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The Element of Surprise: Lead (Pb), A Silent Killer

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## **The Element of Surprise: Lead (Pb), A Silent Killer**

### **Introduction**

Twenty-five percent, or one-in-four California child-care centers have dangerously high levels of lead in their drinking water systems, according to an article by the L.A. Times.<sup>1</sup> This alarming statistic is just one unfortunate example of the lead contamination crises across the United States. Although this metallic element was prohibited from further use in public water systems construction and plumbing under the Safe Drinking Water Act of 1986<sup>2</sup>, the existing lead-contaminated pipelines were exempt, and today pose a national health-risk to millions of Americans.<sup>3</sup> Americans residing in homes, attending schools or daycare facilities, and working in buildings constructed before 1986 may be exposed to lead contaminated tap water, and harming their health against their knowledge.<sup>4</sup>

This leads to the question: Is there a disproportionate relationship between lead-contaminated drinking water and the health of low-income Los Angeles County communities? This paper will analyze the health effects and risks that lead-contaminated drinking water has on lower-income individuals of L.A. County. Analysis will be determined through a collection of data from annual water reports featuring lead contaminants, and U.S. Census data on life expectancy rates, income, and racial demographics on a subgroup of ten

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<sup>1</sup> Pineda, D. (2023, May 18). *Drinking water at 1 in 4 California child-care centers tests dangerously high for lead*. Los Angeles Times. <https://www.latimes.com/california/story/2023-05-18/drinking-water-at-1-in-4-california-child-care-centers-tests-dangerously-high-for-lead>.

<sup>2</sup> S.124 - 99th Congress (1985-1986): *Safe drinking water act amendments ...* S.124 - Safe Drinking Water Act Amendments of 1986. (1986, May 5). <https://www.congress.gov/bill/99th-congress/senate-bill/124>.

<sup>3</sup> Lawson, J. (2023, April 19). *Lead in the water: How some of America's water became too dangerous to drink*. ABC News. <https://abcnews.go.com/US/lead-water-americas-water-dangerous-drink/story?id=98438736>.

<sup>4</sup> Cohen, L. (2023, April 5). *EPA finds more than 9 million lead pipes supplying drinking water throughout the U.S.* CBS News. <https://www.cbsnews.com/news/epa-more-than-9-million-lead-pipes-drinking-water-us/>.

L.A. County cities. This analysis will give insight into disproportional health effects and risks of lead contamination on lower-income L.A. residents, and provide policymakers with awareness and understanding on how to combat this water and social inequality.

### **Significance of Issue**

Lead is one of the most harmful and toxic chemical elements to humankind. It is odorless and colorless, impossible to detect without a test.<sup>5</sup> Nearly 9 million lead service lines are still in operation across the U.S. today, serving tens of millions of people with contaminated drinking water.<sup>6</sup> In early 2023, lead was detected in almost 1,700 childcare centers across California, at concentrations over the national blood lead limit (BLL) of 5 parts-per-billion (ppb).<sup>7</sup> This statistic does not include childcare centers with lead detection under, or at the national limit, which would increase the amount of facilities with lead tracings.

Lead is significantly more harmful to children than adults, as the former is able to absorb 4-5 times as much into their bodies.<sup>8</sup> Lead consumption is not safe at any level, and the effects of contamination are irreversible.<sup>9</sup> Children and adults with elevated blood lead levels (EBLL) have increased risk of lead poisoning, cancer and cardiovascular diseases, neurological and cognitive damage, and many other illnesses or bodily harm.<sup>10</sup> Children with lead poisoning can experience growth and language problems, abdominal and cranial pain, and hyperactivity.<sup>11</sup> Lead accumulates, or absorbs into the body, and is unable to be easily broken-down like

<sup>5</sup> Lawson, J. (2023, April 19). *Lead in the water: How some of America's water became too dangerous to drink.*

<sup>6</sup> Cohen, L. (2023, April 5). *EPA finds more than 9 million lead pipes supplying drinking water throughout the U.S.*

<sup>7</sup> Hao, C. (2023, May 20). *Does your child's day care have dangerous levels of lead in tap water? here's new data for California Schools.* San Francisco Chronicle.  
<https://www.sfchronicle.com/climate/article/lead-water-california-preschools-18106998.php#:~:text=Almost%201%2C700%20child%20care%20facilities.in%20drinking%20water%20for%20children.>

<sup>8</sup> Patil, P. N. (2012). LEAD AS A TOXIC WATER CONTAMINANT - HEALTH EFFECTS AND METHODS OF ANALYSIS. *Journal of Science and Arts*, 12(4), 439-450.  
[https://www.proquest.com/scholarly-journals/lead-as-toxic-water-contaminant-health-effects/docview/1323310427/se-2.](https://www.proquest.com/scholarly-journals/lead-as-toxic-water-contaminant-health-effects/docview/1323310427/se-2)

<sup>9</sup> World Health Organization. (2022, August 31). *Lead poisoning.* World Health Organization.  
[https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health.](https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health)

<sup>10</sup> Levallois P.; Villanueva C.M. "Drinking Water Quality and Human Health: An Editorial. *Journal of Environmental Research and Public Health*, 2019, 1-5.

<sup>11</sup> Patil, P. N. (2012). LEAD AS A TOXIC WATER CONTAMINANT.

minerals and other substances.<sup>12</sup> Over time, lead will calcify in the bones, and eventually destroy the central and peripheral nervous systems.<sup>13</sup>

Lead toxicity in drinking water is extremely dangerous to humans, and disproportionately affects lower-income individuals and people of color.<sup>14</sup> Poorer individuals tend to reside in older neighborhoods, in older homes—which tend to be built before 1986, and may still have lead plumbing or fixtures.<sup>15</sup> Lower income communities are also more likely to contain older schools, which again, have a higher chance of containing lead contamination in their plumbing infrastructure.<sup>16</sup> A 2020 study that conducted research on lead risk in the U.S. found that 42 percent of all health problems associated with lead contamination are from lower-income communities.<sup>17</sup> This staggering percentage is reason enough to investigate further the inequity in the health of these vulnerable communities in regards to lead toxicity, as well as bring awareness to this drastic water issue that the entire U.S. needs to address.

## **Background**

The finding origins of the 82nd element of the periodic table is unknown<sup>18</sup>, but can be traced back to the Ancient Romans.<sup>19</sup> Roman civilization used lead constantly; it was in coins,

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<sup>12</sup> Environmental Protection Agency. (2022, September 8). *Learn about Lead*. EPA. <https://www.epa.gov/lead/learn-about-lead#:~:text=Adults%20exposed%20to%20lead%20can,in%20both%20men%20and%20women>.

<sup>13</sup> Wani, A. L., Ara, A., & Usmani, J. A. (2015). Lead toxicity: a review. *Interdisciplinary toxicology*, 8(2), 55–64. <https://doi.org/10.1515/intox-2015-0009>.

<sup>14</sup> Times Editorial Board. (2023, February 10). *Editorial: Are California school kids drinking water tainted with lead? we don't know, and that's the problem*. Los Angeles Times. <https://www.latimes.com/opinion/story/2023-02-05/la-ed-school-lead-testing>.

<sup>15</sup> Centers for Disease Control and Prevention. (2021, October 29). *Populations at higher risk*. Centers for Disease Control and Prevention. <https://www.cdc.gov/nceh/lead/prevention/populations.htm#:~:text=Across%20the%20United%20States%2C%20there,greater%20risk%20of%20lead%20exposure>.

<sup>16</sup> Johnston, J. E., & Hricko, A. (2017). Industrial Lead Poisoning in Los Angeles: Anatomy of a Public Health Failure. *Environmental Justice*, 10(5), 162-167. <https://doi.org/10.1089/env.2017.0019>.

<sup>17</sup> Marshall, A. T., Betts, S., Kan, E. C., McConnell, R., Lanphear, B. P., & Sowell, E. R. (2020). Association of lead-exposure risk and family income with childhood brain outcomes. *Nature medicine*, 26(1), 91–97. <https://doi.org/10.1038/s41591-019-0713-y>.

<sup>18</sup> *Lead Element Facts*. Chemicool. (2012, December 29). <https://www.chemicool.com/elements/lead.html>.

<sup>19</sup> Lawson, J. (2023, April 19). *Lead in the water: How some of America's water became too dangerous to drink*.

cooking utensils, food, cosmetics, and plumbing.<sup>20</sup> Lead was an extremely durable component in water piping, as it did not easily wear or tear over time.<sup>21</sup> Early Americans incorporated many aspects of Roman civil engineering into their society, and thus created an extensive network of lead-made water pipelines across the country.<sup>22</sup> The major health risks of lead were not well-known until the early 20th century, and even after, people continued to believe that a limited lead intake was safe.<sup>23</sup> Dr. Randolph K. Byers, an American pediatric neurologist, was one of the first to discover the negative health effects of lead consumption in children in the 1940s. Dr Byers' research led to the discovery of adolescent neurological and cognitive damage as a direct result of even a slight amount of lead contamination.<sup>24</sup> This information helped eradicate the notion that lead poisoning was only dangerous in large doses, when in fact, no amount of lead consumption is safe.<sup>25</sup>

A 2014 study suggested that children are the most vulnerable to the health risks associated with lead consumption, as their bodies are able to absorb lead in water at 40-50 percent, in comparison to adults, who absorb the same lead at 3 to 10 percent in a soluble source. Young children ages 1 to 5 are especially at risk of lead poisoning; with every 1-ppb consumed through water their blood lead level (BLL) increases to 35 percent. The same study found that infants consuming powdered formula made with contaminated water is one of the

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<sup>20</sup> Lewis, J. (2016, September 16). *Lead poisoning: A historical perspective*. EPA. <https://www.epa.gov/archive/epa/aboutepa/lead-poisoning-historical-perspective.html>.

<sup>21</sup> *Why the United States still has lead service lines and pipes*. Alliance Water Resources. (2021, January 8). <https://alliancewater.com/why-the-us-still-has-lead-service-lines-and-pipes/#:~:text=From%20ancient%20Rome%20to%20the.high%20durability%20and%20corrosion%20resistance.>

<sup>22</sup> Rabin R. (2008). The lead industry and lead water pipes "A Modest Campaign". *American journal of public health*, 98(9), 1584–1592. <https://doi.org/10.2105/AJPH.2007.113555>.

<sup>23</sup> Ibid.

<sup>24</sup> Needleman, H. L. (n.d.). *History of lead poisoning in the World Dr. Herbert L. Needleman*. Biological Diversity. [https://www.biologicaldiversity.org/campaigns/get\\_the\\_lead\\_out/pdfs/health/Needleman\\_1999.pdf](https://www.biologicaldiversity.org/campaigns/get_the_lead_out/pdfs/health/Needleman_1999.pdf).

<sup>25</sup> Environmental Protection Agency. (2023a, January 27). *Basic Information about Lead in Drinking Water*. EPA. <https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water#:~:text=EPA%20estimates%20that%20drinking%20water.to%20lead%20from%20drinking%20water.>

biggest contributors to their overall lead intake, accounting for nearly 85 percent of total lead exposure.<sup>26</sup>

In a water report conducted by the EPA in early 2023, researchers discovered that when high levels of lead in drinking water are present, 20 percent of a person's total lead contamination could be solely from the water exposure.<sup>27</sup> Pregnant women are often the most at-risk for lead toxicity among adults, including the effects of lead poisoning on the fetus as well.<sup>28</sup> Health effects of the fetus include miscarriage, premature or underdeveloped birth, organ and central nervous system harm, and learning or behavioral disabilities.<sup>29</sup>

One example of disproportionality in the population of people affected by lead can be found in the 2014 water crisis in Flint, Michigan. Flint had just undergone a temporary water-supply change; moving away from Lake Huron and towards the Flint River. The city was in the midst of a developing pipeline project, which would improve their water consumption from Lake Huron. After the water switch, Flint residents noticed a difference in their drinking water: the taste, the odor, and the color was off. Health complaints, such as headaches and rashes, increased. Eventually, outbreaks of the bacterial infection, E-Coli, were detected in the water, as was the chemical element—lead. The water-switch had caused the pipelines to corrode, resulting in lead to leach into the community's water supply. Lead service lines were detected throughout the city, ranging from 10 to 80 percent of the city's entire plumbing system.<sup>30</sup>

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<sup>26</sup> Hanna-Attisha, M., LaChance, J., Sadler, R. C., & Schnepf, A. C. (2016). Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response. *American Journal of Public Health*, 106(2), 283-290. <https://doi.org/10.2105/AJPH.2015.303003>.

<sup>27</sup> Environmental Protection Agency. (2023, January 27). *Basic Information about Lead in Drinking Water*. EPA. <https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water#:~:text=EPA%20estimates%20that%20drinking%20water.to%20lead%20from%20drinking%20water>.

<sup>28</sup> Patil, P. N. (2012). LEAD AS A TOXIC WATER CONTAMINANT.

<sup>29</sup> Centers for Disease Control and Prevention. (2022, July 21). *Childhood Lead Poisoning Prevention: Pregnant women*. Centers for Disease Control and Prevention. <https://www.cdc.gov/nceh/lead/prevention/pregnant.htm#:~:text=Lead%20in%20the%20blood%20during,have%20learnin%20or%20behavior%20problems>.

<sup>30</sup> Hanna-Attisha, M., LaChance, J., Sadler, R. C., & Schnepf, A. C. (2016).

The population of Flint, Michigan, sat just under 100,000 in 2014, with a majority of the population African American.<sup>31</sup> Almost half, or 45 percent of the population is categorized as low-income. Although lead was detected in the city's water between 2014 and 2015, it took almost nine years for real action, and cost the city \$400 million dollars for the residents of Flint to be provided with safe drinking water.<sup>32</sup> According to the City of Flint's website, residents were told they no longer had to boil their drinking water as of February of 2023.<sup>33</sup> It took nearly a decade for this community to receive aid for what the United Nations recognizes to be a "global human right" –clean and safe drinking water.<sup>34</sup> Perhaps this drinking water disparity is being experienced elsewhere, across communities that do not even realize it.

### **Legal Efforts to Combat Lead Contamination**

Throughout the years, the U.S. has taken steps to combat lead contamination after realizing the harm it poses to humankind. In 1986, the U.S. Congress amended the 1976 Safe Drinking Water Act (SDWA) to include regulations for lead contamination.<sup>35</sup> This revision also, according to the Environmental Protection Agency (EPA), prohibited the use of pipes, solder, or flux that were not deemed "lead free" in public and plumbing water systems.<sup>36</sup> Solder and flux, two materials used in piping, were required to have less than 0.2 percent of lead tracing, while pipes were to be manufactured with no more than 8 percent.<sup>37</sup> In 1991, the national Lead and

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<sup>31</sup> Denchak, M. (2018, November 8). *Flint water crisis: Everything you need to know*. Be a Force for the Future. <https://www.nrdc.org/stories/flint-water-crisis-everything-you-need-know#summary>.

<sup>32</sup> *Flint enters final phase of Lead Service Line Replacement*. SOM - State of Michigan. (2022, September 30). <https://www.michigan.gov/egle/newsroom/press-releases/2022/09/30/flint-enters-final-phase-of-lead-service-line-replacement>.

<sup>33</sup> O'Neill, C. (2023, February 13). *Feb. 2023 water main break updates*. City of Flint. <https://www.cityofflint.com/feb-23-water-main-break/#:~:text=The%20boil%20filtered%20water%20advisory,consecutive%2024%2Dhour%20testing%20rounds>.

<sup>34</sup> United Nations. (n.d.). *Human Rights to Water and Sanitation*. United Nations Water. <https://www.unwater.org/water-facts/human-rights-water-and-sanitation>.

<sup>35</sup> *S. 124 - 99th Congress (1985-1986): Safe drinking water act amendments*

<sup>36</sup> Environmental Protection Agency. (2023b, April 11). *Overview of Lead Free Requirements of Safe Drinking Water Act*. EPA. <https://www.epa.gov/sdwa/use-lead-free-pipes-fittings-fixtures-solder-and-flux-drinking-water>.

<sup>37</sup> Ibid.

Copper Rule (LCR) was established, with a target of reducing lead contamination in drinking water to zero, however no goal-timeline was established.<sup>38</sup> A few years later, another amendment was added to the SDWA in 1996, which added plumbing fittings and fixtures to the list of lead-prohibited products.<sup>39</sup> In 2011, the SDWA was again revised, this time reducing the maximum lead content of wetted plumbing items from 8 percent to 0.25 percent in order to be deemed lead free.<sup>40</sup>

In California, former Governor Jerry Brown signed into law Assembly Bill (AB) 685 in 2012, establishing the state as the first in the nation to recognize the human right to clean, safe drinking water.<sup>41</sup> The state recently amended the LCR to include protections for elementary schools and childcare facilities from lead contamination, requiring water serviceline compliance and the statewide removal of lead piping, which will go into effect in fall of 2024.<sup>42</sup>

There is debate currently surrounding AB 249, a bill introduced in early 2023 by California Assemblymember Holden.<sup>43</sup> The bill seeks to expand the California Safe Drinking Water Act to include and require the community water systems that serve California public schools to test for lead in the drinking water. The community water systems would be instructed to prepare and perform tests on each of the schoolsite's water outlets, reporting all lead-sampling data to the state board. Findings would also be made available to the school or local agency serving the school site, as well as to the public, and be posted on the state board

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<sup>38</sup> *Lead and copper rule (LCR)*. ASDWA. (2021, February 19). <https://www.asdwa.org/lead-and-copper-rule-lcr/#:~:text=The%201991%20Lead%20and%20Copper.copper%20within%20the%20distribution%20system>.

<sup>39</sup> Environmental Protection Agency. (2023b, April 11).

<sup>40</sup> *Lead and copper rule (LCR)*.

<sup>41</sup> California State Water Resources Control Board. (2023, March 20). *Human right to water: California state water resources control board*. California Water Boards. [https://www.waterboards.ca.gov/water\\_issues/programs/hr2w/](https://www.waterboards.ca.gov/water_issues/programs/hr2w/).

<sup>42</sup> Environmental Protection Agency. (2022b, December 7). *Revised Lead and Copper Rule: Lead and Copper Rule Revisions Service Line Inventory Guidance*. EPA. <https://www.epa.gov/ground-water-and-drinking-water/revised-lead-and-copper-rule>.

<sup>43</sup> Holden, C. (2023, May 19). *AB 249: Bill Text*. Bill Text - AB-249 Water: schoolsites: lead testing: conservation. [https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill\\_id=202320240AB249](https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202320240AB249).



website. If testing presents high levels of lead in the drinking water, all parties (school site, local education agency, state board, and parents/guardians) would be notified, and all fountains and faucets would be shut off. The community water system would then be required to provide a portable supply of drinking water to the school site, and replace existing faucet and drinking fixtures.<sup>44</sup>

The bill would require the California government to spend millions of dollars to fix each school site, estimating a total of \$15 million dollars to fund just the first installation of lead testing.<sup>45</sup> This number is less significant than the total economic toll on California resulting from lead exposure, according to a 2015 study, which estimates spending of \$8 to \$11 billion dollars over the lifetime of children born annually.<sup>46</sup>

### **Theory and Argument**

I theorize that higher levels of lead contamination in drinking water disproportionately affect and contribute to the health and health risks of lower-income communities in Los Angeles County. To test my theory, I plan to focus on a randomized subgroup of 10 cities from the county, including: Alhambra, Bellflower, Beverly Hills, Calabasas, La Puente, Pico Rivera, Santa Monica, Signal Hill, Temple, and Walnut. I plan to collect lead contamination data on each city, using their annual city water quality and consumer confidence reports from the year 2021. My independent variable  $x$  is the levels of lead contamination in the drinking water from each city. My dependent variable  $y$  will be measuring the health effects of each city, which I will measure using their California Healthy Places Index (HPI) ranking and drinking water contaminant percentage<sup>47</sup>, and each city's poverty level and the percentage of the population with poor

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<sup>44</sup> Holden, C. (2023, May 19). *AB 249: Bill Text*.

<sup>45</sup> Pineda, D. (2023, May 18). *Drinking water at 1 in 4 California child-care centers tests dangerously high for lead*.

<sup>46</sup> Public Health Institute's California Environmental Health Tracking Program. (2020, April 22). *Costs of environmental health conditions in California children*. Public Health Institute.  
<https://www.phi.org/thought-leadership/costs-of-environmental-health-conditions-in-california-children/>.

<sup>47</sup> *CA Healthy Places Index (HPI)*. Healthy Place Index (HPI). (n.d.). <https://www.healthyplacesindex.org/>.

physical health from the U.S. Census Bureau<sup>48</sup>. I will also be collecting data from the Southern California Association of Governments (SCAG) 2021 Local Housing Reports<sup>49</sup>, specifically focusing on each city's percentage of housing constructed before 1979, or before the Safe Drinking Water Act's prohibition of lead in home materials and water fixtures<sup>50</sup>. Through gathering the data for my x and y variables, I believe that my findings will support my hypothesis that communities with higher rates of lead contamination are more likely to be lower income, and have higher health risks because of this equity difference.

A confounding variable in my research includes the pre-existing health conditions of individuals living in the 10 communities I am analyzing, which could contribute to the area's overall U.S. Census poor-health quality percentage. Other water pollutants are also a confounding variable to my research, such as copper, which is another common material found in older water pipes and plumbing fixtures.<sup>51</sup> The city's location is a final factor that could affect my research findings, as nearby industrial factories, freeways, or trash dumping grounds could potentially affect the community's health, and worsen underlying health conditions. These factors will be considered in my research, and will be accounted for in the research implications.

## **Research Design**

I will be conducting a small-n study on a randomly selected population of cities from Los Angeles County, using quantitative data to answer my research question. I placed all of the 88 cities of Los Angeles County into an online randomization system, which generated 10 cities.<sup>52</sup> The cities include Alhambra, Bellflower, Beverly Hills, Calabasas, La Puente, Pico Rivera, Santa

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<sup>48</sup> Bureau, U. C. (2023, May 29). Census.gov. <https://www.census.gov/>.

<sup>49</sup> *Local profiles*. Southern California Association of Governments. (2020, November 14). <https://scag.ca.gov/data-tools-local-profiles>.

<sup>50</sup> Environmental Protection Agency. (2023b, April 11). *Overview of Lead Free Requirements of Safe Drinking Water Act*. EPA. <https://www.epa.gov/sdwa/use-lead-free-pipes-fittings-fixtures-solder-and-flux-drinking-water>.

<sup>51</sup> Environmental Protection Agency. (2022b, December 7). *Revised Lead and Copper Rule: Lead and Copper Rule Revisions Service Line Inventory Guidance*. EPA. <https://www.epa.gov/ground-water-and-drinking-water/revised-lead-and-copper-rule>.

<sup>52</sup> *Wheel of names*. Wheel of Names. (n.d.-a). <https://wheelofnames.com/>.

Monica, Signal Hill, Temple, and Walnut. I wanted to collect a randomized sample to try and reflect all of Los Angeles County's regional, and economic differences.

My research hypothesis is that the communities with higher rates of lead contamination in their drinking water are more likely to be lower income, and thus have greater health risks as result. The independent variable in my research is the levels of lead contamination in each of the 10 cities, which will be measured using the cities' annual drinking water quality and consumer confidence reports. I will be measuring and collecting this data from the 2021 reports. My dependent variables are the health effects of lead contamination, which I will be collecting data from California Healthy Places Index (HPI) ranking and drinking water contaminant percentage<sup>53</sup>, and each city's poverty level and the percentage of the population with poor physical health from the U.S. Census Bureau.<sup>54</sup> I will also be collecting data from the Southern California Association of Governments (SCAG) 2021 Local Housing Reports<sup>55</sup>, specifically focusing on each city's percentage of housing constructed before 1979, or before the Safe Drinking Water Act's prohibition of lead in home materials and water fixtures.<sup>56</sup>

The 2021 annual city water reports measure the quantity of lead contamination by parts-per-billion (ppb), with regards to the national lead limit of 15 ppb, and the federalized public health goal set at 0.2 ppb.<sup>57</sup> When collecting this data, I considered any level of lead detected higher than 0.2 ppb to be dangerous, as previously stated, no level of lead consumption is safe, or without irreversible consequences. To conduct lead drinking water tests, the public water agencies collect water samples throughout their districts in order to establish

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<sup>53</sup> *CA Healthy Places Index (HPI)*. Healthy Place Index (HPI). (n.d.). <https://www.healthypacesindex.org/>.

<sup>54</sup> Bureau, U. C. (2023, May 29). Census.gov. <https://www.census.gov/>.

<sup>55</sup> *Local profiles*. Southern California Association of Governments. (2020, November 14). <https://scag.ca.gov/data-tools-local-profiles>.

<sup>56</sup> Environmental Protection Agency. (2023b, April 11). *Overview of Lead Free Requirements of Safe Drinking Water Act*. EPA. <https://www.epa.gov/sdwa/use-lead-free-pipes-fittings-fixtures-solder-and-flux-drinking-water>.

<sup>57</sup> Environmental Protection Agency. (2023a, January 27). *Basic Information about Lead in Drinking Water*. EPA. <https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water#:~:text=EPA%20estimates%20that%20drinking%20water.to%20lead%20from%20drinking%20water>.

their lead contamination findings. These reports are public records, which I located on each cities' public utility webpage. I then collected the lead-level findings into an excel spreadsheet, converting each lead level into the ppb decimal measurement.

To collect data for my dependent variables, I used the California Healthy Places Index (HPI) which ranks each Southern Californian city by health quality, and environmental pollutants, out of 100 percent.<sup>58</sup> The higher the percentage, the better off that city's overall health quality, but the higher the environmental pollutant percentage, the worse off. The second resource I used to collect data on each city's health was the U.S. Census Bureau, which has a section on their website dedicated to poverty levels, and another regarding health.<sup>59</sup> I managed to collect data on each city's poverty level percentage, and the population percentage of individuals with poor physical health, both out of 100 percent. The third resource I used to collect data regarding health quality was through the Southern California Association of Governments' (SCAG) Local Housing Reports, focusing on the year 2021.<sup>60</sup> Through each of the ten cities' reports, I found the percentage of housing per city that had been constructed before 1979. The year 1979 is important to consider in my research because that was the year that the federal Safe Drinking Water Act was passed into law, and prohibited the use of lead in future home and building construction. Cities with a high percentage of housing prior to 1979 would probably have a higher percentage of lead contamination in the drinking water, as the Act prohibited the use of lead in new construction, but did not require existing homes to replace their lead plumbing and water fixtures.<sup>61</sup>

Through my data findings, I plan on comparing the levels of lead contamination by city to the population percentage of poor physical health. I will create a scatter plot diagram to

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<sup>58</sup> *CA Healthy Places Index (HPI)*. Healthy Place Index (HPI). (n.d.). <https://www.healthyplacesindex.org/>.

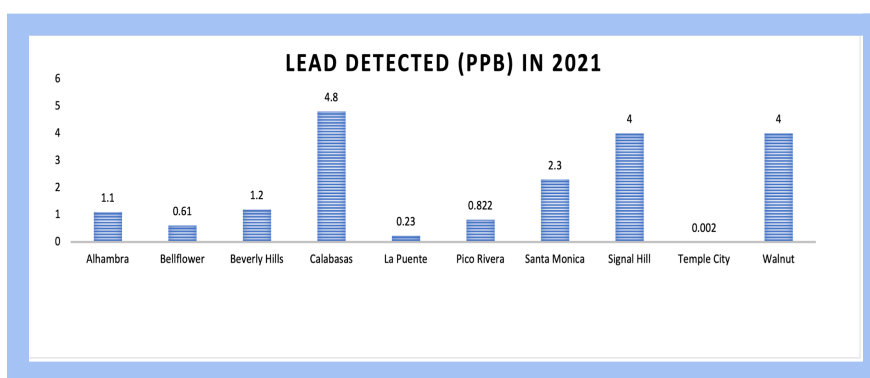
<sup>59</sup> Bureau, U. C. (2023, May 29). Census.gov. <https://www.census.gov/>.

<sup>60</sup> *Local profiles*. Southern California Association of Governments. (2020, November 14). <https://scag.ca.gov/data-tools-local-profiles>.

<sup>61</sup> Environmental Protection Agency. (2023b, April 11). *Overview of Lead Free Requirements of Safe Drinking Water Act*. EPA. <https://www.epa.gov/sdwa/use-lead-free-pipes-fittings-fixtures-solder-and-flux-drinking-water>.

determine if there is a correlation between the two variables. I also plan to analyze the levels of lead contamination and the poverty rate by city, to see if cities with a higher poverty level also have higher levels of lead pollution, which would help support my overall hypothesis. A scatter plot diagram will best depict this relationship, as well. Finally, I will compare my independent variable to the overall sum of my dependent variables, which I will convert the four variables into percentages and add them together. I believe that a bar chart will be best suited to illustrate this data, where I hope to see a direct correlation that strongly supports my hypothesis that lower income communities are more likely to be affected by the negative health effects from lead contaminated drinking water.

### **Findings & Analysis**

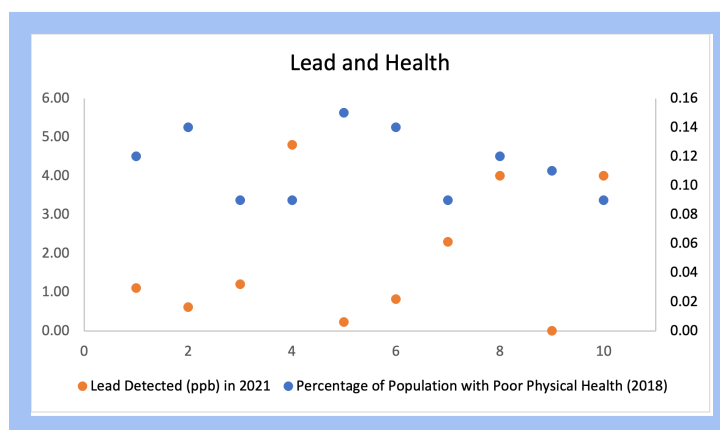


***Figure 1: Levels of Lead per City (2021)***

**Figure 1** above depicts the lead levels per city for the year 2021. Through my analysis and data collection of the 2021 annual city water reports, I found that the city with the highest levels of lead contamination was Calabasas, at 4.8 ppb. While this city was still under the national safety limit of 15 ppb, it did not meet the public health goal (PHG) of 0.2 ppb, which is set by the California Office of Environmental Health Hazard Assessment (OEHHA).<sup>62</sup> The city with the lowest level of lead was Temple City, with just 0.002 ppb of detected contaminants.

<sup>62</sup> Public health goal for lead in drinking water - california office of ... Office of Environmental Health Hazard Assessment. (2009). <https://oehha.ca.gov/media/downloads/water/chemicals/phg/leadfinalphg042409.pdf>

Temple City was the only city out of the ten I analyzed that met both the federal safety limit and the public health goal.



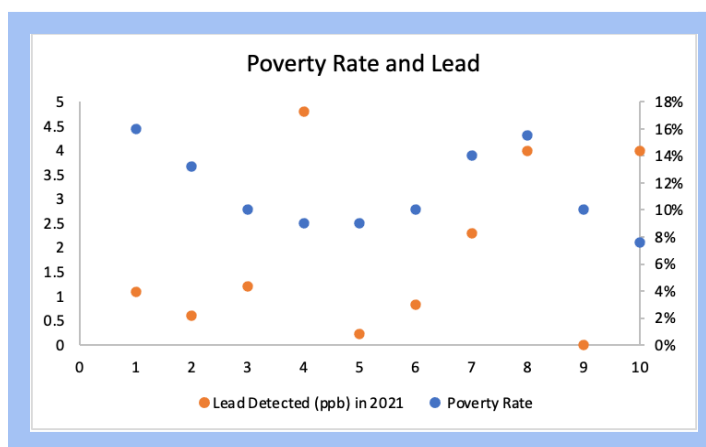
**Figure 2: City Lead Contamination and Poor Physical Health (2021)<sup>63</sup>**

Analyzing my data collection and research materials, I did not find any relationship between my independent and dependent variables strong enough to support my overall hypothesis. I found a weak relationship between the levels of lead contamination in each city, and the percentage of population with poor physical health, as shown in **Figure 2**. There were cities with low lead levels, but a high percentage of poor physical health, and vice versa. The city with the highest level of lead was found to be Calabasas, at 4.8 ppb, but with only 9 percent of the population experiencing poor physical health. The city with the greatest percentage of poor physical health was La Puente, which only had 0.23 ppb of lead detected in the drinking water.

There may be confounding variables to consider that affect this research outcome, such as underlying health risks or effects. Other variables to consider include water contaminants besides lead, such as copper, another key material used in plumbing and water fixtures, and the city's location; if it is near a river, a dumping ground, factories, or the freeway. All of these

<sup>63</sup>- X-Axis: 10 Cities [in order] (Alhambra, Bellflower, Beverly Hills, Calabasas, La Puente, Pico Rivera, Santa Monica, Signal Hill, Temple, Walnut)  
 - Left Y-Axis: Levels of lead contamination, ppb (2021)  
 - Right Y-Axis: Percentage of Population with Poor Physical Health

variables have the possibility of affecting the outcomes of this research, and may or may not help to support the overall hypothesis.



**Figure 3: City Poverty Levels and Lead Contamination (2021)<sup>64</sup>**

There was also no correlation between the poverty percentage levels of each city, or the lead contamination levels. This data collection, as shown in **Figure 3**, did reveal that four of the cities I analyzed, Alhambra, Bellflower, Santa Monica, and Signal Hill, all had poverty levels that are higher than the state's 11.7 percent poverty rate, as of 2021.<sup>65</sup> Two of the cities, Santa Monica and Signal Hill, had high levels of lead contamination and high levels of poverty, which suggest a relationship between the two variables. The city with the highest level of contamination was again Calabasas, at 4.8 ppb, but only had a poverty level of 9 percent. The cities with the greatest poverty levels were found to be Alhambra and Signal Hill, both sitting at 16 percent, or 4.3 percent greater than California's statewide 2021 poverty level. Alhambra had detected levels of lead contamination at 1.1 ppb, whereas Signal Hill had 4 ppb of lead detected. This data again presented no correlation between my independent and dependent

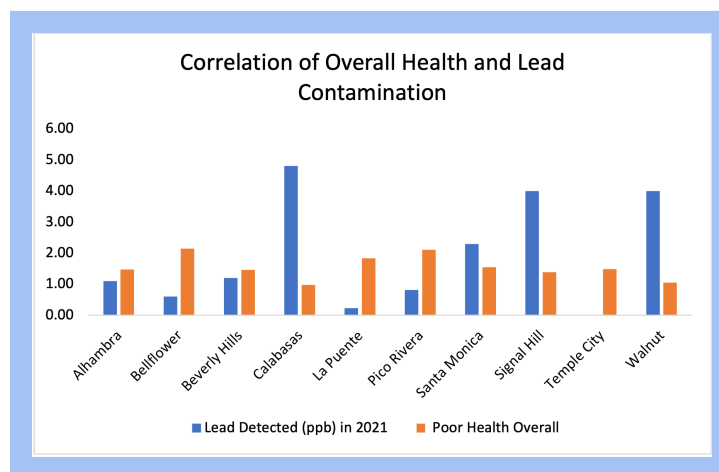
<sup>64</sup>- X-Axis: 10 Cities [in order] (Alhambra, Bellflower, Beverly Hills, Calabasas, La Puente, Pico Rivera, Santa Monica, Signal Hill, Temple, Walnut)

- Left Y-Axis: Levels of Lead Contamination, ppb (2021)

- Right Y-Axis: Poverty Rate Percentage

<sup>65</sup> Person, Danielson, C., Malagon, P., & Bohn, S. (2023, May 25). *Poverty in California*. Public Policy Institute of California. <https://www.ppic.org/publication/poverty-in-california/>.

variables. All 88 cities of L.A. County would need to be analyzed further to see if the randomized cities represent the norm of the correlation between low-income and high lead contamination.



**Figure 4: City Contamination and Overall Health**

Lastly, my comparison of my independent variable, the lead contamination levels, and the sum of my dependent variables, the health effects or factors associated with health effects, did not support my hypothesis. **Figure 4** depicts these data findings above. Two of the cities, Alhambra and Beverly Hills, had roughly the same percentage amounts in both the dependent and independent variables, but the other eight cities did not show a correlation of increased poor health with an increase in lead contamination. The lack of relationship and hypothesis supportance between my variables are great.

Unfortunately, the data shown in my research does not support my research question that inquired if low income individuals are disproportionately affected by lead contamination in the drinking water. Nor does it reinforce my hypothesis that cities with higher levels of lead have higher levels of health risks, and are more likely to be lower income. The research presented does shed light on the fact that 9 out of the 10 cities do not meet the PHG of 0.2 ppb of lead in the drinking water, and perhaps my research will spread this awareness to the cities to improve their quality of water. Finally, further research should be conducted on a broader scale in order to more accurately attempt to answer my hypothesis, taking into account the confounding



variables that might affect my research outcomes, such as other water pollutants, like copper, and underlying health risks or problems. The entire L.A. County would need to be analyzed in order to see if there is a strong enough correlation between the two variables to support my hypothesis.

### **Implications**

Conducting the research and collecting data led me to realize as the researcher how there are such limited resources available to collect data regarding city water reports. I had great difficulty locating these public documents, and some were missing key data components. Other L.A. County cities had public record online requests, which could take many weeks to be processed, while others simply had no resources available online. I would recommend for cities to consistently update and upload their public records, especially those relating to the health and well being of the public, like consumer confidence water reports, to promote awareness and increase accessibility on such topics. Water quality is important, and individuals should have easy and up to date access to data regarding water contamination in their drinking water.

Another implication of this research would be to expand the experiment to include the entire population of L.A. County, not just a randomized sample of cities. Some of the cities I randomly selected were right next to each other, wealthier and had extreme differences in population. Analyzing the entire county would eliminate these research errors, and include a better sample of racial and economic differences, poverty, and community location, to name a few. Some communities may also be located near waste dumping facilities, freeways, or factories, which can contribute to the overall environmental health of that region. I also discovered that cities with high levels of drinking water contamination, but low levels of lead detected in the water supply, might have other water pollutants, like copper, another commonly used material in service lines and plumbing. Accounting for this contaminant in future research studies on L.A. County's water contamination would be helpful to see what other pollutants are potentially affecting the health of lower income communities.

Finally, I came to the realization that although all 10 cities met the federal lead safety levels, 9 of the cities failed to meet the PHG of 0.2 ppb of lead in the drinking water. California should pass legislation that requires its cities and counties to meet this federal public health goal, and set a realistic timeline for doing so. The state could meet the reduced contamination levels by distributing funding through an application process, perhaps having specific qualifications for people to meet, such as having a lower income, acting as a single parent, or having certain health issues that could be related to water contamination. California could also distribute funding to counties to oversee, fund, and incentivize city public works projects to replace lead service lines and plumbing. Reaching these health goals are important, as drinking water is a human right, and is vital for the health of its citizens, and ultimately the success of the state.

### **Conclusion**

This research focused on a small study to determine whether or not cities with high levels of lead contamination in their drinking water also had disproportionate health effects in low income communities. My research demonstrated this is not the case, and there is not a strong enough relationship between my variables to support my hypothesis. There was a lack of evidence to suggest that areas with high poverty levels and a high percentage of homes built prior to 1979 have high levels of lead contamination. Cities that had high levels of lead tracing did not have abnormally low levels of health quality, nor did they have significant percentages of poor physical health in their communities. There were, however, suggestive findings that there are other pollutants contributing to the overall health and water contamination of these communities, that will have to be analyzed in the future. My overall findings did not support my hypothesis. More time to conduct this experiment would allow for a focus on a span of years, not just 2021, and include the entirety of L.A. County, not only a randomized subgroup. More time would also be helpful to delve into the major confounding variables that had the potential to affect my research.

As for the legislature, Assemblymember Holden's bill AB 249 has the potential to reduce the amount of lead contamination in school sites and child care facilities, which would help bring down the levels of lead in the drinking water statewide. If this bill passes, it would benefit many people, especially those residing in older communities with school structures built prior to 1979. Lower income communities would be positively impacted by this legislation, as they tend to live in older neighborhoods, and attend older schools.

Water quality is an important subject that needs to be addressed, as millions of people are harmed by the contaminants they are consuming and exposed to regularly. Lead contamination, however faint the tracings may be, needs to be eradicated from California's drinking water. Lawmakers like Assemblymember Holden are helping build a better future for California's children, and their access to clean, safe drinking water. Future policy needs to continue to combat the issue of water pollution, and future research needs to bring widespread attention, information, and social change to protect all of California's residents.

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