to integrate it into what they already do, walking or biking to places instead of using other means of transportation. As for the second barrier, lack of energy, in a study comparing the level of physical activity to brain volume and dementia risk, it was indicated that "even a modest amount of physical activity may be protective against dementia" (Tan et al., 2016). Thus, even if you don't have the time or energy to complete the recommended amount of physical activity each day, simply striving to increase the amount of exercise you commit to each day can have long-term benefits. Finally, some people find it hard to participate in physical activities because they require a lot of money. However, there are multiple resources in LA to engage in fitness without payment. For instance, free yoga is offered throughout the week at Runyon Canyon from 10:30 to 11:30 am (Donabedian, 2015). Another way to work on aerobic exercise without paying money would be to go on hikes. For instance, Los Liones Canyon has around a 3-mile hike with views of the Pacific Ocean and Topanga State Park. There are more than enough places to go in LA to make physical activity fun without paying money.

# BLUE ZONES, WHERE LONGEVITY MEETS ENVIRONMENTAL HARMONY

By Mariya Shareef

Do you know where people tend to live the longest? **Blue Zones**. Blue Zones are unique geographical regions around the globe where communities exhibit exceptional longevity and an extraordinary quality of life. While each Blue Zone is scattered across diverse cultures and continents, a common thread that binds these communities is their deep connection to the environment, in addition to their dietary and lifestyle choices. The environmental factors at play in Blue Zones extend beyond mere geography; they encapsulate a way of life that nurtures both the residents and their natural surroundings.

The term Blue Zones has been made popular due to the National Geographic Fellow Dan Buettner and refers to regions where people not only live longer but also experience a higher quality of life. These areas, characterized by a concentration of centenarians and a low prevalence of age-related diseases, include Ikaria in Greece, Okinawa in Japan, Nicoya in Costa Rica, Sardinia in Italy, and Loma Linda in California, USA.

Ikaria, Greece is a mountainous island located in the Eastern Aegean Sea, where inhabitants tend to have a lower socioeconomic status and a multitude of cardiovascular issues (Chrysohoou et al., 2016). However, 32.9% of the population eats locally sourced food and 35.7% of the population eats a mix of locally sourced food and food from the supermarket (Chrysohoou et al., 2016). With an emphasis on locally sourced, seasonal foods, there is naturally less packaged foods, and therefore less generation of waste that contaminates the land. Packaged foods lead to an abundance of greenhouse gasses since they require an extraordinary amount of energy to be processed, packaged, and transported. Since there is a lower dependency on packaged foods among the Ikarians, they will consequently have better air quality. The island's agricultural practices favor organic cultivation, minimizing exposure to harmful pesticides and chemicals. This harmonious interaction with the environment not only supports individual well-being but also ensures the long-term sustainability of the island's ecosystem.

Okinawa, often referred to as the "Land of the Immortals," is nestled among lush greenery and is surrounded by the cerulean waters of the East China Sea. The traditional Okinawan diet emphasizes the consumption of rice, potatoes, fish, and vegetables, which is researched to be linked to the longevity of the people (Mimura, Murakami, & Gushiken, 1992). Intake of green and yellow vegetables was also 50% higher than the national average for Japan (Miyagi et al., 2003). Eating vegetables allows for less waste of energy and resources, lower toxic chemicals in the environment as a whole, and significantly lowered production of carbon dioxide. Eating vegetables also allows for people to consume the same amount of food and feel full but consume less calories. Additionally, people from Okinawa tend to eat every part of the pig, which is largely different from the rest of the Japanese's diet as they typically eat fish. Pig offers these centurions lots of Vitamin B1 and B2, in addition to the ample amount of collagen, which allows for heavier muscle mass and healthier bones. Eating every part of the pig allows for less food waste and less emission. Pigs actually have to chew their food to digest it, so unlike cows, sheep and deer, pigs produce significantly less amounts of methane.

Moving across the Pacific Ocean is Nicoya, a tropical paradise on the Pacific coast of Costa Rica. Here, research has shown that the calcium and magnesium content in the water was the highest in Costa Rica. This suggests that Nicoyans meet their suggested calcium levels simply through drinking water. Such an availability of calcium prevents heart disease, as the heart requires calcium to be healthy. This also allows bones to remain strong and healthy with correct amounts of calcium intake. If there's ample amounts of calcium in one's system, then that calcium can help prevent fractures and bone deterioration over time, which allows people to live longer and healthier lives (Buettner, 2012).

The Costa Rican concept of "pura vida," meaning "pure life," permeates every aspect of daily existence in Nicoya. This philosophy extends to the local cuisine, where locally sourced rice, beans, and animal protein take the stage. All these foods do not make one's blood glucose level rise too much and provide Nicoyans with lots of



fiber (Rosero-Bixby, Dow, & Rehkoppf, 2013). The reliance on plant-based, locally sourced foods not only contributes to the well-being of Nicoyans but also supports sustainable agriculture and reduces the carbon footprint associated with food production and transportation, just like the other blue zones.

Now moving across the Atlantic Ocean, Sardinia, an island in the Mediterranean is renowned for their diet which is composed of locally produced wine, dairy products, whole grains, and a variety of fruits and vegetables, thus being the ideal diet to protect the elderly from diseases related to old age. The agricultural practices, deeply rooted in sustainable methods, prioritize the preservation of the island's natural resources (Nieddu et al., 2020). Here, Sardinians also have moderate wine consumption, which entails drinking 1-2 glasses per day (Buettner & Skemp, 2016). Wine is known to decrease stress levels as the consumption of resveratrol, a compound found in wine, activates the PARP-1 protein to reduce stress and repair damaged body cells (Sparaco, 2020). Additionally, moderate consumption of wine allows for an increase in HDL cholesterol, which is the good cholesterol which lowers the risk of heart disease, hypertension, and metabolic syndrome (Milman et al., 2014).

Lastly, Loma Linda, a beautiful city not too far from Los Angeles is a unique Blue Zone with a diverse population of 9000 Seventh-day Adventists. The designation of Loma Linda as a Blue Zone is due to the Seventh Day

known to improve one's life expectancy because religious individuals are more likely to refrain from unhealthy practices (Medical News Today, Religious belief may extend life by 4 years). For example, studies have proven that Orthodox Jews tend to live longer and the reason is thought to be because they have a clear direction on how to live their life. Due to the sense of direction provided by the Seventh Day Adventist Church, the residents exemplify a lifestyle where environmental consciousness is woven into the fabric of their daily lives, especially through food. Like many other blue zones, the plant-based diet embraced by many in Loma Linda aligns with sustainable and environmentally friendly food choices, as they locally source their food. However, despite these benefits, vegetarianism isn't the best thing that has happened to the Loma Linda community. A study has shown that a vegetarian diet has resulted in decreased sperm counts in the community, which can hinder population growth (Orzylowska et al., 2016).

Blue Zones have several factors in common that allow their citizens to live long, healthy lives: they tend to locally source their foods, have an emphasis on relaxing and enjoying life, and also their inhabitants have utmost respect for nature. Whether in the lush landscapes of Okinawa, the sun-soaked shores of Nicoya, or the rugged beauty of Sardinia, the residents of Blue Zones showcase a harmonious coexistence with their environment and keep their cultures that support the best choices for their health.

# THE POISON OF VAPING

Interview with  
Rob McConnell, MD

The e-cigarette has poisoned the lungs of our world. Commonly referred to as “vapes,” their usage has exploded since their introduction in the mid-2000s, especially among teens (NCCDPHP, 2016). While some research has been carried out into the health effects of vaping, the long-term effects of these devices on humans are yet to be seen. To combat the threat of marketing misinformation regarding vaping, I sat down with Dr. Rob McConnell, physician and environmental epidemiologist, as well as Division Chief of the Division of Environmental Health in the Department of Population and Public Health Sciences at USC’s Keck School of Medicine. Dr. McConnell has conducted numerous studies into vaping, dealing with topics such as patterns of initiation and use, risk of progression to smoking, effectiveness of policy to prevent sales to children, and respiratory health effects of vaping.

What is often underestimated is how prevalent vaping is. As Dr. McConnell puts it, this epidemic has developed right in front of our eyes. In 2021, 4.5% of adults were e-cigarette users (Kramarov, 2023). In 2023, a startling 2.13 million middle and high school students in the United States currently used e-cigarettes (CDC, 2023). Dr. McConnell adds that general trends show some specific populations with a rate of ever usage up to 25 or 30%. These trends are strongest with at-risk populations, namely those already struggling with substance use. He further notes the strong complementary relationship between vaping and cigarettes, with both potentially being gateways to the other, not to mention cannabis as well.

The specific effects of vaping are even more troubling. Dr. McConnell’s research examined these effects. He and his team published one of the first studies demonstrating a link between vaping and respiratory symptoms. They also later concluded that these symptoms were due to vaping and not likely to be explained by other confounding variables. Vapes produce acetaldehyde, formaldehyde, and acrolein. The aldehydes can potentially cause lung disease and cardiovascular disease. Acrolein, a herbicide, can also cause acute lung injury and COPD (American Lung Association, 2023). Other symptoms observed in vape users are increased diastolic blood pressure, nausea, vomiting, diarrhea, abdominal pain, renal insufficiency or poor kidney function, contact dermatitis or rashes, and more (Seiler-Ramadas et al., 2020). Furthermore, a recent study showed that the DNA damage in oral cells was equal

By Mugil Shanmugam

in vapers and smokers and significantly more than non-users, with more vaping increasing damage (Tommassi, Blumenfeld, and Besaratinia, 2023).

EVALI, a breakout of lung-related injuries caused by vaping, is a further example of the harmful effects of vaping. It occurs mainly in cannabis vapes, as under high temperatures, one of the ingredients, Vitamin E acetate, can thermally decompose into ketene gas, potentially causing serious lung injury or death (American Lung Association, 2024; Committee on Acute Exposure Guideline Levels 2014; Wu and O’Shea, 2019). Furthermore, Vitamin E acetate can cause lipid pneumonia, a condition involving lung inflammation, as the chemical can potentially penetrate and disturb phospholipid bilayers like the pulmonary surfactant (Kamal and Raghunathan, 2012; Maddock et al., 2019; Massey, She, and Pownall, 1982; Torres 2020; Zuo et al., 2008). The pulmonary surfactant is the lining of the alveoli, the sacs in our lungs that facilitate gas exchange. While all this is troubling, Vitamin E acetate isn’t used much in e-cigarettes anymore and Dr. McConnell mentions that further research is still needed in order to uncover the direct relationship between Vitamin E acetate and EVALI. He also notes there is some controversy about whether only cannabis vapes or nicotine vapes as well cause EVALI, since most cases occur in those vaping cannabis.

Vitamin E Acetate is just one example of the hazards of vaping exposures, especially since the ingredients of vapes are not well regulated and therefore there is a lot of room for one ingredient to cause negative effects. Examples of these ingredients are often flavoring agents or other components. Dr. McConnell has done research into the flavoring of vapes and reports that some inhaled flavors can damage lung tissue. Referring back to the earlier mentioned study regarding DNA damage, it was found that sweet, mint/menthol, and fruit-flavored vapes was linked to the most DNA damage (Tommasi, Blumenfeld, and Besaratinia, 2023). Many other researchers have also conducted studies into how different flavoring chemicals can harm vapers. For example, Johns Hopkins Medicine reports that diacetyl, a food additive that gives microwave popcorn its buttery taste, can cause inflammation and permanent scarring in lungs when inhaled (Broderick, 2021). Furthermore, menthol, which gives a mint flavor, has been suggested by a University of Pittsburgh study to

produce more toxic microparticles and be associated with poorer lung function (Chandra et al., 2023). Researchers from the University of Rochester found that cinnamon, vanilla, and butter flavoring chemicals were the worst on white blood cells(monocytes), but that combining these flavors was even more harmful (Muthumalage et al., 2018). Cherry is another flavor, along with cinnamon and vanilla, that might react with propylene glycol, a chemical found in many vape juices—these reactions can create new chemicals that may irritate the lungs (Erythropel et al., 2018).

Perhaps the most important chemical when it comes to smoking or vaping is nicotine. While not all vapes have nicotine, it is a toxic chemical. Not only is it highly addictive, producing cravings and withdrawal symptoms, but also raises blood pressure and the chances of having a heart attack by inducing the release of adrenaline (Blaha, 2022). Nicotine addiction is due to its release of dopamine, leading to the reinforcement of behaviors such as vaping that give a “reward” (National Institute on Drug Abuse, 2020). It can further harm the brain development of teenagers and can cause premature or low birth weight births (American Cancer Society, 2022). Specifically, nicotine can affect how synapses are built in teenage brains, as well as

damage growing brains, specifically the areas that control learning, attention, mood, etc. (CDC, 2023). Companies sometimes market vapes as containing synthetic nicotine or nicotine produced in the lab. Although it is not from tobacco, it can be harmful, especially since synthetic nicotine was not under FDA regulation until 2022, meaning that there could be byproducts or dangerous chemicals in these synthetic nicotine vape juices (Center for Tobacco Products, 2022). There is no evidence that synthetic nicotine is healthier than nicotine from tobacco products (Berman, Zettler, and Jordt, 2023).

Up to now, we have focused on the direct effects on the vape user. However, the vape user is not the only one affected. Dr. McConnell with his colleague Dr. Talat Islam have found that just like users of vapes, secondhand vaping exposure to bystanders was associated with a greater risk of bronchitic symptoms and shortness of breath among young adults (Islam et al., 2022). When someone vapes, chemicals such as nicotine, ultrafine particles, diacetyl, and benzene (also a chemical from car exhaust) all assail those around the vaper (Broderick, 2021).

Secondhand inhalation can also lead to increased asthma attacks, with studies still ongoing to discover more effects as



the chemicals in these aerosols can potentially be cancer-causing (American Thoracic Society, 2020). Thus, vaping isn't just a personal risk, it endangers bystanders as well.

Vaping also affects the environment. Liquid nicotine found in vapes can be toxic to wildlife (McFarling, 2022; NIOSH, 2011). Furthermore, lithium in vape batteries can seep into the groundwater and soil, creating contamination hazards (McFarling, 2022; Kang, Chen, and Ogunseitan, 2013). Emissions from vapes such as carbon monoxide, particulate matter, volatile organic compounds, heavy metals, and other chemicals can be contributors to air pollution; vape aerosols contain as much or more

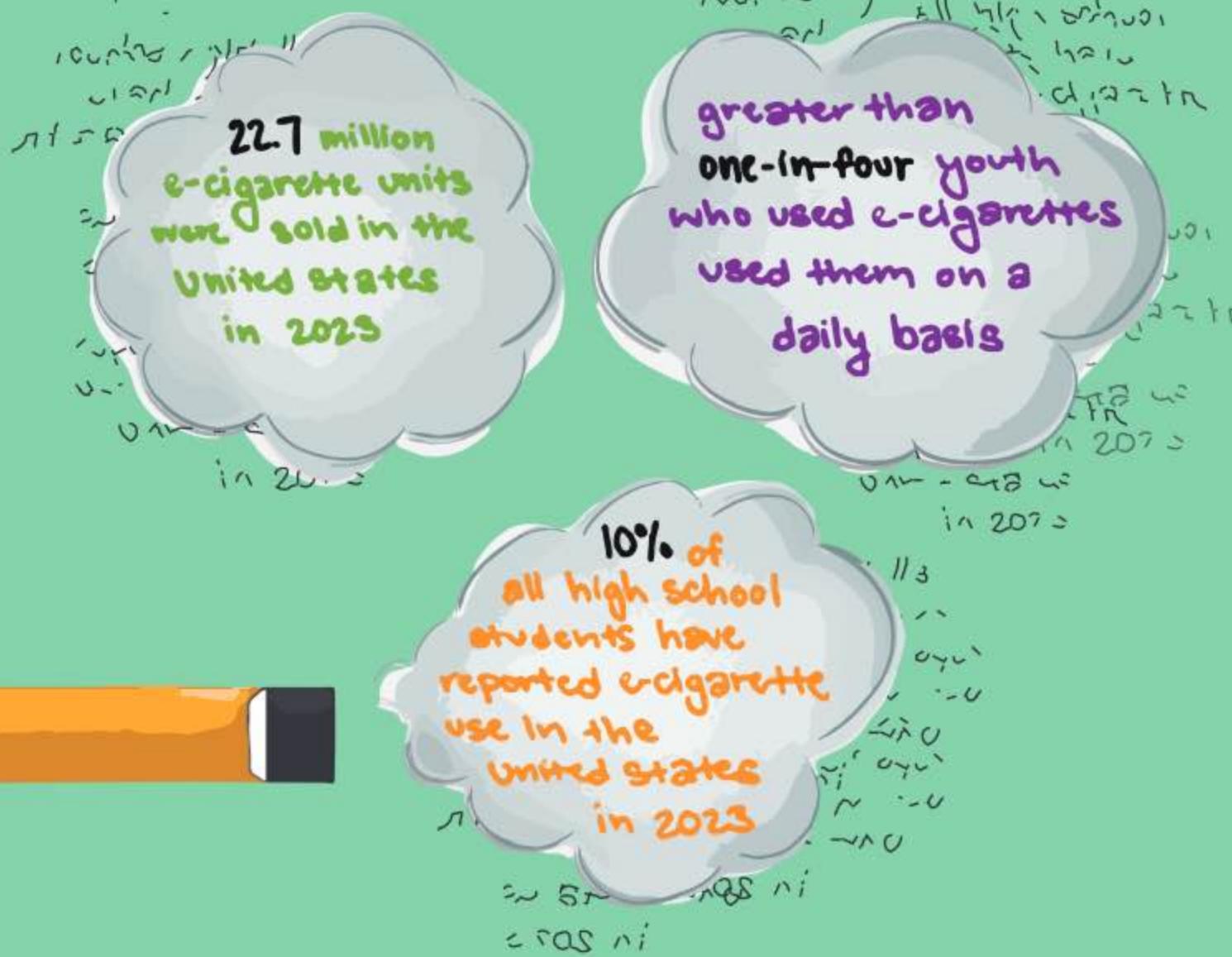
particulate matter and heavy metals than normal cigarette smoke (Ngambo et al., 2023). With the smoke cloud created by a vape consisting of so many ingredients, we can only assume that there are other harmful environmental and physiological effects.

Just as important as the ecological impact is our social stance, and our public perspective. Dr. McConnell mentions that vaping works similarly to tobacco products in this regard. When someone in a social circle smokes, such as a parent, roommate, or friend, it makes others likely to smoke as well. How someone gets their first vape also impacts their attitude towards their own use and the use of others. Dr. Alyssa Harlow and Dr. Jessica

Barrington-Trimis, leading an effort along with Dr. McConnell found that underage vapers who bought their own vapes were more likely to vape more times, vape more puffs each time, and have dependence than vapers who do not buy their own vapes (Harlow, McConnell, and Barrington-Trimis, 2023). Furthermore, even the built environment can have impacts on vaping. For example, having vape shops near schools may increase rates of vaping. However, Dr. McConnell does offer a glimmer of hope for the vaping epidemic, taken from the lessons learned in the process of denormalizing tobacco. At one point, smoking was quite socially acceptable, which increased rates of uptake. However, showing the public the impacts of second-hand smoke played a big role in denormalizing tobacco. While vaping may not have the exact same impact, the symptoms for users and bystanders should be an important argument in combating vaping and denormalizing it. One can only hope the message against vaping won't take the same death toll and personal loss needed to prove the dangers of regular cigarettes.

While denormalization is a big step in eliminating the threat of vaping, policy can be another valuable tool. One such example is regulating the selling of vapes to underage individuals in each municipality. Although this is already a nationwide law, it is not enforced very well. To combat this, some municipalities conduct sting operations to identify any sellers who are not abiding by these policies. The fines levied upon these sellers can be used to continue the monitoring program. Dr. McConnell's team saw a reduction in the uptake of vapes in communities that had better regulation of this sort. Under California law, vapes are regulated similarly to combustible cigarettes (Aliferis, 2016). Dr. McConnell also recalls Dr. Daniel Soto and Dr. Yaneth Rodriguez, members of his department, testifying in front of the city council of Beverly Hills about vaping. Beverly Hills later became the first city to almost completely ban the sale of e-cigarettes and cigarettes in 2019, with the ban going into effect in 2021 (City of Beverly Hills). As of July 2023, 34 countries have banned vapes, including Brazil and India (World Health Organization, 2023). Furthermore, as of December 2023, the WHO has advised nations to treat vapes just like regular tobacco in terms of regulation (World Health Organization, 2023). While not much research has been done into the impact of these policies, they are a step in the right direction towards a healthier future.

Some herald vaping as a smoking alternative, helping smokers quit cigarettes. However, the evidence that e-cigarettes help smokers quit is highly controversial. For example, one study comparing nicotine replacement



## ADOLESCENT BRAIN FROM VAPING

therapy to e-cigarettes found that e-cigarettes can actually continue nicotine dependence, as e-cigarette usage was linked to lower rates of nicotine abstinence long term (Hanewinkel et al., 2022). Other methods may be more effective, such as the aforementioned nicotine replacement therapy, relaxation深深-breathing techniques, physical activity, and more (Mayo Clinic, 2022). Specifically, nicotine replacement therapy is meant to help people reduce their nicotine use completely, rather than swapping one nicotine product for another. At the end of the day, e-cigarettes can negatively affect the user, those around them, and the environment. Especially with teenagers increasingly using these products, policies such as those mentioned above are of the utmost importance. Through research, policy, and education, hopefully, we will one day eliminate this menace from the lungs of our world forever.

Reviewed by Jennifer Unger, PhD

# THE IMPACT OF ENVIRONMENTAL HEALTH ON CHILDREN'S HEALTH

By Elisa Liu



In our interview, Dr. Kamai stated that children are uniquely vulnerable to environmental hazards due to their higher metabolic uptake and the ongoing development of their nervous and reproductive systems. These factors make exposure to toxins and pollutants particularly detrimental to their well-being, often resulting in long-term effects. The unseen consequences of environmental hazards can cast a shadow over a child's entire life, affecting their physical health and cognitive and emotional development. The World Health Organization estimates that annually, three million children worldwide under the age of 5 die from diseases related to factors in their environment (WHO, 2023). What about the rates in the states? California? Los Angeles? Overall, there is great urgency to address environmental health issues in children from a global perspective.

Then, since all children deserve to live, play, and thrive in healthy environments, the overarching goal in this context is striving for environmental justice, the attainment of which will require establishing universal access to clean air, water, soil, safe food, and secure homes and neighborhoods. However, not all children have access to such a healthy environment. For example, low-income families are disproportionately burdened by environmental hazards and pollution due to unequal policies in the fields of healthcare, law, social structure, etc. Dr. Kamai mentioned redlining, urban renewal, and, especially here in LA, freeway expansion as examples (Kamai, 00:04:30). From the discussion above, we can understand that the impact of inequities in environmental justice can vary from one community to another, shaped by different hazards and flawed policies. Zooming in on specific under-resourced regions in LA, Dr. Kamai demonstrates that climate change exacerbates inequalities in child health, affecting underdeveloped countries and low socioeconomic classes the most (Kamai, 00:06:41). These communities require more resources and

Reviewed by  
Elizabeth Kamai, PhD, MSPH

Interview with  
Elizabeth Kamai, PhD, MSPH



infrastructure to mitigate the challenges posed by climate change, reducing the gaps.

After surveying current research for solutions, Dr. Kamai proposes that environmental health issues in children require a multifaceted approach. While individual behavioral changes such as vaccinations, handwashing, balanced diets, adequate sleep, and physical activity are essential components of children's health, the most effective improvements come from structural, systemic, or policy changes. She introduces a concept called the Hierarchy of Controls, a framework from the occupational health and safety fields. This framework categorizes all kinds of safety interventions by their effectiveness. Structural, policy, and systematic changes, such as reducing air pollution, are at the top. These can have a more significant and lasting positive impact than relying solely on individual behavioral changes. The successful regulation of lead in paint and gasoline exemplifies how policy changes can improve children's health. Another classic example mentioned by Dr. Kamai is examining the process of goods movement as a broader issue of food quality, waste, and overconsumption. Children's health can be better supported in developing online shopping and global supply chains by mitigating negative environmental influences.

In short, issues in environmental hazards and environmental justice profoundly impact our children's health and future. Addressing these obstacles is not just a matter of child health but is fundamental to the well-being of society as a whole, both locally and globally. Learning more about environmental health can create a world where children thrive in a healthy, equitable, and sustainable environment.



### INTRODUCING OUR INTERVIEWEE:

#### DR. ELIZABETH KAMAI

"I collaborate across multidisciplinary teams to support community-led participatory science, analyze and visualize data, and translate research into actionable resources across environmental justice communities in Southern California" (Kamai).

Dr. Elizabeth Kamai is an accomplished environmental epidemiologist dedicated to studying environmental chemical exposures, reproductive and pediatric health, and building productive community partnerships. Her groundbreaking research has profoundly impacted understanding the effects of environmental factors on human health.

Dr. Kamai's studies include the AIRE study, where she characterizes air pollution sources and health implications, focusing on vulnerable children living in rural California. Additionally, she works on the BELLA and MADRES studies, investigating how proximity to oil and gas production affects the health of urban Latina women.

During the interview's conclusion, Dr. Kamai shared her journey into environmental health and justice. Growing up with easy access to clean air and water sparked her environmental interest. Supportive internship experiences with an environmental epidemiologist introduced her to the world of public health and environmental health. This led her to pursue a Ph.D. in epidemiology, driven by her passion for problem-solving and addressing challenging questions related to environmental exposures and health impacts. Dr. Kamai joined USC because of the Environmental Justice Research Lab, led by Dr. Jill Johnston, which is known for its community-based, action-oriented research and impact on policy changes.

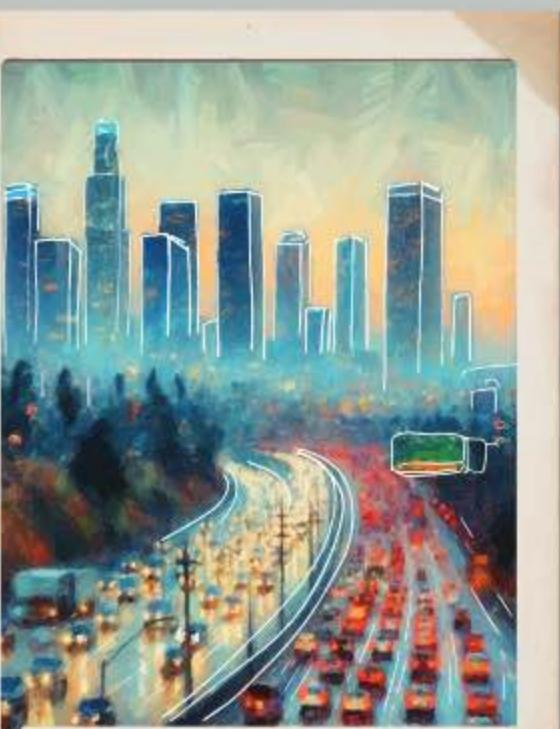


Dr. Kamai also discussed ongoing research studies in her lab, such as the "Get the Lead Out" study measuring lead in residential soil and the "Lasmosis" study examining air pollution around urban oil drilling sites in South LA. She highlighted a new NIH-funded Children's Environmental Health Research Translation Center, focusing on the goods movement and addressing environmental injustices linked to fossil fuel production and transportation.

In response to a question about advice for students interested in environmental justice, Dr. Kamai emphasized the interdisciplinary nature of environmental health, involving fields like public health, epidemiology, biostatistics, urban planning, and data science. "There is no one career path in environmental health, and connecting one's interests to the field can lead to meaningful and valuable work" (Kamai, 00:29:06). She encouraged students to follow their passions and interests, reach out to professors and researchers for potential collaborations and internships.

# A GREENER FUTURE: SUSTAINABLE TECHNOLOGICAL INNOVATIONS

By Nicole Hoeborn



## INTRODUCTION

With recent technological advancement and unprecedented human progress, it seems that qualms about the negative impact of technology and industrialization on the fate of the world and the health of the planet are often being ignored by those in positions of power. We see the effects climate change has been having on the environment, our health, and the future of our society daily. We are faced with the undeniable truth that more must be done to preserve our planet. When imagining a “greener future,” what comes to mind is a world where people are driving futuristic electrical vehicles, reducing air travel, and complex recycling systems. But what if we changed this narrative? What if instead, we took what we already have and found solutions to make it greener? This is what USC Professor Travis Williams researches. Within the chemistry department, Dr. Williams brings to light a mindset that may make a greener future more sustainable. With his work, he has delved into multiple areas of interests, Dr. Williams has a focus on technological innovations surrounding the area of recycling and green energy.

## GREEN HYDROGEN

The process of creating green hydrogen involves the production of renewable energy via wind, solar, water, or hydro energy. This process includes the electrolysis of water, which breaks it down into O<sub>2</sub> and H<sub>2</sub>, the H<sub>2</sub> molecules are then captured and O<sub>2</sub> is released into the atmosphere which is where it manifests naturally. This form of renewable energy has been forecasted to be key in the race against reaching net zero (Majewski et al., 2023). It has the potential to be an alternative to gasoline thanks to its high value as a transportation fuel, and could be the key ingredient in the quest to reduce the carbon footprint of automotive vehicles.



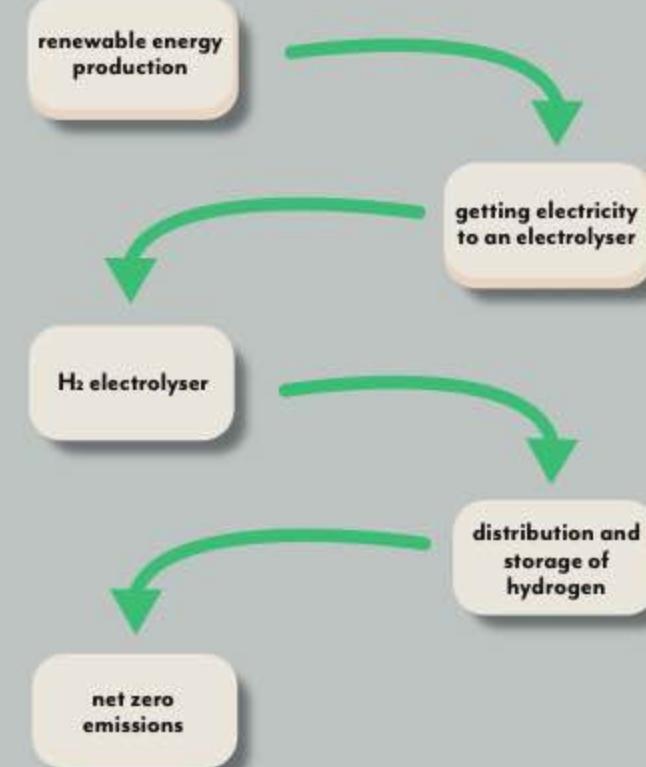
Though promising, there is a big question surrounding the transportation of hydrogen. Scientists have been asking this question, looking into methods of ways this chemical can be transported safely and efficiently. Dr. Williams focuses on this issue of distribution, of how this can be better implemented to reduce carbon footprint. He brings to the picture a “dummy molecule”, which collects the hydrogen to create an energy carrier, which can then be transported and utilized. This would be in the form of a liquid. When ready to be used, it can undergo a chemical reaction to extract the hydrogen to be used as a fuel source. This development allows for extremely safe and an accessible transport of hydrogen gas.

## CARBON FIBER REINFORCED POLYMERS

The use of fiber-reinforced polymers (FRP) has stretched out to the manufacturing of multiple everyday applications, such as aerospace, wind turbine blades, and sporting goods. Carbon fibers are used in composite materials in which carbon fibers provide the strength and stiffness and the cohesive matrix from the polymer holds and protects the fibers together (Fekete and Hall, 2017). These FRPs can be altered in their strength, length, directionality, and the amount of the reinforced fibers used in the polymer matrix (Fekete and Hall, 2017). The unique properties of FRPs allow them to be a primary structural material in the aerospace industry since they are lighter, more resistant to fatigue and corrosion, as well as have reduced / lower fuel consumption (Navarro et al., 2020). Since the fuel is lighter, the entire aircraft weighs less, so the aircraft requires less fuel to fly.

Although these composites bring a lot of benefits in manufacturing, there are drawbacks in their larger market application. The greatest is the end-of-life waste production. There is a great difficulty in recycling FRP's since they are thermosets, meaning that the epoxies used to secure the fibers in place are cured from a thick liquid to become a stiff solid (Navarro et al., 2020). This process of curing the epoxy is irreversible, making recycling FRP's a large obstacle. Current recycling methods include the shredding of FRP's to be used as an additive material to create reinforced concrete, the other method being to dissolve the polymer (plastic) matrix. In both cases, the matrix and fibers are destroyed, meaning that their once strong and stiff characteristics are now gone and have become randomized short-fiber mats.

## GREEN HYDROGEN



The increase in demand for composite aircrafts brings to light the importance of having proper end-of-life recycling techniques as 99.1% of composite materials from aircrafts end up in the landfill. A composite aircraft is expected to create 20% less fuel per passenger mile, but the production of the fibers creates a large carbon footprint. It takes more energy to produce a composite vehicle than to mill process aluminum. Even though the aircraft is emitting less CO<sub>2</sub> and it cancels out at the end of the vehicle's life, there is no reduction in the overall CO<sub>2</sub> production.

Working with Prof. Steven Nutt in USC's MC Gill Composites Center, Dr. Williams' focus is to get more of the carbon intensity that is already embedded in the aircraft into higher value manufacturing applications. In his lab, he and his team created a couple of chemical processes to depolymerize the thermosetting epoxy to get the carbon fibers back, undamaged. Along with this, the chemicals from the epoxy are also available to be reused. With this technique it allows for a second life carbon composite vehicle. These separated parts can now be used to recreate carbon FRPs for other applications, these carbon fiber substrates can be used in the manufacturing of other goods. It is mainly a great substitute to produce wind blades, which are often built out of glass-fiber. The use of an aviation grade carbon fiber substrate allows it to produce a lower carbon intensity wind blade, supporting a more efficient way to recycle carbon FRPs.

#### PLASTICS TO DRUGS

The next area of interest takes us to Catalina Island, where the USC Wrigley Institute is located and the facility in which Dr. Williams is an associate. Though this island holds many different research institutes, it is also collecting plastic as a result of its location. The island's location causes it to face in the direction of the Great Pacific Garbage Patch, which is a patch encompassing 1.6 million square kilometers, and Catalina continues to collect microplastics from this patch (McQuiston, 2023). The increase in plastic dependency in different industries stresses the importance in creating innovative methods in reclaiming the product after their first-use, especially with polystyrene. Dr. Williams mentioned that the recycling rate of polystyrene is very low. Only 0.9% was recycled in 2018 in the United States.

Dr. Clay C.C. Wang, professor and chair in the department of pharmacology in the Mann School of Pharmacy, and Dr. Williams work together to tackle this through a biological, pharmaceutical, and chemical lens. By utilizing their skill sets, they created a method in which polystyrene can be taken from the ocean and broken down into carboxylic diacids made of benzoic acid. Benzoic acid is an intermediate

taken from the ocean and broken down into carboxylic diacids made of benzoic acid. Benzoic acid is an intermediate substance required to form the product. This acid is fed to fungus created in Dr. Wang's lab to synthesize the target product. The fungal strains, Aspergillus nindulans, can be genetically altered for them to produce the ideal, valuable byproduct. This byproduct are medications used for pharmaceutical testings or have agricultural applications.

This methodology allows for the mass production for the use of pharmaceutical testing, instead of synthetically producing this in large amounts. Dr. Wang and Dr. Williams created an alternate method in tackling the issue of mass plastic production and created a solution that allows for the removal of this waste. Dr. Williams mentions that this methodology will most likely not be implemented to the pharmaceutical market for sale, but if this can be done on a kilo scale, there is a thousand times more substrate to aid in accelerating drug discovery. Dr. Williams also believes this can be utilized in agriculture, where the number of carbon atoms seen with the plastic in the garbage patch lines up with the carbon atoms needed in an agricultural field. Therefore, allowing a higher yield of plastic to be removed from the oceans to aid agriculture.

#### CHANGING THE GREENER NARRATIVE

After taking a look into the research of the Williams lab, it represents the endless possibilities surrounding sustainability. Dr. Williams focuses on supporting the economy while being sustainable. Instead of limiting the realm of sustainability through changing individuals' habits, more and faster change may come from applications on the larger, industrial scale, for the benefit of both the individual and industry. Instead of seeing sustainability as a hurdle/obstacle, we should all embrace the possibility to change and the benefits. By implementing these small changes, there can be a large long term effect on the environment and the planet we call home. By adopting a different approach to sustainability we can learn that a sustainable future is attainable.

Please refer to the companion audio to hear more from Dr. Williams and his research.

# WOMB WARRIOR: DEFENDING EXPECTANT MOTHERS AND BABIES FROM AIR POLLUTION AND TOXIC METALS

By Aidan Scanlan

Interview with  
Elizabeth Kamai, PhD, MSPH



Reviewed by  
Carrie Breton, ScD

## INTRODUCTION

Every mother wants what is best for her children, and delivering an underweight baby can be a source of stress and fear for mothers. Low birth weight can lead to developmental delays in a child, including lagging expected growth and cognitive developmental milestones. Missing growth and cognitive development milestones can be challenging and distressing as a mother, because they would worry about their child's ability to develop effectively and succeed in the world. Emerging research conducted by Dr. Carrie Breton, Professor of Environmental Health in the Department of Population and Public Health Sciences at USC, suggests that in-utero exposure to air pollution and toxic metals can lead to low birth weight, which could have negative effects on a child's development. More broadly, her research centers around the health effects of environmental exposures on early infant development and maternal health.

## AIR POLLUTION

Dr. Breton has conducted extensive research in order to determine the effects of air pollution exposure on infants and their mothers. The main metric she tracks is birth weight. A study conducted by Dr. Breton suggests that exposure to air pollution, including traffic-related air pollution (TRAP), is associated with lower birth weight (Niu, 2022). Furthermore, one of the major findings of that study was that "not all pregnant women were equally vulnerable to the effects of the ambient pollutants." This negative effect of air pollution on birth weight was particularly pronounced when the mother reported experiencing high levels of psychological stress during the pregnancy. Mothers who lived in neighborhoods with higher levels of environmental burden, such as toxic waste sites, contaminated water, and high asthma rates, as well as social burdens like high crime rates, were more susceptible to the negative effects of air pollution on birth weight compared to mothers who lived in low-burden neighborhoods.

Interestingly, one study conducted by Dr. Breton and colleagues found that exposure to traffic-related air pollution during pregnancy was associated with higher leptin levels in infants (Alderete, 2017). Leptin is a hormone that regulates how hungry someone feels—high leptin levels inhibit hunger, while low leptin levels cause a feeling of hunger (Cleveland Clinic, 2022). In the study, higher leptin levels were observed in the infants, which was in turn associated with higher infant weight at six months after birth.

Dr. Breton explains,

"One hypothesis is that even though air pollution has been associated with lower birth weight, there may be room for greater catch-up growth driven by air pollution in the early years, [leading to a] greater risk of obesity later in childhood. But we really don't know where that happens. Our [study] would provide some evidence to suggest that some growth is happening at a faster [rate] after delivery. At six months, [the study subjects] had a slightly higher birthweight for gestational age."

An important question is how to mitigate or minimize the negative effects of traffic-related air pollution on fetal development during pregnancy. Dr. Breton has a few ideas, although they are not medical recommendations and are still subject to further research. On a societal level, limiting how close residential property can be to freeways could help. Generally, the closer to a freeway someone is, the higher their exposure to TRAP. Air filtration and using air conditioning inside buildings could be an effective way to limit one's exposure that is also relatively cost-effective and non-invasive. Dr. Breton explains that from her perspective, "It would be much better to solve the problem by reducing systemic sources of pollution rather than [telling] every pregnant woman 'here's another thing to do to make sure you don't hurt your baby, because we have polluted everywhere but will force you to deal with it.'" While there may be some utility to individual actions like using air filtration systems in one's home, or using the air recirculation feature in modern cars, the most effective solutions will decrease the amount of air pollution being produced on a societal level. For instance, a majority of the population switching from using primarily cars to primarily public transportation, or from gasoline-powered cars to electric cars, could decrease the amount of TRAP being produced overall. However, decreasing the amount of TRAP being released into the air is a problem that will likely require more nuanced solutions than those, because as Dr.

Breton points out, "We don't know what is in TRAP really. Moving toward electric vehicles might decrease your tailpipe emissions. But if tire wear, rubber getting worn and particulate tire matter becoming dust, or brake wear are the sources of TRAP, then we aren't decreasing the amount of TRAP being produced if we switch to electric vehicles." While current research is still working to understand the specifics, it remains clear that reducing air pollution is an important step toward protecting the health of pregnant mothers and their fetuses.

There are a lot of hypotheses that attempt to explain how exactly air pollution affects birth weight and fetal development. The two prevailing theories about the mechanism of this are:

### 1. Oxidative Stress

Signaling pathways triggered by the inhalation of polluted air can increase oxidative stress through the overproduction of reactive oxygen species. Oxidative stress is the result of an imbalance between reactive oxygen species (which are created in the body through exposure to air pollution) and antioxidant molecules. Too many reactive oxygen molecules relative to antioxidant molecules leads to cellular damage that may have a negative impact on fetal development and birth weight (Pizzino, 2017).

### 2. Inflammation

Inhaled air pollutants deposited in the mother's lung can impair oxygen and nutrient transport to the fetus as well as cause systemic inflammation in the fetus, both of which lead to fetal underdevelopment and low birth weight (Yi, 2022).

## METAL EXPOSURES

In her research, Dr. Breton has explored the impact of exposure to metals and metalloids on the health of fetuses and pregnant mothers.

Her research has found that "...lead and mercury were associated with [decreased birth weight], but the more nickel you had the more you dampened that effect...There are definitely people interested in, specifically with metals, thinking about how nutritional interventions might actually be helpful because you might be able to fill that pathway more with the good stuff and less with the bad stuff." At the moment, the research is not at a stage where scientists can make recommendations about specific nutritional interventions to take to protect oneself against toxic metals, but future research hopes to shed light on this promising field of study. Luckily, there are some proven ways to minimize exposure to the "bad stuff" (harmful metals that can be present in drinking water).

Activated carbon water filters are a cost-effective method of removing or reducing the presence of certain metals in contaminated drinking water. The filters can trap copper, lead, mercury, zinc, and other organic impurities that are present in water. This could help protect a mother and her fetus against the negative birth weight

effects of lead and mercury. As long as they are replaced regularly, activated carbon filters are very effective at removing the contaminants mentioned above. Dr. Breton notes that activated carbon filters cannot completely remove arsenic or PFAS (Perfluoroalkyl and Polyfluoroalkyl Substances, a set of chemicals that are used to make products that resist heat and repel oil, stains, and grease). While water filters cannot remove all contaminants, they remain one of the easiest and most cost-effective ways to protect oneself against many common metal contaminants in drinking water.

## CONCLUSION

Dr. Breton's research has helped illustrate how exposure to air pollution and toxic metals often presents a danger to mothers and to the development of their fetuses. Luckily, there are some things that can be done by pregnant mothers and those who care about them in order to minimize the risk, such as air and water filtration. While some efforts have been made by legislators to decrease the amount of pollutants released into the air and water supply, there is still room for further gains on a society-wide level, and protecting the health of mothers and their fetuses during a vulnerable period of their lives should be a priority throughout the country.



# CALIFORNIA'S AGRICULTURAL CONUNDRUM: PESTICIDES, FARMWORKERS, AND PARKINSON'S DISEASE

By Erika Li

## INTRODUCTION:

2.4 million farmworkers make up the backbone of the American agriculture industry (Economic Policy Institute), 76% of them immigrants and many hailing from Mexico (Cheney et al., 2014). California alone houses between 500,000 to 800,000 of these workers, driving the pulse of the nation's agricultural sector (La Cooperativa Campesina de California, 2023). The labor-intensive environments of these occupations pose grave risks to agricultural workers. Farmwork is a notoriously dangerous career, with great physical demands and environment or machinery-related risks. As a result, agricultural workers have higher risks of both acute fractures and chronic injuries due to the labor-intense nature of their work, and an increased risk of mental and psychiatric symptoms due to their stressful working conditions (Arcury et al., 1998).

## THE PESTICIDE PROBLEM

One well-documented hazard of agricultural work is pesticide use. Farmers interact with pesticides either by directly working to mix and spray them on crops, or through indirect contact by working in fields already sprayed. Frequent pesticide use can have numerous health implications. The National Institute for Occupational Safety and Health (NIOSH) reports that 10,000 to 20,000 agricultural workers are treated by physicians for pesticide poisoning every year—yet the true number of pesticide-related work injuries could be much higher, due to the number of workers who choose not to or are unable to seek medical treatment. In Monterey County, California, farm laborers exhibited median urinary pesticide metabolite levels 395 times higher than those found in a nationally-representative survey (Salvatore et al., 2008).

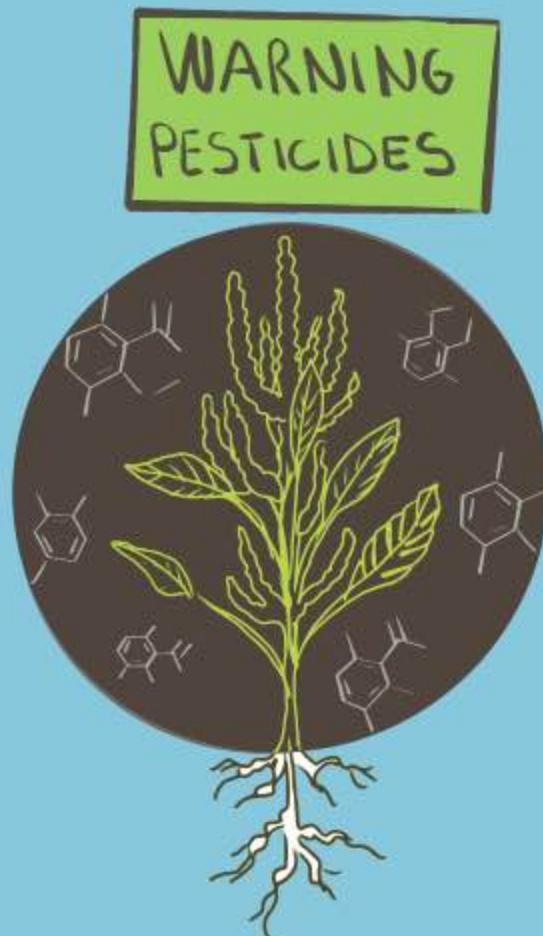
Short term exposure to pesticides, such as through skin-contact, inhalation of fumes, and ingestion, can cause

intense acute symptoms. For example, herbicides like glyphosate, commonly found in weed killer products like RoundUp, can cause skin and eye irritation, respiratory issues, and nausea or vomiting (CDC, 2020). Repeated exposure to pesticides can have grave, long-term effects. Many pesticides, such as amitrole and cyhalothrin, contain endocrine disrupting chemicals (EDC), which bind to estrogen and androgen receptors and disrupt reproductive functions such as spermatogenesis, and are correlated with higher rates of prostate and breast cancer (Mnif et al., 2011). Chloryprifos, the most widely used agricultural insecticide in the U.S., stands as a "potential carcinogen" per the National Cancer Institute (NCI), capable of inducing seizures, coma, and even death upon prolonged, intense exposure. This organophosphate pesticide exerts its neurological impact by inhibiting an enzyme called acetylcholinesterase in the human body (National Pesticide Information Center, 2009). This essentially causes an accumulation of acetylcholine, a neurotransmitter, which results in health issues including blurred vision, respiratory distress, and gastrointestinal problems. However, other mechanisms in which chlorophylls and other organophosphate pesticides interact with the human body are still unclear, and may interact with other cell-signaling and hormonal processes.

Paraquat is one of the most commonly used pesticides in California, with over 1 million pounds being applied on farms annually (Center for Biological Diversity, 2022). This herbicide, recognized for its efficacy in controlling unwanted vegetation, operates through a mechanism that generates reactive oxygen species (ROS) upon contact with the foliage (Li et al., 2013). The resulting oxidative stress leads to cellular damage and plant death. However, its toxic nature extends beyond weeds, posing substantial health risks to humans. The adverse effects of paraquat exposure are alarming. Once ingested, paraquat targets the lungs and other vital organs, causing severe respiratory distress, kidney failure, and heart complications (Sukumar et al., 2019). These dangers have warranted its total ban in the European Union, yet today it remains widely used across the U.S. agricultural sector.

## PARKINSON'S DISEASE

Amidst the documented hazards of pesticides, a deeper concern lurks largely uncharted: the correlation between pesticide exposure and Parkinson's Disease. This neurological condition, while recognized, remains inadequately studied in the context of farmworkers. Parkinson's Disease (PD) is a neurodegenerative disease that involves the progressive loss of dopamine-producing neurons in the brain's substantia nigra. Dopamine is a neurotransmitter essential for regulating movement and coordination. As neurons in the substantia nigra deteriorate, the brain's ability to produce dopamine diminishes, leading to the characteristic motor symptoms of PD, including tremors, rigidity, and impaired movement. This condition has long been associated with genetic and age-related factors. However, in recent years, research has increasingly emphasized the profound influence of environmental factors in its development. While genetics play a role, environmental contributors, particularly pesticide exposure, are gaining recognition for their significant impact.



Please note that the views and information presented in this article are for informational purposes only and have not been accredited by a professional in the field.

on PD onset and progression. Toxic compounds present in various pesticides, such as Paraquat and Maneb, have been implicated in PD development (Costello et al., 2009). Exposure to these chemicals leads to oxidative stress, mitochondrial dysfunction, and the formation of protein aggregates—hallmarks of neurodegeneration observed in Parkinson's. Paraquat in particular is structurally similar to toxic metabolite MPP+, which interrupts complex I of the electron transport chain, causing dopaminergic neuron death (Costello et al., 2009). Other pesticides not only directly damage neurons but also disrupt the blood-brain barrier, enabling these toxins to reach the brain more readily. Furthermore, the combination of multiple pesticides, a common scenario in agricultural settings, might act synergistically to intensify their neurotoxic effects, magnifying the risk of PD and other neurodegenerative disorders.

Investigations have shown a concerning association between pesticide exposure and an increased risk of Parkinson's Disease amongst farmworkers. Studies from California's Central Valley spanning from 1998 to 2007 utilized data from the California Pesticide Use Reports revealed a 75% increased risk of PD among individuals exposed to both Maneb and Paraquat within a 500-meter radius of their homes (Costello et al., 2009). This association not only underscores the elevated risk for the predominantly Latinx demographic of farmworkers directly handling pesticides but also raises concerns for their families residing in close proximity, potentially affected by the lingering effects of pesticide exposure.

## CURRENT PROTECTIONS

Attempts have been made to protect farmworkers from pesticide exposure. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) stands as a crucial safeguard for farmworker health and safety by regulating pesticide use in agricultural settings. FIFRA mandates protections for agricultural workers and pesticide handlers, ensuring access to training, information, and protective gear. It requires employers to provide detailed training on safe pesticide usage, potential health risks, and the importance of personal protective equipment (PPE). Yet while PPE and hand-washing behaviors in agricultural workers were found to reduce pesticide metabolites in urinary samples, these farmworkers still exhibited notably elevated exposure levels compared to a national reference sample (Salvatore et al., 2008), indicating that current PPE measures are not sufficient for protection against pesticide exposure.

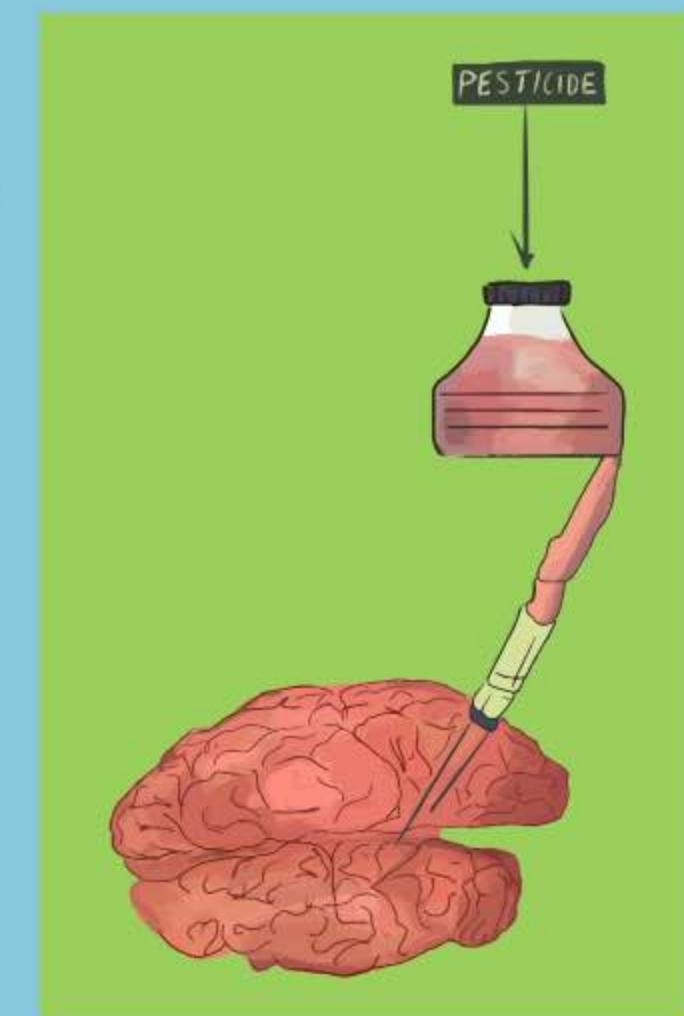
Furthermore, FIFRA, while pivotal in enhancing farm-worker safety regarding pesticide exposure, intersects with Parkinson's Disease (PD) due to the condition's lengthy incubation period. PD's development often occurs over an extended period, making it challenging to directly link it to specific instances of pesticide exposure regulated by FIFRA. The prolonged latency period between exposure and the onset of PD poses a substantial hurdle in definitively associating specific pesticide exposures under FIFRA with the disease's development. This complicates the ability to establish causal relationships between pesticide exposure encountered in agricultural settings, regulated by FIFRA, and the eventual emergence of Parkinson's symptoms, contributing to the complexity of assessing occupational health risks for farmworkers.

## WHAT'S NEXT?

In October 2020, the EPA reapproved Paraquat for agricultural use, despite well-documented risks including its association with PD development. This underscores a troubling reality of systemic vulnerabilities and racial disparities within the agricultural workforce. Predominantly comprising immigrant laborers, notably from Latinx communities, these workers face compounded risks due to language barriers, restricted access to healthcare, and insufficient legal protections.

It's not just farmworkers who are disproportionately affected by pesticide use - it's their greater communities too. Researchers from the California EPA discovered that pesticide usage represented the most significant pollution disparity concerning race, ethnicity, and income across the state, outweighing air pollutants and other toxic releases. The study revealed that nearly all pesticide use concentrated in the 60% of California zip codes with the highest percentage of people of color (Cushing et al., 2015). Moreover, it was observed that over half of the glyphosate used in California was applied in the state's eight most impoverished counties, where 53% of residents identified as Hispanic or Latinx (Donley et al., 2015). The disproportionate burden of pesticide-related health hazards on these communities underscores not only the occupational risks but also the wider socio-economic disparities prevalent in the agricultural sector. The lack of adequate safeguards, coupled with language barriers, exacerbates the challenges faced by these workers, impeding their access to critical healthcare information and services.

Policy interventions must address these racial inequities, emphasizing culturally sensitive healthcare outreach programs and ensuring linguistic accessibility in educa-



tional initiatives. Bridging the gap through multilingual resources, community outreach, and tailored support systems is indispensable in protecting the health and rights of these marginalized workers. Moreover, advocating for the implementation of inclusive policies that consider the unique needs of immigrant farmworkers is pivotal. Ensuring equitable access to healthcare, legal protections, and education about pesticide risks in their native languages can empower these communities and mitigate the disproportionate health risks they face.

Safeguarding the health and well-being of farmworkers requires a holistic approach that acknowledges and confronts the intersectional challenges they encounter. Addressing racial disparities, linguistic barriers, and inadequate protections is essential for cultivating a fair and safe working environment within the agricultural industry. Through collective efforts and policy reforms, we can aspire to create a more just and equitable landscape for all individuals contributing to the nation's agricultural vitality.

# CRUSHING POLLUTION: THE COST OF THE EXPANDING SHIPPING INDUSTRY

By Amisha Kumar

The port of Los Angeles is the busiest port in North America, and the volume of cargo it imports continues to increase. In the last year alone, imports rose 11% (Port of Los Angeles, 2023). However, as more cargo enters the port, more infrastructure is needed to get cargo out and support the shipping industry. This expansion has created three interconnected public health problems in Los Angeles and the Inland Empire: increased truck idling in ports, increased traffic within city centers, and a warehouse boom that threatens residential communities. The common thread that all three problems share is that the shipping industry relies on diesel trucks to move goods from ports to their final destination. These trucks exhaust diesel particulate matter, which are tiny, solid particles made of soot, unburned fuel, and other chemicals. When inhaled, they become trapped in our lungs and our bloodstream, causing headaches and dizziness in the short term. In the long term, exposure to diesel particulate matter can cause asthma, heart attacks, respiratory or heart failure, accompanied by lung cancer (Cooney and Hickey, 2008).

In addition, these diesel trucks release chemicals including gaseous nitrogen oxides, causing severe respiratory problems when inhaled. In the short term, nitrogen oxides can cause asthma and respiratory infections. In the long term, they can eventually lead to chronic lung disease (Ricciardolo et al., 2004). Nitrogen oxides also react with other compounds in fuel to produce ozone, the main component of smog. Ozone irritates the linings of the airways and lungs, causing inflammation and leading to emphysema, bronchitis, asthma, and scarring of the lungs (EPA, 2023). For that reason, at each stage of transport, the nearby, typically low-income communities are at risk because of chronic exposure to these chemicals.

## SMOG

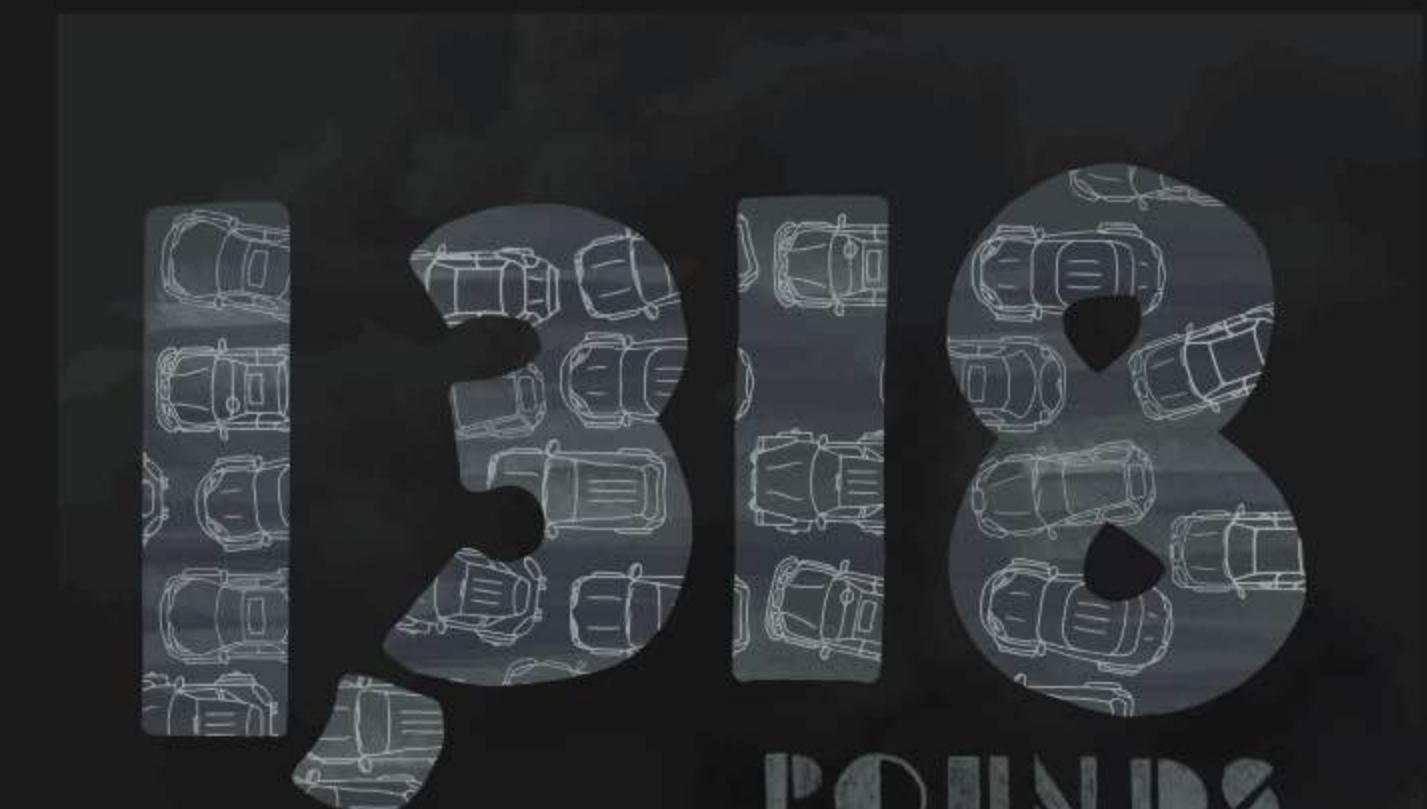
Smog is a mix of pollutants released into the air by cars, trucks, and industrial plants. These pollutants include particulate matter, nitrogen oxides, sulfur oxides, and ozone, all of which are toxic and can cause irritation of the lungs and respiratory tract.

## DIESEL POLLUTION AT THE PORTS

The damage begins at the ports, where trucks load cargo for transport. As imports increase, more trucks are required to port them, leaving trucks at a standstill due to traffic. In 2019, truckers reported an average wait time of 2 hours before loading at the port of Los Angeles, a figure greatly worsened during the pandemic. The problem is that trucks are left idling for excessive periods of time, releasing a continuous stream of diesel particulate matter in a single location. At the port of Los Angeles, diesel particulate matter emissions rose 56% between 2021 and 2022, and nitrogen oxides rose 54%, according to the Los Angeles Times. As the port continues to expand, the bottleneck will continue to grow and emissions will rise further.

The 220,464 residents of the three harbor cities surrounding the port of Los Angeles—Wilmington, San Pedro, and Carson—are annually exposed to almost 1.7 million tons of pollutants. While other factors are involved, diesel exhaust due to truck idling and congestion at the ports has been directly linked to the high rates of cancer in the area. The risk of developing cancer due to air pollution in Wilmington is in the top 2% for the South Coast Basin (Los Angeles, Orange, San Bernardino, and Riverside counties), according to CalMatters (Yee and Getahun, 2022).

The health issues produced by diesel pollution are compounded by several factors. In addition to shipping infrastructure—rail lines, freeways, and warehouses—they also have chemical plants and oil refineries that add toxins to the environment. Thus, the respiratory and cardiac problems brought by pollution are compounded for these cities' residents, the majority of whom are Hispanic, African American, or Asian American. Moreover, while these industries bring some high-paying jobs to the area, keeping the median income comparable to the rest of the state, the rate of poverty is incredibly high: in Wilmington and San Pedro, 20.9% and 18.5% of residents live below the poverty line, respectively (U.S. Census, 2021). This makes it difficult for them to access healthcare and increases their risk of contracting chronic diseases,



further exacerbating the impact of diesel pollution on their health.

Unfortunately, this problem is not limited to areas adjacent to the port of Los Angeles; as trucks traverse Los Angeles, they create similar health concerns for the communities surrounding freeways.

## EN ROUTE TO WAREHOUSES

Freeways are a fact of life in Los Angeles. I-10 is to the north, 105 to the south, 110 and 101 to the east, and I-405, one of the busiest and most congested freeways in the country, to the west. This vast network of highways ensures that the entire city is covered with a blanket of smog, and with so many more trucks on the road due to the expansion of the shipping industry, as well as the chronic overpopulation, the amount of pollution being released into the surrounding area is only increasing.

Scientists have argued that because of the inherent health risks of this exposure, no one should live in housing within 500 feet of a freeway; even living 1000 feet away or

more can still impact one's health (Los Angeles advisory for projects within 1000 feet of a freeway). To these scientists' horror, many Los Angelans are in close proximity to multiple highways. Yet the growing housing crisis, coupled with a lack of information about diesel pollution available to the general public, has led companies to create housing development projects closer and closer to the freeways despite health concerns expressed by residents. 1.2 million people currently live in developments within 500 feet of a freeway, while an additional 2.3 million people are within 1000 feet of a freeway. Unfortunately, despite taking as many precautions as possible, including using air filters, these individuals are suffering respiratory and cardiovascular health problems at a far greater rate than those who are not in these high-risk areas (Barboza and Strauss, 2017).

In the Children's Health Study, a long-term study performed by USC that followed 12,000 children from elementary school to high school, it was found that kids living closer to freeways were more likely to have asthma or other respiratory conditions that often followed them into adulthood (Gauderman et al., 2004). Furthermore,

adults who live in these areas have some of the highest rates of hypertension and respiratory disease in the state. Yet, for many of the families in this area, they cannot afford to move anywhere else due to the exorbitant cost of housing. As of 2023, the median cost of owning a home in California is above \$1 million (Menendian, 2023), and the average rent falls between \$2,248 and \$3,690 for a 2-bed apartment (Rent).

For a property near a freeway, however, the rent can be significantly lower, ranging from approximately \$1,500 to \$1,700 a month (Apartment Guide). Thus, they are much more cost-effective for low-income families, who often cannot afford to live somewhere else. Yet, living in these apartments increases their exposure to diesel particulate matter and other environmental toxins exhausted by the cars and trucks on the roads nearby. However, even as these pollutants take a toll on their health, they are trapped—there is nowhere else they can go (Menendian, 2023). And worst of all, unless the city stops approving developments near highways and starts funding affordable housing development, the situation will only worsen. Even neighborhoods that are away from freeways are not unscathed; while they seem safe from the pollution brought by the shipping industry, they are threatened by the building of warehouses.

## THE WAREHOUSE BOOM

In some ways, Los Angeles got lucky: there simply isn't enough space for warehouses in an urban center. For that reason, when companies are looking for a place to store cargo, they don't think of the city—they think of the Inland Empire.

Located only a few hours away from the port, the Inland Empire is drier and less fertile. Unfortunately, that has made it a popular target for the construction of warehouses to store imported goods, which will later be shipped off to target destinations across Southern California. Having faced little resistance from local councils due to the promise of economic growth and new jobs, there are now 9,016 warehouses in this region, with 289 more planned and approved (Warehouse CITY). Worse yet, they are not being built on the outskirts of cities, away from the residents who live there. Rather, they are being built directly inside these communities, sometimes within neighborhoods. As of today, there are at least 300 warehouses located less than 1000 feet from a school (Newton, 2023).

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The travel of trucks to and from these warehouses deposits 1,318 pounds of diesel particulate matter per mile per day into the surrounding area; unsurprisingly, the rates of childhood and adult asthma, as well as cardiovascular disease, have risen dramatically in these places. Yet, up until very recently, this construction hasn't slowed; while residents have been able to stop three warehouses from being approved for construction, far more are still being pushed forward in spite of local opposition.

This situation is not unique to the Inland Empire. Warehouse construction is being expanded in several places, most recently in Torrance, where locals in the Harbor Gateway community are protesting the approval of a warehouse directly in a residential neighborhood. 5 new warehouses are planned and approved in Los Angeles, which are predicted to emit a total of 1.4 pounds of diesel particulate matter per mile per day due to increased traffic (Warehouse CITY); 2 of these 5 warehouses are located next to a residential neighborhood, while another is located next to a shopping center.

## THE PROMISES MADE

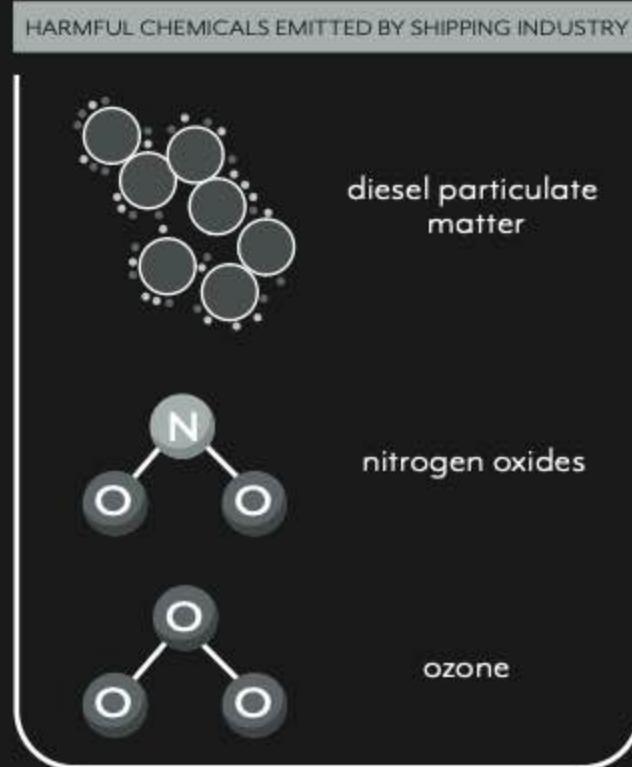
Legislation has been proposed to curb diesel pollution at every stage in the shipping process. The California Air Resources Board (CARB) has implemented a 5-minute idling limit for diesel trucks to prevent pollution at the ports, while in 2017, the mayor of Los Angeles signed a commitment to make the ports a zero-emissions operation by 2030. To combat pollution on the freeways, a law was passed in the state legislature banning the sale of diesel trucks from 2036 onwards and mandating that large trucking companies switch their entire fleet of trucks from diesel to electric or hydrogen power by 2042. In theory, these laws could resolve the burden of pollution in every community the industry crosses.

However, they have fallen short of their goals. Regarding the truck idling fee, CARB does not constantly monitor trucks at the ports, meaning that the law against idling is not being enforced. Ports have consistently opposed any clean-air regulations that have passed and are being slow to make changes, meaning that they will likely miss the targets set by the government. Even the legislation itself is imperfect: by 2042, companies with fleets of 50 trucks or less are exempt from the rule to switch to renewable energy. The end result is in both the short and the long term, diesel pollution will continue to harm nearby communities unless we hold firm to the economically restraining regulations proposed.

## THE WORK LEFT TO DO

Ultimately, the problem is not that we are not taking action; all of the laws listed above have the potential to resolve the health burden of the shipping industry. However, they can only fulfill that potential if we commit to enforcing the policies implemented. At the moment, companies have been able to push back against making changes without facing any consequences for missing the deadlines set. So far, only a handful of nonprofit organizations in Los Angeles have been attempting to hold them accountable.

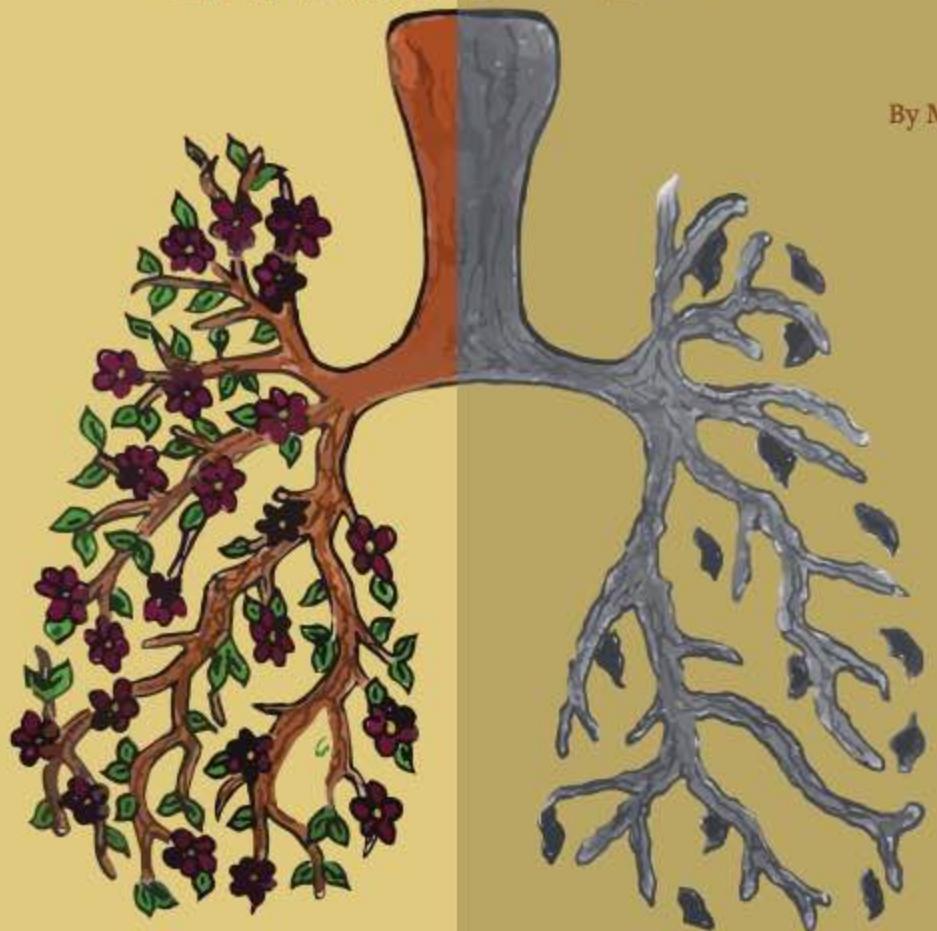
That being said, there is a strong possibility that we can reverse some of this damage moving forward. Residents in local communities have successfully petitioned to block development of warehouses in their neighborhoods and have convinced their representatives to take action against the expansion of the shipping industry. As more people become aware of this issue, there is a greater public demand for change. For that reason, it falls on us, the people who are being affected by these issues, to advocate for ourselves by contacting our representatives and urging them to impose penalties until companies are in compliance with the laws proposed.



## U.S. PORTS VOLUME COMPARISONS



# LA AIR POLLUTION



By Malinda Madrigal

## INTRODUCTION

We treat air pollution as an undesirable yet unavoidable consequence of industrial development. While everyone desires the engine that produces smog, the reluctance to bear the consequences is evident. As a consequence, there is a noticeable correlation between pollution levels and income. Even though it has been over fifty years since residents of Los Angeles started advocating for improved protection against poor air quality, the most substantial pollution burdens persist in communities with lower income levels.

## HISTORY OF SMOG IN LOS ANGELES

Los Angeles has undergone a considerable transformation. In 1943, a significant smog scare prompted residents to flee as they feared a Japanese gas attack. The city's once-clear coastal air had turned into a toxic haze that caused everyone's eyes to fill with tears, and its origins were initially unclear. It seemed like a fluke of geography. However, the surge in air pollution became evident in the

1940s when the number of cars in L.A. doubled from one to two million. During this period, scientists were just beginning to comprehend the environmental impact of industrialization and development. Initially, smog was wrongly attributed to chemical plants and backyard trash fires, and it wasn't until 1948 that Arie Haagen-Smit, a biochemist from Caltech, connected the issue to car exhaust. Despite the truth of his discovery, Haagen-Smit faced opposition from researchers backed by the oil industry who sought to discredit his findings. Although change occurred, it was gradual. The Clean Air Act was passed by Congress in 1963, and a little over a decade later, national laws mandating catalytic converters for new automobiles were introduced. While these laws helped alleviate the haze in Los Angeles, they came too late for the millions who had grown up under oppressive smog. By 1987, an estimated 27 percent of Angelenos were living with "severely damaged" lungs. Statewide, nearly 10,000 people continue to die due to illnesses related to air pollution each year.

## HISTORY OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

In the early 1970s, public concerns about deteriorating city air quality, natural areas with debris, and urban water supplies contaminated by hazardous impurities escalated, leading President Richard Nixon to deliver a groundbreaking 37-point message on the environment to both the House and Senate. Some points included urging the establishment of national air quality standards and rigorous regulations to decrease emissions from motor vehicles, initiating federally-funded research aimed at reducing pollution from automobiles, mandating the cleanup of federal facilities responsible for contaminating both air and water, and suggesting the implementation of a tax on lead additives present in gasoline.

At the same time, President Nixon established a council to address the organization of federal government initiatives aimed at reducing pollution. The objective was to streamline these programs to align with the environmental goals outlined in his message.

Acting upon the council's suggestions, the president submitted a proposal to Congress for the consolidation of various environmental responsibilities of the federal government into a new entity—the Environmental Protection Agency (EPA). This restructuring aimed to enhance the government's capacity to respond to environmental issues beyond the capabilities of existing pollution control programs. The EPA would possess the capability to conduct research on significant pollutants, regardless of the medium in which they are found, and assess their impact on the overall environment. Independently and in collaboration with other agencies, the EPA would monitor the environmental condition, encompassing both biological and physical aspects. Utilizing the data, the EPA could establish quantitative "environmental baselines," crucial for measuring the success or failure of pollution mitigation efforts. The EPA, in coordination with states, would be empowered to establish and enforce standards for air and water quality, as well as for specific pollutants.

Industries aiming to minimize the adverse environmental impact of their operations would benefit from consistent standards addressing a comprehensive range of waste disposal challenges. As states developed and expanded their pollution control initiatives, they could turn to a singular agency—the EPA—for financial support, technical assistance, and training to bolster their efforts.

## OZONE POLLUTION TRAPPED IN THE BASIN

Recent reports from the American Lung Association have

painted a concerning picture of air quality in the United States, revealing that 40% of Americans live in areas with unhealthy pollution levels (Hayes, 2021). Furthermore, Los Angeles and surrounding counties received an 'F' grade for poor particle and ozone pollution, marking LA as the worst air-polluted city in the nation (Hayes, 2021). The chemical process leading to pollution involves a photochemical reaction on hot, sunny days, where car emissions and other pollutants create ozone. Additionally, the city's unique semi-basin geography collects and traps ozone, toxic exhaust, and pollutants (Adams, 2021). Individuals can find themselves with irritation, coughing, wheezing, asthma attacks, and, in extreme cases, heart attacks, strokes, lung cancer, and premature death. However, the average concentrations of particulate matter—fine particles that can damage lungs and trigger heart attacks—have dramatically decreased and are meeting federal health standards. Between 1998 and 2018, the number of potential cancers tied to toxic air pollutants also declined by 87% (Yee and Getahun, 2022). While some aspects of air quality have improved, the fall of 2020 saw a rise in nitrogen oxides, key components of smog and fine particles (Cheung, 2022). This raises questions about the causes behind the recent spike in pollution despite notable progress over the past decade.

## VEHICULAR EMISSIONS AND TRADE IMPACT

As the third most economically powerful city globally, Los Angeles contains the Port of Los Angeles and the Port of Long Beach, the two busiest container ports in the United States, which play a significant role in contributing to the region's air pollution. The heavy reliance on fossil-fueled vehicles to transport goods in and out of the ports has taken a toll on air quality. Nearly 40% of the country's imports pass through the LA area, and the associated emissions from ships, trucks, and other transportation modes contribute to the city's 'non-attainment' air quality status (Cheung, 2022). The functioning of these ports depends on the use of fossil fuels, particularly diesel, to power ships, trucks, and various forms of transportation. This has significantly contributed to deteriorating air quality, especially in recent years with the expanding trade relations with Asia. Container trade at the two ports surged by 18% compared to the levels observed in 2019 (Yee and Getahun, 2022). The increase in cargo imports, exacerbated by pandemic-induced supply chain disruptions, has led to a surge in anchored vessels running on polluting auxiliary engines, further deteriorating air quality.

Unfortunately, residents of Wilmington, Carson, and West Long Beach live with significant pollution sources located

in close proximity to their homes, including the nation's two busiest ports, five oil refineries, nine rail yards, four major freeways, multiple chemical facilities, and the third largest oilfield in the contiguous United States (Yee and Getahun, 2022). Situated in the southwestern part of Los Angeles County, these neighborhoods were among the initial areas designated for California's groundbreaking environmental justice initiative, aimed at addressing air pollution in the state's vulnerable regions. Approximately 300,000 residents who live in these communities are predominantly people of color (Yee and Getahun, 2022).

Starting with positive developments, the air quality has significantly improved compared to previous years. For instance, on most days last year, the air quality in Wilmington was classified as good or moderate. However, persistent issues persist as the community still contends with polluted air. On 23 days in the past year, fine particle concentrations exceeded the national health standard, with some days registering levels more than twice the standard, as per data from the Los Angeles and Long Beach ports (Yee and Getahun, 2022). On these occasions, the air quality was deemed unhealthy for all residents.

Residents are also regularly exposed to industrial chemicals in the air. In 2020, industries in Wilmington and Carson reported emitting nearly 1.7 million pounds of toxic air contaminants, including ammonia, hydrogen cyanide, and benzene—a known leukemia-causing agent (Yee and Getahun, 2022). Individuals in these environmentally compromised port communities experience more frequent asthma attacks compared to residents in cleaner cities. The cancer risk, mainly attributed to diesel exhaust from trucks, ships, and trains, is 98% higher in Wilmington than in the broader Los Angeles basin (Yee and Getahun, 2022).

While the region has witnessed a substantial improvement in air quality in recent decades due to local and state regulations targeting cleaner vehicles and industries, a concerning uptick began in air pollution last fall. Nitrogen oxides and fine particles, which constitute key components of smog, started increasing in the fall of 2020 (Yee and Getahun, 2022). As a result, residents in these communities, particularly in West Long Beach, face heightened risks of asthma attacks, often requiring emergency room visits (Yee and Getahun, 2022). Diesel exhaust, fine particles, and smog can act as triggers for these attacks.

Moreover, they breathe in elevated levels of pollutants, primarily diesel exhaust, linked to cancer. For example, in Wilmington, 664 individuals are at risk of cancer per

million people exposed, surpassing the threshold of acceptability which is 100 individuals per million (Yee and Getahun, 2022). Wilmington's cancer risk from air pollution ranks in the top 2% for the entire basin, encompassing most of Los Angeles, Orange, San Bernardino, and Riverside counties (Yee and Getahun, 2022). Continuous exposure to diesel particles can also contribute to or exacerbate heart and lung diseases, including asthma. Unfortunately, the local economy relies heavily on the oil and shipping industries, with oil refineries being the largest industrial source of smog-causing gasses and carcinogenic pollutants.

### THE IMPACT OF COVID-19 ON AIR QUALITY

Similar to numerous cities around the world, LA saw a significant improvement in air quality in the initial weeks of the COVID-19 pandemic due to a substantial reduction in transportation and the advent of global lockdowns. In a 2020 study, Yifang Zhu, a professor at the University of California, Los Angeles (UCLA), discovered that the reduction in traffic in LA directly led to a 30% decrease in nitrogen oxides (Zhu et al., 2021). However, as restrictions eased and traffic resumed after a few months, the temporary decline in driving had only a short-lived impact on pollution. The fleeting improvements in air quality were unable to counterbalance the resurgence of driving, wildfires, and heat waves induced by climate change.

### AIR QUALITY AS A HEALTH INEQUITY

Dr. Olawale Amubieya, pulmonologist and junior faculty member in the Division of Pulmonary and Critical Care Medicine at UCLA Health, describes how air pollution intersects with health equity in a way that harms minority and low-income communities (Schlossberg, 2021). It has been a noticeable pattern that people of color are the ones who are most often affected by the negative effects of air quality as they are the ones more closely located to the pollution sources, ultimately affecting the communities' health. According to Dr. Amubieya, "policies of the past cut out low-income, minority and urban communities from suburban communities where the traffic and smog are less dense" (Schlossberg, 2021). While policies themselves may not explicitly favor the rich, the implementation and enforcement of regulations can sometimes be influenced by economic and political factors. For example, communities with more resources and political influence may have better access to information, legal representation, and avenues to voice their concerns, potentially leading to more effective enforcement of environmental regulations. Furthermore, Dr. Amubieya emphasizes that "[these policies] relegated [minority and low-income communities] into areas that are close to industrial plants,

justice, where lower-income communities or communities of color are disproportionately affected by air pollution due to the location of industrial facilities, highways, or other pollution sources. These communities, such as Wilmington, Carson, and West Long Beach, face higher exposure to pollutants and have experienced greater health risks. These communities are considered to be in the high-risk category, which includes low-income communities with large percentages of racial minorities, people experiencing homelessness, pregnant people, children, elderly adults and people with disabilities and chronic conditions. Dr. Amubieya states that "it really does put these at-risk communities at even higher risk because of the health effects (Schlossberg, 2021).

A group of UCLA researchers found that air from census tracts in communities with most socioeconomic disadvantages not only contained a greater amount of pollution, but also that the pollution in these areas was 25% more toxic than in other parts of Los Angeles (Colgan, 2022). "Overall, people living in these places experience about 65% higher toxicity than people in the most advantaged group" said Suzanne Paulson, the senior author of the study and a UCLA professor of atmospheric and oceanic sciences (Colgan, 2022). Based on a combination of socioeconomic factors, researchers sorted the communities into quartiles, from those with the least socioeconomic advantages to those with the most. They found that the amount of dangerous pollution decreased as socioeconomic advantages increased. They also concluded that 63% of the pollution came from vehicles (Colgan, 2022). Even though health officials recommend living at least 1,000 feet away from freeways due to vehicular pollutants, huge swaths of the population have had no say in the matter (Barboza and Schleuss, 2017). Historically many of the nation's highways have bisected communities of color, placing them next to major sources of pollution.

### CONCLUSION

Pollution has a detrimental toll on both individuals and entire populations, posing severe threats to public health and the environment. Exposure to pollutants contributes to a range of health issues, from respiratory problems to cardiovascular diseases, affecting individuals on a personal level. Moreover, exposure to pollution can result in long-term health consequences that extend to future generations. While attempts have been made in addressing pollution through environmental regulations and technological advancements, there is an ongoing need for further improvement. Even as we recognize that progress has been achieved, we still have a collective responsibility to continue enhancing measures to reduce pollution. The pursuit of cleaner technologies, sustainable practices, and heightened awareness is essential to create a healthier and more resilient future for individuals and populations worldwide. While controlling the pollution emitted by large cargo ships and the multitude of trucks would be most effective, it's crucial to consider the significant employment opportunities and goods facilitated by these systems. Implementing a comprehensive transformation will be a slow process. However, sustainable solutions are essential for long-term improvement. Expanding and improving public transportation systems, utilizing fuel-efficient vehicles and renewable energy, cleaning up pollution sources, and implementing better urban planning are crucial steps. Encouraging practices like telecommuting and reducing reliance on private vehicles can also significantly benefit air quality. Furthermore, implementing a combination of policies tailored to the specific needs of each community can contribute to a significant reduction in poor air quality in low-income neighborhoods. Collaboration between government agencies, communities, and businesses is essential for the success of these initiatives.

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# THE IMPACT OF URBAN BLIGHT ON HEALTH OUTCOMES

By Justin Boogaard

## INTRODUCTION

When defining one's environment as merely one's surroundings, it becomes clear that the quality of one's environment is intertwined within a broader socio-cultural context. There are clear and present indications that historical legislation and cultural norms have impacted who can most likely benefit and who might struggle. The insecurity and discomfort from economic turbulence reinforced by inequitable policies is what unfortunately leads to the physical, cultural, and economic decay of a city and is collectively termed as urban blight. This issue is more than aesthetic and places a socioeconomic marker on communities to remind them that they are members of the population who have been left behind.

An area marked with urban blight is likely to have vacant and abandoned homes, crumbling infrastructure, as well as deteriorating or littered streets and sidewalks. However, the issue of urban blight is more than physical. Communities burdened with urban blight are more likely to feel helpless and doubt that their living situation will ever improve (Garvin et al., 2013). Additionally, many in these communities will likely suffer from social isolation because of fears that there are close and constant dangers (Teixeira, 2016). And, in relation to the rest of society, residents of blighted communities will often feel as if they are the subjects of stigmas held by outsiders based merely on the physical state of their neighborhoods (Wutich et al., 2014). It is also important to recognize the issue of entrenched racism in American institutions which remains a persistent factor impacting many who already face restricted opportunities. Naturally, this is important when analyzing community health given that one's opportunity strongly determines the quality of neighborhood one is likely able to afford. The power of a community's poor environment identified by physical signs of decay is immense and reinforces debilitating, complex, yet preventable burdens on disadvantaged populations.

## HISTORICAL CONTEXT

The decay of many of America's urban communities has roots in federal legislation which worked to benefit the development and prosperity of white communities at the expense of their black and brown counterparts. The Wagner Housing Act of 1937 is one piece of federal legislation responsible for the condition many underprivileged communities find themselves in today. By nature of this act, any new public housing projects, constructed by the Federal Housing Administration, could not be developed unless an equivalent number of previously constructed public housing units were simultaneously destroyed (Wilson, 2008). Such requirements marked an important precedent of the federal government legislating in order to protect the interests of wealthier, private homeowners who wanted their neighborhoods to remain desirable and the value of their assets to be sustained (Wilson, 2008). This maneuver by Congress marked a generational trend of protecting the interests of the upper classes often at the direct expense of the city's poorest residents.

With this precedent being set, post-WW2 policies prioritizing suburbanization continued to impact communities of lower socioeconomic status which disproportionately harmed black and brown communities. The most notorious piece of legislation, the Interstate Highway Act of 1956, contributed greatly to the racialized landscape of urban communities which has persisted into the present. Passed to incentivize development and promote economic growth, highway construction ran almost exclusively through already impoverished communities, many of which had substantial black and brown populations (Wilson, 2008). Indeed, unlike their wealthier neighbors, these communities lacked the bargaining power necessary to resist federal incursions (Wilson, 2008). As a result, such communities became effectively cut off from the rest of the city and the opportunities it offered. In the city of Nashville, the construction of I-40 led to the demolition of a large portion of local Black communities and specifically destroyed "more than 620 black homes, twenty-seven apartment houses, and six black churches" (Karas, 2015).

Community groups attempted to reroute the construction of I-40 in Nashville but were unsuccessful when the court system agreed with state officials who believed the impact on Black businesses was “exaggerated” (Karas, 2015). Yet, while in Nashville one may be able to make the argument that state officials could not have foreseen the impact that the construction of I-40 would have on local minority communities, in other cities the racist intent of public officials is more blatant. For example, in the city of Baltimore, interstate developers convinced officials that “the areas slated for highway construction would not include anything ‘familiar and cherished,’ but communities and neighborhoods that would ‘not constitute a loss to Baltimore’”(Karas, 2015). Flint, Michigan is another city where it is clear that public officials disproportionately targeted poorer neighborhoods with dominant minority populations as sites for highway construction. In contrast to surrounding areas, the city of Flint was diverse and individuals who identified as Black represented 28% of the city’s population (Archer, 2020). Yet, when interstates were constructed, 58% of those displaced were Black as large portions of the historically Black neighborhood, Sugar Hill, and other Black communities in North Flint were demolished (Archer, 2020). In the neighborhood of Sugar Hill specifically, three thousand families were displaced without any form of acknowledgment or compensation by interstate developers or state and federal officials (Archer, 2020). Even in light of these egregious displays of racism in infrastructure development and urban policy, it is impossible to state that highway officials in every city across the country used interstate construction as a means to advance their own policy agendas. However, clearly there are many cities across the country where developers and city officials worked in conjunction to advance their own economic interests irrespective of the repercussions which would result for minority communities. The factor race and class played in the development of many interstates cannot be ignored and represents how the protection of wealthier, white neighborhoods held a continued precedence over the basic rights and mobility of low-income and minority communities.

#### HOW CAN YOUR HEALTH BE IMPACTED?

There is a studied and real impact on the health of individuals who live in neighborhoods burdened with elements of urban decay. These health impacts are multifaceted and can negatively affect residents in regard to both physical and mental well-being. In Philadelphia, a city hard-hit by urban blight, residents who live within 2-3 blocks of vacant lots in two low-income neighbor-

hoods of the city described how they felt about their poorly maintained environment (Garvin et al., 2013). This study was qualitative, with respondents giving anecdotes of how they felt they were affected by their local environment. For many of the respondents, concern was raised over their physical health because of the prevalence of individuals using abandoned homes and vacant lots in order to conduct illicit activities related to narcotics and prostitution (Garvin et al., 2013). In addition to the criminal aspect of such activities, the litter that often accumulated from individuals who may not care about the property they illegally occupied led to other nuisances such as rodents (Garvin et al., 2013). This erosion of surroundings was found to contribute to a community-wide helplessness about the livability of their community which contributed to widespread personal isolation (Garvin et al., 2013). Such effects are by no means limited to underprivileged communities in Philadelphia but are commonalities between many American communities burdened with urban decay.

Urban communities facing blight are well-studied as many seek to understand the psychological effects such living conditions can have on an individual’s well-being. One theory which has been advanced and is successful in explaining the study conducted in Philadelphia is the Broken Windows Theory, proposed by Wilson and Kelling (Teixeira, 2016). According to this theory, social and physical disorder, including elements of urban blight, increase criminal activity because it is assumed that residents are indifferent to the treachery of their conditions, and thus will neglect to act in preventing its continued deterioration (Teixeira, 2016). However, while this theory has become well-established amongst policymakers, it is important to note that studies have largely provided mixed results with a primary challenge being what should be included as “disorder” when conducting studies (Ren et al., 2022). Yet, this theory is still worth discussing because of its prominence and its validity when evaluating social behaviors in certain communities. For example in some cities, this theory has been used to explain data which shows that youth who grow up in communities surrounded by urban blight are more likely to face violence, develop mental health conditions, and sustain negative health outcomes later in life (Teixeira, 2016). In a study conducted in Pittsburgh, children were provided a platform to share their own perspectives on the impact they have felt while living in Homestead, a low-income and highly blighted neighborhood. In numerous interviews with teenagers from a

local school program, those who lived in Homestead voiced similar narratives that the prevalence of disrepair has instilled a universal understanding that the community simply “doesn’t care” and contributed to fear-driven social isolation . Those who shared their stories also discussed the degree to which criminals, who assume such indifference is real and widespread, have pushed local youth into delinquency as well (Teixeira, 2016). Use more than once source, this had to be replicated. And you dont have to cite every sentence.

There are clear indications that communities suffering from urban blight face worsened health psychologically amid heightened fears for their safety as well as perceived societal stigmas related to how, or if, one is able to contribute to society. Largely in media and popular culture, neighborhoods characterized by urban blight are often presented to the public as crime-ridden, dangerous, and unsuitable places to live. Similar stigmatizations due to race, income, or gender have already been studied to result in negative health outcomes related to heightened stress levels, hypertension, heart disease, and risk of stroke. (Wutich et al., 2014). In addition to instilling fears that one may face injustice, stigmas can have notable and direct health impacts in preventing individuals from seeking care because of overarching fears of mistreatment (Wutich et al., 2014). Another study analyzed two groups to understand differences in community perception between two neighborhoods : a low-income Latinx neighborhood and a high-income white neighborhood. Within the South Phoenix area, researchers found individuals were markedly more likely to fear discrimination from broader society because of stigmas associated with where they live (Wutich et al., 2014). When taking into account other possible sources of stigmatization such as race or perceived immigration status, health outcomes suggest that neighborhood stigmatization continues to act as an independent contributor to increased stress and worsened health (Wutich et al., 2014). There are multiple forces at fault: a media that contributes to inflammatory assumptions about neighborhoods and their residents, as well as a culture which would rather focus on the issues that burden a community rather than its resilience.

#### CONCLUSION

There is no easy solution to tackling the burden of urban decay as the issue is rooted heavily in systemic inequality and race-based stigmatization. The harm urban decay imposes on communities is complex and cannot be alleviated by knocking down buildings and constructing new ones in their place as even with new, fresh-looking buildings, people in these communities will continue to face systemic obstacles to opportunity. Yet, in some of America’s heavily blighted cities, some believe such a response is a just policy. In other words, some policy-makers and developers want to remove the aesthetic burden without making any attempt in tackling foundational socio-cultural issues. In cities like Detroit, which have faced decades of underdevelopment and decline, developers have sold the vision of demolishing blighted neighborhoods in order to pursue modern and green alternatives (Fraser, 2018). Underlying these initiatives is the assumption that because these communities are blighted, they can easily be replaced without regard for the individuals who still call them home (Fraser, 2018). The urban ruin present across America is not a recent discovery, so why should people who never previously showed interest in revitalizing blighted communities now be given unquestioned authority? There is indeed a need to revitalize urban communities, but such an effort cannot come at the expense of providing a place for these neighborhoods’ current residents. It may seem tempting to want to knock everything down and start over, but it would be remiss to ignore that beyond the incursions of ruin and discrimination there are countless communities who, while disadvantaged, are neither broken nor dispensable.

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# GOING NUCLEAR: RADIOACTIVE POLLUTION AND SOCIOECONOMIC FACTORS

By Nate Ackerman



"Nuclear power is safe" has become a commonly mantra'd phrase by politicians seeking support from environmentally-conscious voters. These politicians believe that by propping up nuclear power plants around the United States, they will slowly phase out the use of fossil fuels in generating electricity, thereby reducing the impact of global warming. However, skeptics of this utopian notion are justified in their concerns, as the nuclear energy industry does not have the best track record as a "clean" energy source.

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Commonly-cited nuclear disasters include Ukraine's Chernobyl, Japan's Fukushima, and the United States' Three-Mile Island. These events all serve as evidence against the safety of nuclear energy, as over five million people were affected by Chernobyl alone when its nuclear reactor melted down, contaminating 150,000 square kilometers of land across Russia, Belarus, and Ukraine with nuclear radiation (The International Atomic Energy Agency, 2016). Disasters like these are harrowing reminders for those who live next to nuclear power plants that there is always the threat of meltdown—that what we see on TV shows, like HBO's *Chernobyl*, could possibly happen to us. As someone who grew up less than three miles from the Limerick Generating Station in Pottstown, Pennsylvania—another nuclear power plant—there is no denying that I would prefer if the station were never built. Receiving ThyroSafe® potassium iodide tablets in the mail from the Pennsylvania Department of Health—pills designed to protect the thyroid gland from radiation in the event of a meltdown—coupled with the generating station's ear-piercingly loud semi-annual emergency siren tests, act as terrifying reminders of what could happen so close to home.

However, these events are exceedingly rare and should not be the primary concern of nuclear energy's critics, as there are over 440 nuclear reactors running across the world and only a handful of disasters (World Nuclear Association, 2023). Instead of focusing on massive meltdowns, critics should turn their attention to less obvious but far more consequential concerns surrounding nuclear power—specifically, the low-level leakage of radiation from nuclear power plants, the correlations between proximity to nuclear power plants and cancer rates, and if low-income and minority communities are targeted for station construction. Before we discuss these topics, I want to clarify that I am, by no means, anti-nuclear energy—my intention is to play devil's advocate by not blindly trusting that nuclear energy is entirely safe and clean.

Using Pennsylvania Cancer Registry Data, we can identify troubling correlations between the opening of the Limerick Generating Station in 1986 and the increased incidence of cancer in Montgomery County. For the purpose of this investigation, data from 1985-1986 will serve as baseline pre-nuclear cancer incidence, and data from 1996-1997 will serve as the post-nuclear cancer incidence, ten years after the opening of Limerick. Between these two time windows, the incidence of radiation-associated cancers such as thyroid cancer increased by 128%, leukemia increased by 48%, and breast cancer increased by 61%. Furthermore, the number of childhood cancer deaths increased by 71%, contrasted by reductions in nearby counties without nuclear power plants (Pennsylvania Department of Health, 2023). The Radiation and Public Health Project (RPHP) also found that donated baby teeth of 146 children in Montgomery County also had high levels of Strontium-90 (Sr-90), a radioactive isotope that forms only in nuclear reactors or nuclear explosions. In Pottstown, the town neighboring the Limerick Generating Plant, Sr-90 levels were 62% higher than the Pennsylvania average (Mangano, 2003). While these are merely correlational statistics and there could easily be unidentified confounding variable(s) at play, such as pollution, nuclear bomb testing, diet, etc., they are nonetheless thought-provoking findings.

The environmental justice movement, which has gained attention in recent years, seeks to identify and address disparities in environmental quality across marginalized communities. The previously discussed statistics regarding sudden increases in cancer incidence with nuclear plant construction raise the question of how nuclear energy developers and officials approving

nuclear plant construction decide where the plant will be built, assuming that it could possibly leak radioactive pollution into the surrounding area. Consider these questions: will nuclear power plants be built in wealthy areas, or will they be built in poorer areas? Who will be subjected to the eyesore of two 500 ft tall cooling towers spewing clouds of steam into the sky, and who will be the first to be irradiated in the event of a meltdown? Many people's gut answer to these questions would be that lower-income, non-white individuals are most likely to live near nuclear plants, but the opposite is true. In fact, one study analyzing 2010 census records found that 83% of residents within a ten mile radius of nuclear power plants are white. That same study found that as the distance from nuclear power plants increased, the poverty rate increased, and mean household income decreased (Kyne, 2015). These findings suggest that, in choosing sites for nuclear power plant construction, minority and low-income groups are actually not singled out! A possible explanation for this phenomena is that nuclear power plants frequently supply populous cities with energy, and it is most efficient to situate these plants in suburbs just outside these cities—suburbs which are predominantly white and of above-average income. In addition, because the less population-dense suburbs are oftentimes chosen as sites, there is less pushback from the general public, and the land is less expensive and less developed.

The general consensus around nuclear power is that it is a safe, clean energy source that could help offset the impact of burning fossil fuels and slow the progression of global warming. However, more research should be conducted to investigate the possibility of carcinogenic radiation leakage from these plants, as well as tracing the sources of Strontium-90 isotopes found in children's baby teeth in areas surrounding nuclear plants. Dr. Karl Z. Morgan, director of health physics at Oak Ridge National Laboratory, stated that "there is no safe level of exposure and there is no dose of radiation so low that the risk of a malignancy is zero," suggesting that even small leakages of radiation from nuclear plants have the potential to trigger carcinogenesis. Therefore, when buying a home or deciding on a place to live and raise a family, one should consider proximity to nuclear power plants as a possible factor, especially since fetuses and children are more susceptible to radiation (Kutanzi et al., 2016).



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