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Neal J. Wilson

Research Scholar, Global Institute for Sustainable Prosperity

Faculty in Critical Studies, California Institute of the Arts

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Research Scholar, Global Institute for Sustainable Prosperity
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Abstract:
Pediatric lead poisoning is one of the most studied and persistent issues of environmental and racial injustice facing the United States. Great strides have been made at lowering pediatric blood lead levels in the aggregate since the NHANES began systematically tracking the problem in the late 1970's but disparities continue to compound. Lead poisoning in children continues to take a disproportionate toll on African American, Hispanic, and poor neighborhoods. A successful Green New Deal must address environmental, racial, and economic justice. Confronting lead poisoning provides this opportunity while providing a robust return on investment (Gould 2009). This paper closes with 11 programs related to addressing this injustice and environmental problem. 1) restorative justice for adult survivors of pediatric lead poisoning. 2) Universal testing and tracing for pediatric lead poisoning. 3) Comprehensive lead-soil testing. 4) Provide necessary and ongoing support services for children identified as lead poisoned. 5) Safely removing lead paint from the exterior and interior of pre-1978 housing. 6) Lead service line replacement and the overhaul of ageing municipal water infrastructure. 7) Remediation of lead in soil. 8) Develop effective and safe recycling strategies for lead loaded products. 9) Prevent the continual poisoning of children through closer oversight of consumer products. 10) Continued development of alternative-to-lead battery technologies. 11) Adequate nutrition for children and expectant mothers. If the Green New Deal does not build the equity in disadvantaged communities, it will fail.

Keywords: Jobs, Equity, Health, Environment, Lead Poisoning, Green New Deal, Public Policy

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Covid-19 has made clear to all what public health professionals have long known; that the social determinants of health produce outcomes that belie individual choice (Haggerty and Johnson 1996; Braveman and Gottlieb 2014). As the pandemic has made clear, health is a social product manifest in discrete cases. The home, the built environment, the neighborhood and its infrastructure all participate in a production process the outcomes of which we can recognize as ill-health or wellness (Zahran *et al.* 2013; Moody *et al.* 2016). Even if what constitutes the production process are seldom conceptualized as such.

Among the definitional aspects of the Green New Deal is that it recognizes exactly this: the built environment—our jobs, homes, neighborhoods, infrastructure, etc.—produce significant non-agenda (Ocasio-Cortez 2019). In the context of this essay this means the built environment can produce bad health outcomes. In the discussion of the Green New Deal, more generally, we recognize the built environment producing things like global climate change. To its credit The Green New Deal is organized conceptually around the active reconstruction of the built environment through state initiatives that do not have to meet a market test in terms of the timely capture of private returns. As we know the rich and poor alike will be impacted, but the poor will be impacted more severely and have less recourse for adaption.

Together this is a promise of the Green New Deal: targeted programs to reconstruct the built environment in which the most environmentally disadvantaged communities also benefit the most. Success of the Green New Deal is predicated on building equity in exactly these communities. Stated another way, if the built environment is not reconstructed to produce better health outcomes in African American, Hispanic, and poor communities, the Green New Deal will have failed. The balance of this essay is focused on one particular area, Green New Deal programs targeted at the elimination Pediatric Lead Poisoning and thus the bundle of health outcomes that it creates.

Lead is poisonous to humans at the sub cellular level because the body confuses lead for calcium which is used throughout every organ system (Sanders *et al.* 2009), yet we have managed to build lead into every landscape on the planet, from the deep ocean, to Himalayan glaciers, to the Nebraska Prairie, to suburban Boston (Settle and Patterson 1980).[1]

[1] There is a relevant anecdote about the only time in the last 3000 years levels of lead in Swiss glaciers have fallen to their background levels was during the black death (More *et al.* 2017).

Consider the "chicken pox diagram" of Clair Paterson. The diagram is designed to illustrate the challenge of returning to natural levels of lead exposure. The figure on the right, covered in dots, represents contemporary levels of lead exposure. The figure in the center represents one quarter the level of lead exposure on the right and is the standard cut off level for health interventions. The figure on the left illustrates the historic level of lead exposure, 100x less lead than represented by the figure in the center.

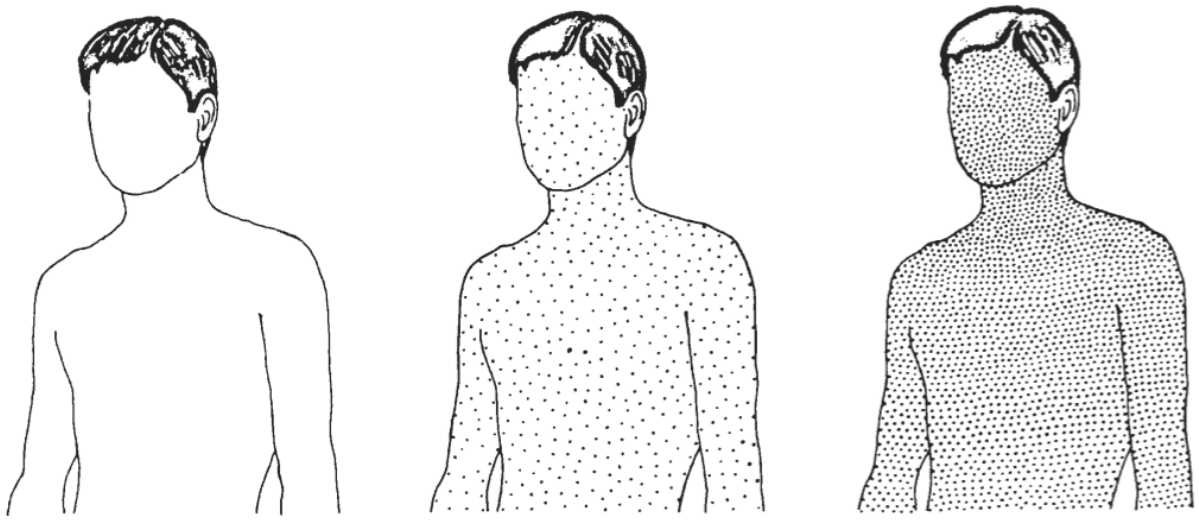


FIGURE 1 Comparison of relative amounts of lead in people: natural amount found in prehistoric people on the left; average amount found in present-day Americans in the middle; and minimum amount which will cause classical lead poisoning in a significant fraction of a group of people on the right. Each dot represents a unit of lead equivalent to 3×10^{-4} g Pb/70 kg person, based on a prehistoric natural skeletal value Pb/Ca (atomic) $= 6 \times 10^{-8}$ at age 45, reference [1].

source: (Patterson 1980, 276)

I would like to draw the parallel with greenhouse gas emissions in the difference between current trends (figure on the right), reductions in atmospheric carbon and other greenhouse gasses (figure in the center), and the active removal of carbon from the atmosphere (figure on the left). It is useful conceptualize the task at hand is as the unbuilding the Anthropocene—the reconstruction of our geologic epoch.

Lead is a *useful element* and that usefulness engenders applications in everything from paint, to fuel, to children's toys, to cosmetics, to electronics of all sorts (Dignam *et al.* 2019). Lead is also a waste product that comes from smokestacks, e-waste and particularly spent car batteries (Moody *et al.* 2016; Zhang *et al.* 2016). To staunch its health risks, we need an aggressive comprehensive approach, thus the Green New Deal programs. I group the proposed Green New Deal programs into three overlapping agendas: legibility, infrastructure renewal, and research.

The legibility agenda involves seeing the extent of the problem in an expansive and inclusive way; understanding through direct measure where lead is and where it is not. State capacity in general

is dependent on legibility programs (Scott 2008). The United States Census, for example, is a legibility program. In the US our county level Covid-19 response is dependent on the legibility of diagnoses, hospital admittance, ICU capacity, etc. Here in the US the National Health and Nutrition Survey (NHANES) has been assessing the health and nutritional status of Americans in a nationally representative sample periodically since 1971, and biannually since 1999. One intent of the programs I am discussing is to change the way the state interacts with its constituents and associate legibility with caring outcomes (Waller 1992). “I am from the government and I'm here to help.” No irony implied.

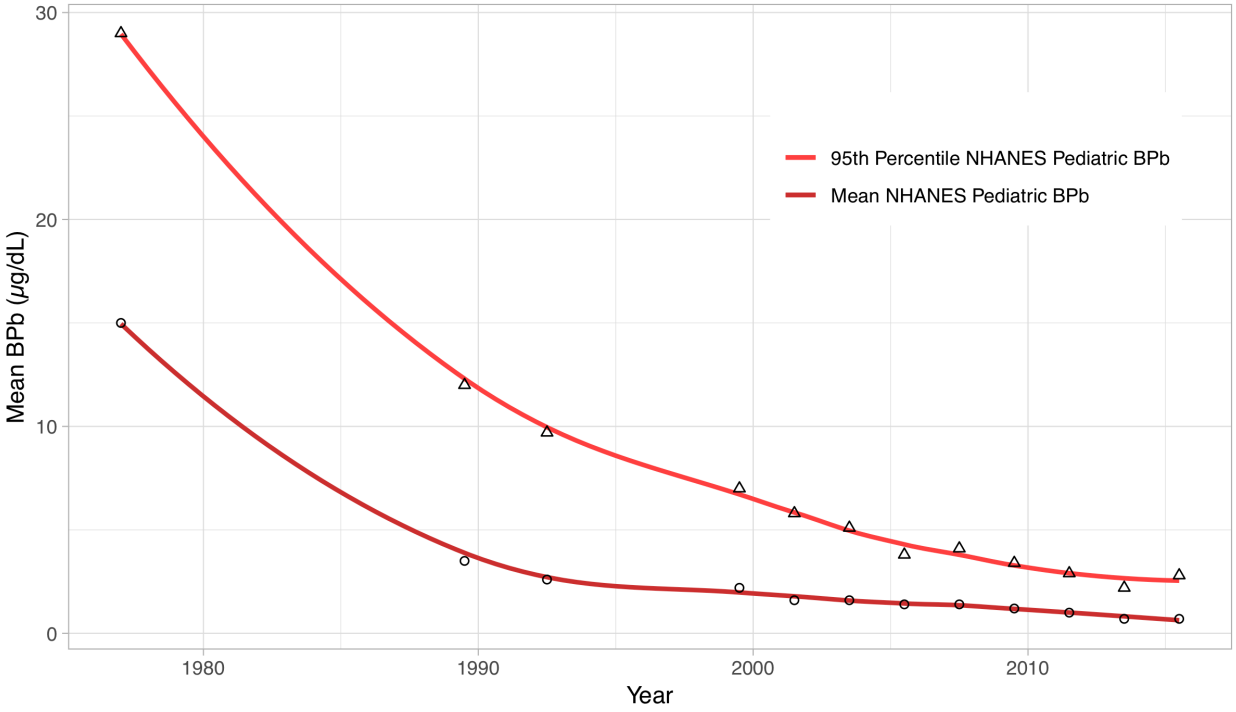
For legibility to be associated with caring depends on building equity, that is, successful infrastructure renewal programs and ultimately better health outcomes. Infrastructure in this case should be understood in the expansive sense to cover, yes, water and power but also educational infrastructure, the material content of our older homes, the ground we walk upon and the air we breathe. This is where the majority of the jobs will be created, the vectors by which the lived experience will be transformed, and the social determinants of health addressed.

Finally, there are several research agendas which compliment infrastructure renewal and follow from the legibility agenda. Replacing lead, the useful material, in its industrial applications will require basic research while the remedial processes used to remove lead from the built environment can also benefit from comprehensive research attention.

Can we do it—staunch the risks of lead exposure? On some level I know we can because we have done it before.

In 1980, in a report prepared for the National Academy of Sciences, Clair Paterson wrote, "Sometime in the near future it probably will be shown that the older urban areas of the United States have been rendered more or less uninhabitable by the millions of tons of poisonous industrial lead residues that have accumulated in cities during the past century." The veracity of his statement, now 40 years past, can thankfully be judged as incorrect. At the time, however, his warning was spot on.

Figure 1: Geometric Mean BPb in US Children (≥6years), 1978-2015



Source: Centers for Disease Control and Prevention, National Center for Health Statistics and National Center for Environmental Health, National Health and Nutrition Examination Survey

NHANES II, completed in the same year his warning was published, reported that the geometric mean blood lead level of children in the United States was 15µg/dL, (and that 88.2 percent of children age 1 to 5 had blood lead levels greater than or equal to 10 µg/dL.) But by 2015 the geometric mean of childhood blood lead had fallen to under 1 µg/dL (with just 5 percent of those children exhibiting blood lead levels of 2.75 µg/dL or greater) ("America's Children and the Environment" 2019). A tremendous success enabled not by the manipulation of the price mechanism but by environmental legislation that effectively prohibits the use of lead in paint (1978), gasoline (1975), and in plumbing products (1985) and regulations that placed limits on lead emissions into the atmosphere water (Griffith *et al.* 1998). By prohibiting the use of lead in industrial applications and the continued production of a lead loaded environment this raft of environmental policies did double duty as a health policy (Reyes 2015).

We need to look no farther for examples of the state creating caring outcomes, but we must temper any optimism with uncomfortable facts. You cannot honestly talk about lead poisoning without talking about race and class. The national mean obscures significant disparities in the experience of these caring outcomes. For example, when disaggregated by race, it is clear that throughout the NHANES era, that is the last 50 years, African Americans as a group have experienced blood lead levels significantly higher than either the national average or that of any other racial or ethnic group. Meanwhile the production of lead loaded environments continues (Banzhaf, Ma, and Timmins 2019). The examples of Flint Michigan and The Exide Recycling facility in East Los Angeles testify to that fact (Barboza 2015; Hanna-Attisha *et al.* 2016). It is poor and minority

neighborhoods where improvements are slowest and new hazards continue to emerge (Bullard 2000). It is hard to interpret being the most impacted and least benefited as expressions of care. Thus, as we focus on getting pediatric blood lead levels to zero it is the unequal distribution of lead in the built environment that must be targeted first. Along these lines I am going to introduce several programs intended to build equity while eliminating lead poisoning. I do not spend much time discuss these programs in cost benefit terms though people have (see: Nevin *et al.* 2008; Gould 2009; Zhou *et al.* 2017; Martin and Acs 2018). For instance, David Jones, in 2012, reported a lower bound estimate of the benefits associated with the reduction in lead poisoning – derived from increased expected lifetime earnings and reduced medical expenditures – as two to twenty times the estimated costs of remediations (Jones 2012). Elsewhere the Minnesota department of public health estimated that spending 4 billion dollars on eliminating lead in drinking water will yield over 8 billion in societal benefits from avoiding cognitive impairments in particular, that is, lower lifetime earnings associated with lower IQ (Neltner 2019).

There is a related but distinct ethical case for eliminating lead poisoning which may be stronger the case made in monetary terms. The ethical case is rooted in Sen's capabilities approach and turns on valuing each person's right to their own physical integrity (Sen 1984).
The production of lead poisoned children entails the involuntary degradation of a child's physical integrity the effect of which is cognitive impairment, damage to the brain and central nervous, and other negative health outcomes too numerous to report here (Sanders *et al.* 2009). If we believe that no one should be involuntarily subject to a reduction in their potential in physical terms, then removing lead from the built environment is an absolute imperative.

Turning to possibilities for Green New Deal programs I briefly introduce eleven programs that will work together to increase equity while fighting lead poisoning and its effects. Each of these programs is complex enough to benefit from a more expansive treatment, the intent here is to describe the scope required to challenge this problem. I begin with the programs associated with legibility before turning to the infrastructure renewal and research agenda.

Restorative Justice for Adult Survivors of Pediatric Lead Poisoning

Although mean pediatric blood lead levels have fallen precipitously, we are still experiencing an epidemic of lead poisoning. The average child surveyed by NHANES II would be considered severely lead poisoned today, that same child has recently passed into their fourth decade of lead poisoned life. By way of evocative comparison, those areas of Flint MI that experienced the greatest frequency of lead poisoning nearly saw 11% of the children with blood lead levels greater than 5µg/dL (Hanna-Attisha *et al.* 2016). NHANES II reported 88% of all children in late '70's America to have blood lead levels greater 10µg/dL (Dignam *et al.* 2019). This is a fact that we have not as a country come to grips with.

Recently MI Governor Whitmer began the process of bringing some restorative justice to the victims of the poisoning in Flint, approving the creation of a $641million dollar fund, 80% of which is to be allocated to individuals who were still minors at the time of the lead contamination (LeBlanc 2020). No such program exists for the victims of tetraethyl leaded gasoline or lead paint, the closest that I know of is a tax on the gasoline and paint industry to pay for some lead testing.

A first step for the adult survivors of lead poisoning could be an acknowledgement of the injustice that occurred. Documentation of the precise extent of past poisoning is limited to the analysis of the lead content of trabecular bone and/or deciduous teeth. Due to the invasiveness of these procedures a precise accounting of the lead poisoning epidemic is unethical (Woolfolk 2021). However, there remains the necessary task of thinking through what restorative justice would look like to those subjected to this biological disinvestment process. Perhaps this is a jobs program prioritizing lead's victim for dignified employment.

Universal Pediatric Blood Lead Testing

We do not currently understand the extent of pediatric lead poisoning. Only 10 states, plus the district of Columbia, have universal screening requirements for children under 5. Compliance with these requirements runs as low as to 68%. Eight states have targeted programs that require children with an economic or geographic risk factor for lead to be tested. Compliance with this ordinance means that as few as 8% of children (in WV) are tested for lead (27% on the high end). 27 states recommend testing on the basis of a risk assessment alone, testing rates run as low as 1% (as high as 20%). Five states have no official screening recommendations and provide no information about the % of children tested. Additionally, rules for reporting and recording test results differs from state to state with many states only requiring reporting above thresholds which change from state to state (Dickman 2017).

As we know from the corona virus pandemic, there is tremendous value in testing the asymptomatic. The effects of lead poisoning, like Covid-19, are often not apparent though the individual is stricken. Universal testing is more useful than target testing, it also produces better understandings of the geography, enables the identification of unexpected risk factors, and is more cost effective than targeting testing.

The potential exists in Universal Testing to align the interests of the rich and the poor. Because there is no safe level of pediatric blood lead, if the affluent see their lot is cast in with the poor, perhaps they will be motivated to do more to support these programs.

Comprehensive Soil Testing

Soil has been discussed as a repository for lead waste since at least 1970, and
understood in medical literature as an important pathway for human lead exposure since the mid-1990's (Motto *et al.* 1970; Mielke and Reagan 1998). Certainly this is true for the soil in brownfields and superfund sites, current epidemiological models exist that connect soil lead levels in residential neighborhoods with elevated blood lead levels of the children who live there (Zahran *et al.* 2013). Despite such knowledge, extensive documentation of neighborhood soil lead levels does not exit.

Soil lead testing compliments universal blood lead testing but these legibility programs are of little value on their own. Legibility qua legibility is not the goal. Only where systematic observations are put to use in the identification of unexpected causes or clusters of lead poisoning and guiding health interventions is legibility associated with caring. Legibility enables government to target the areas of most pressing concern and guide infrastructure renewal programs. Legibility programs together with jobs for reconstructing the built environment embody hundreds of thousands of decent, well paid, equity building jobs.

Enhanced Assistance for Children with Lead Poisoning

A Diagnosis of pediatric lead poisoning need not be a life sentence. Billings and Schnepel (2017) illustrate that health and educational interventions, following the diagnosis of elevated blood lead levels, can produce large long-term benefits. The set of treatments in the Carolina Abecedarian Project, which focus on social, emotional, and cognitive assistance for young children (aged 1-5) has been associated with increases in educational attainment, reductions in criminal activity, and improved adult health (Billings and Schnepel 2017). Providing this support is labor intensive however this good work underscores that a child's possibilities are not foreclosed upon diagnosis.

Housing Based Lead Removal (Interior/Exterior)

The effect of removing lead from the built environment on lowering blood lead levels is supported by decades of research. This fall, the US Department of Housing and Urban Development announced $165million in funding for Lead Based Paint Hazard Reduction grants to remove lead from over 7,000 housing units nationwide ("HUD Awards…" 2020). David Jones (2012) finds that each remediated home prevents ~2.5 cases of lead poisoning. This is excellent work, ongoing now since 1995 has prevented an estimated half million cases of lead poisoning. However, the scale of the work that remains to be done is staggering, in 2011 the American Healthy Homes Survey reported that there are over 23 million homes in the US with one or more lead-based paint hazard. Underscoring the importance of removing housing based lead hazards, both the National Academy of Sciences and the American Academy of Pediatrics recommend housing-based interventions as a form of treatment for chronic disease, moving the treatment of chronic disease 'upstream'; removing the cause to prevent the injury (Council on Environmental Health 2016; National Academies of Sciences, Engineering, and Medicine 2019).

Lead Service Line Replacement

We should not neglect the importance of the pipes below the ground. Lead pipes can be a vector of exposure, particularly in the case of infants fed with instant formula. Lead service lines were banned in new construction in 1985. In 2020 the EPA revised its 'lead and copper rule' for the first time since 1991. This revised rule is designed to more reliably identify elevated lead levels in the nations 68,000 public water systems and compel water utilities to replace their portion of a lead service line anytime a resident decides to replace the lead pipe leading to their home. However, the new rule extends the time frame for replacing pipes with high levels of contamination from 14

to 33 years (Kaplan and Dennis 2020). Some states have set their own rules for service line replacement. For instance, Minnesota has its own program that targets complete replacement of lead service lines in 20 years at an upper bound cost of $.37 billion with lower bound benefit of $2.12 billion (Neltner 2019).

Estimating the benefits produced in these infrastructure renewal programs is one research agenda among many. The Green New Deal will have to employ scientists to carry out basic research if it is to achieve its goals of arresting global climate change and staunching pediatric lead poisoning.

Soil Remediation Techniques

Soil is a critical and underdiscussed vector of lead poisoning and its remediation is necessary for improved health outcomes (McClintock 2015). That said, the balance of soil remediation methods (solidification, in situ vitrification, and electrokinetics) are not suitable in scale and efficacy to meet the challenge of soil born lead in residential environment.

The standard method in the residential environment is to dig up the contaminated soil and haul it to the landfill, then replace the missing dirt with 'clean' soil mined at another location. A second standard practice is to encapsulate contaminated soil beneath a layer of clean fill, mulch, sod or new planting. These methods are effective, but they are intensive, invasive, and expensive. We can do better.

Safe-lead Recycling

We are using more lead than ever to support our modern lifestyles and most of the lead we use finds its way into a recycling stream where it is consolidated and melted down, or in the case of most e-waste it is exported to be recycled in an unregulated environment. Recycling lead batteries and the legacy of that activity is a source of ongoing pollution in minority neighborhoods (most notoriously the Exide facility in East Los Angeles) (Ross 2020). The challenge to tame the export of toxins grows more pressing by the year as some cities in developing countries specialize in unregulated recycling. Unregulated e-waste workers, through their exposure to lead and other heavy metals, actively enter a disinvestment process (Jordan 2021). Investment in engineering safe lead reclamation technology coupled with oversite of e-waste exports is the more ethical path forward.

Oversight of Consumer Products

Despite strict rules against producing lead loaded consumer products in the US we continue to import them from overseas. Target, Amazon, Dollar Tree, Walgreens, and many other retailers that are not household names have all been cited for selling lead loaded consumer products and required to issue recall notices. These consumer products, often dishes or toys, are vexing source of lead poisoning as they can elude easy identification and circulate for years passing between family members and through resale shops.

Unfortunately, in the age of Covid-19, the investigation of lead safe products from overseas has stopped altogether. The Consumer Product Safety Committee cut back its oversight of imported consumer products by over 95% on March 19, 2020 without a public disclosure of that fact or notifying congress. Now, the only way to catch the lead loaded items which have passed into our homes unmolested is by identifying the children they have poisoned (Stein and Murphy 2020). The recent scandal regarding inadequate regulation of heavy metals in baby food underscores the importance of competent oversight of consumer products (Subcommittee on Economic and Consumer Policy and Committee on Oversight and Reform 2021).

Alternative Battery Technology

Research into lead-free battery technology does not directly build equity in the communities that need it, though decreasing the number of lead batteries used will lessen the burden from unsafe recycling activities. This is area where preventing lead poisoning most readily touches preconceived notions of fight against global climate change. Any transition to clean energy is predicated on developing a new battery technology to store the intermittent power generation of renewable sources and replace the fleet of lead batteries that currently power cars, trucks, boats, planes, electrical substations and so forth.

Adequate Nutrition for All Children

Providing adequate nutrition for all children may not come to mind directly as a green new deal program, however using nutritional assistance to combat lead poisoning may be an effective strategy to bridge what will be a long project of reconstructing a lead-free built environment. While the prophylactic effectiveness of nutritional interventions is not extensively studied, research does suggest that deficiencies in iron, calcium, protein, and zinc are related to higher blood lead levels and potentially increase a child's vulnerability to the negative effects of lead. Similar effects have been observed with regard to expecting mothers.

Malnourished children are an afront to human dignity no less than lead poisoned children are. That it may be possible to address both indignities simultaneously is all the more reason to expand the influence of the caring state building equity through green new deal programs focused on eliminating lead poisoning.

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