Toxic Play: Addressing CCA-treated Wood Playground Structures in the City of San Francisco, California - an Environmental Justice Issue?

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Abstract Arsenic in chromated copper arsenate (CCA)-treated wood playground structures leaches to the surface of the wood and to the soil beneath it. Because it is a registered human carcinogen, the leaching arsenic poses a health risk to children who spend time on the contaminated playgrounds. The purpose of this study is to examine how this public health issue is being addressed and if certain populations are being exposed to CCA in the City of San Francisco. The study takes into consideration the municipal bureaucracy as well as the demographic features of the city's communities in determining CCA-treated playground usage and renovation patterns. This investigation was accomplished through (1) interviews with city managers about the organizational processes through which these decisions are made and (2) the production of GIS-based maps that combine city demographics and CCA-wood play structure locations. This study attempted to resolve the question of whether an environmental justice issue is at large such that the environmental burden of CCA on playgrounds is disproportionately distributed throughout San Francisco. This study found San Francisco to have a management program in place that is collaborative between departments. The ratios of CCA-treated play structures to non-CCA-treated play structures in Asian, African-American, Latino, and White communities to be inconclusive, while the ratios significantly decreased when measured against increasing median family income. This study concludes that the availability of funding outweighs scientific assessment and community involvement when considering CCA-treated playground removal and replacement, and is a major factor that influences the remediation actions that can be carried out by city management.

Introduction

Results from several studies suggest that children are at risk of inorganic arsenic exposure from wooden play structures treated with chromated copper arsenate (CCA) (Dube et al. 2004, Hemond et al. 2004, Kwon et al. 2004). CCA is a chemical mixture that consists of chromic acid (CrO_3), copper oxide (CuO), and arsenic acid (As_2O_5). It is a registered pesticide in the United States and has been used as a wood preservative for the past 60 years to weatherproof wood and prevent decay from insects and mold (U.S. DHHS 2000, Hingston et al. 2001, Dube et al. 2004,). Because CCA treatment has proven to be effective in making wood more durable over time, CCA-treated wood (also known as pressure-treated) has been the primary building material used to construct outdoor structures, especially for recreational facilities such as playgrounds (Dolesh 2004). It has been found, however, that arsenic from the CCA compound leaches to the surface of and soil beneath the wood over time (Hemond 2004, Townsend et al. 2005). In addition, CCA is a waterborne wood preservative; therefore, precipitation accelerates the leaching of arsenic from outdoor structures made of CCA-treated wood and facilitates transfer (Hager 1969, Lebow 2003, Townsend et al. 2005, Shalat 2006).

The dislodgeable inorganic arsenic from CCA-wood play structures is a notable health concern to children for several reasons. First, arsenic is a registered human carcinogen and is tied to increased risk of cancer as well as causing adverse effects to the gastrointestinal tract and central nervous system (USEPA 2000). Second, a previous study found that children who played on CCA-treated playgrounds had approximately five times more arsenic on their hands than those who played on non-CCA-treated wood structures (Kwon et al. 2004). This poses a problem for children, who are mainly exposed to the arsenic through ingestion due to their frequent hand-mouth activity and consumptive nature (EWG 2001, Kwon et al. 2004, Hemond et al. 2004). Research on children's behavior shows that the younger the child is, the higher the rate of hand-to-mouth contact is (Reed et al. 1999, Tulve et al. 2002). Furthermore, children's bodies are still developing and are less able than those of adults to metabolize arsenic through methylation, a process that converts the arsenic into a less toxic form (NRC 1999, EWG 2001).

Due to these rising health concerns, the pesticide industry voluntarily agreed to stop using CCA to treat wood in residential settings, including play-structures, in 2002. The agreement prohibited the use of CCA-treated wood in residential areas by December 31, 2003 (EPA 2003). The promulgation of this rule encouraged municipalities to replace playground equipment with alternatives, such as naturally resistant wood, metals, or plastics, or to use sealants every two years to temporarily lock in the arsenic. However, arsenic exposure to children from CCA-treated wood playground and from the surrounding contaminated soil continue due to the natural resistance to biological deterioration of CCA-treated wood and the high cost of replacement by non-arsenic alternatives (Shalat 2006).

The concerns over CCA-treated wood in playgrounds and children's health are not limited to the United States. To create a guideline for exposure reduction and risk management, researchers in Canada tested over 200 wooden play structures in the City of Toronto for arsenic levels by sampling soil and wood surfaces (Ursitti et al. 2004). This Canadian study identified play structures that posed a significant risk to arsenic exposure to thereby enable remediation efforts. The researchers suggested the following remediation options in order of increasing cost: sealing on a regular basis, replacement of soil below the play structure, and accelerated replacement with an arsenic-free structure (Ursitti et al. 2004). Similarly, the City of San Francisco has developed a management program to replace or seal CCA-containing playground structures in response to concerns about CCA-treated wood playgrounds.

Although several studies have been conducted to quantify children's exposure to arsenic from CCA-treated wood playgrounds, and health and risk assessments have developed, there is no study that looks into the influences that societal factors may play in the role of renovating CCA-treated wood playgrounds. The purpose of this project is to fill this gap by conducting a case-study on the City of San Francisco, California. Previous research has shown that environmental justice[1] plays a role in the distribution of environmental risks based on socio-economic status and ethnicity (Evans 2004, Brulle 2006). My study adopts an environmental justice lens to consider whether the environmental burden of CCA-treated wood play structures is disproportionately distributed throughout San Francisco.

The objectives of this study were (1) to investigate how the public health issue of arsenic exposure from CCA-treated wood playgrounds is being addressed by the City of San Francisco and (2) if certain populations are more likely to see CCA-treated wood playgrounds in their communities.

[1] The US Environmental Protection Agency defines environmental justice as, "[the] fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. It [is] achieved when everyone

Methods

The methodology in carrying out this study was three-folded. The first part called for the need to identify a study site as a case study. The second called for the need to conduct interviews with city managers who play major roles in addressing their city's CCA-treated playground issue. The purpose of the interviews was to determine the factors that are involved in the decision making and bureaucratic processes in replacing or sealing the contaminated playgrounds, as well as the structural organization of the management program. The third called for the production of geographic information system (GIS)-based maps to spatially analyze the distribution patterns of present CCA-treated play structures and the demographic features of the communities they serve. The rationale for utilizing GIS in this study stems from its popular use as a tool in Environmental Justice research due to its ability to depict demographic information on a map (Sheppard 1999, Dolinoy 2004, Johnson 2004, Maclachlan 2005, Fisher 2005).

Study Site San Francisco[2] was chosen as the study site because of the accessibility of the city managers and information on the City's CCA-treated wood play structures. San Francisco is also culturally diverse, making the City a suitable study site to investigate potential environmental justice issues. Figure 1 depicts San Francisco's major ethnic populations. About 50% of the population is white, 31% Asian, 14 % Latino, and 8% Black. In addition, the City contains progressive municipalities with a Pressure-Treated Lumber Management Program in place to address health concerns related to CCA-treated wood. Many of the wood play structures in the City have been replaced with metal or plastic materials, but 85 wood play structures still remain, 29 of which contain CCA (SFRPD 2005). To prevent arsenic leaching, these structures are being sealed every two years, until funding becomes available to replace all wood play structures. In addition, the city pays attention to the recommendations made by the state, the Consumer Product Safety Commission, and the United States Environmental Protection Agency, and also stopped purchasing CCA-treated wood products in 1992 (SFRPD 2005). Much of the research was focused on the Recreation and Parks Department website, where information on the City's public parks could be found as well as the contact information for the department managers.

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enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work." (EPA 2003)

[2] The City of San Francisco does not include the City of South San Francisco

Interviews To explain how bureaucratic processes address the issue of CCA-treated playgrounds, and potentially contribute to differential playground treatment, I collected data on the decision making inputs and programs that govern the replacement or sealing of CCA-treated wood in playgrounds. To collect these data, I conducted interviews with city officials who manage CCA-treated wooden play structures maintenance and replacement. I chose city officials based on data from the City's website or through referral, and requested interviews with them via email or phone. Each interview lasted between 30 and 60 minutes. The interviews were held in the city officials' offices and were recorded using an audio recording device.

City of San Francisco

Total population: 776, 733
Geographic size: 47 mi²
Median Household Income: $55,221

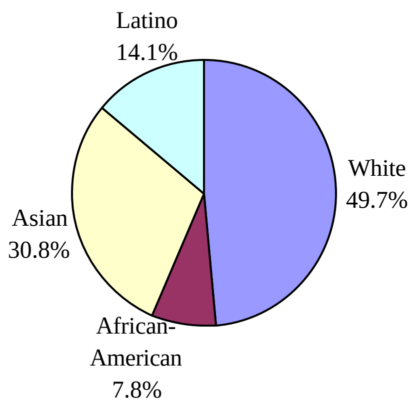

Figure 1. Demographic and geographic profile of San Francisco (Census 2000)

I reviewed the responses from these interviews to compile data on the decision inputs that managers emphasized, as well as the coordination channels and challenges that decision makers faced in reducing arsenic exposure. These data provide a basis for how the issue of CCA-treated wood play structures was addressed and for determining the extent to which community characteristics and use patterns are taken into account and how these patterns related to characteristics of the municipal bureaucracy.

Geographic Information System GIS-mapping was used to spatially analyze the distribution patterns of CCA-treated play structures that are currently in use and the communities the playgrounds serve. A list of 77 wood playgrounds that were tested for arsenic residues was available on the Recreation and Parks Department website as well as the list of the 29 CCA-treated wood playgrounds that are being sealed every two years. The locations of these playgrounds were obtained from the Recreation and Parks Department's "Facility Search" website and general internet search engines. The addresses or street intersections of the playgrounds were then converted into longitude and latitude coordinates. Using ArcGIS software, the longitude and latitude coordinates of the tested playgrounds were plotted as points against a street map of San Francisco. Two different colors symbolized a CCA-treated wood play structure (red) or non-CCA-treated wood play structure (blue). Using this version as a template, I created two different sets of maps: (1) involving median family income data and (2) involving data on the heaviest population densities for the major ethnic groups. Census 2000 data sets of San Franciscan demographic information consisting of the median family income and the population densities of White, Asian, Latino, and Black ethnic groups was retrieved as block data from the American FactFinder website, which is affiliated with the U.S. Census Bureau. Each set of data was extrapolated and uploaded into ArcGIS so that it became a layer of information based on defined blocks of San Francisco. Thus, I created two maps, each with a different demographic layer of data on a map of San Francisco with the points representing locations of the tested play structures.

These maps created a visual to analyze patterns of the distribution of CCA and non-CCA-treated wood play structures against gradients of major ethnic communities and median family income. I counted the number of playgrounds that are located in each major ethnic community and income block to determine how many play structures of each category was located in an ethnic community and income block. The structures that are located on the boundaries of ethnic communities or income blocks were counted towards both groups that the boundary divided to account for overlap and the structure serving both communities.

Results

Interviews San Francisco has a highly sophisticated Pressure-treated Lumber Management Program involving a joint effort between the Department of the Environment and Recreation & Park Department (figure 2). The Department of the Environment's role in the decision-making process is to assess which kinds of products the city could purchase if CCA-treated wood were banned. The Department of the Environment hired a scientist to conduct a study that researched the chemistry of all wood preservatives to find

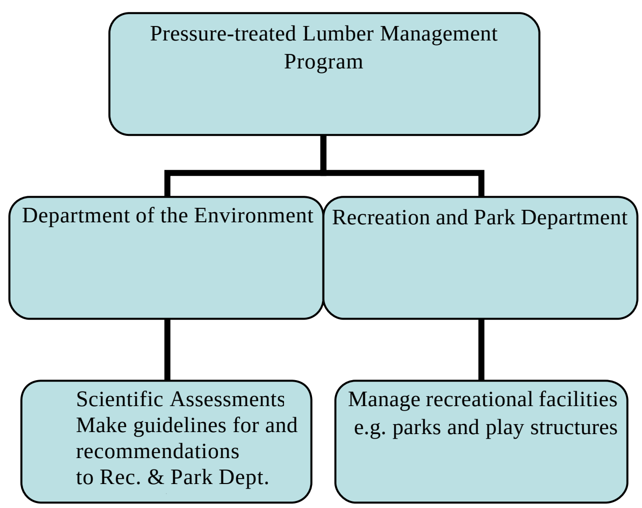

Figure 2. Organizational chart of Pressure-Treated Lumber Management Program

those that minimized harm. From this assessment of alternative wood preservatives, the Department was able to construct guidelines as to which preservative are least harmful and better suited for wood play structures. Although this seems like a potential solution to address the issue of CCA-treated wood playgrounds, the problem is that San Francisco already has play structures made of CCA-treated wood, and due to financial reasons, the city could not and cannot afford to completely remove and replace them. Thus, the Department of the Environment was faced with the decision to either close the contaminated play structures to the public, which is a highly unpopular action, or seal the wood every two years according to state regulations. San Francisco took the approach of temporarily sealing all equipment although this only solves near-term problems. As a result, the Department of the Environment assessed which sealant is the best to use by evaluating the various sealants that are available.

In this way, the Department of the Environment was able to share this information with Recreation and Park Department and tell the staff that the best sealant to use is specifically a colored stain. Thus, the role of the Recreation and Park Department, especially the Capital Improvement Division, is to apply the sealants, maintain the sealing schedule, erect signs notifying the public of the presence of CCA-lumber (figure 3), and conduct wipe tests to measure the levels of arsenic leaching and track the effectiveness of the sealants over time. A source from the Department of the Environment indicated that based on the results of the wipe tests and the physical condition of the play structure, the Recreation and Park Department prioritizes the structures' replacement schedules. For example, the older, splintering, and chipping wood play structures treated with CCA have already been replaced due to their poor condition and impossibility in sealing them. Furthermore, the remaining CCA structures may be high in arsenic, but are relatively in good shape; these are the structures that the San Francisco has on the agenda

to replace, but are sealing for the time being. A source from the Recreation and Park Department said that regardless of the results of the wipe test – high or low arsenic levels – all of the play structures are managed the same, but the prioritization of which gets replaced first depends heavily on the physical condition

Figure 3. A warning sign put up by the San Francisco Recreation and Parks Department at Washington Square Park

of the play structure. It just so happened that some of the older structures were contaminated with CCA.

Both funding and community involvement were indicated as major factors influencing the removal of play structures. According to sources, how vocal a community is may instigate political pressure to seal the structures more often, or prioritize the playgrounds higher up in the political agenda[CW1]. For example, the community is involved in organizing criteria to prioritize the play structures. Health tends to be one such criterion, thereby potentially influencing faster remediation efforts to take place on certain CCA-treated wood play structures. In addition, the replacement of play structures is money driven with ancillary costs, American Disability Act requirements, and other health and safety requirements easily costing $800,000. One source indicated that such money is hard to come by, especially when the equitable distribution of funds is a political issue.

Geographic Information System Figure 4 depicts the location of 77 tested wood playgrounds in the major ethnic communities of San Francisco, including those that contain CCA and are being sealed. 2.6% of the play structures in the Latino communities are CCA-treated and 6.5% of the play structures are not. 3.9% of the structures in the African-American communities are treated with CCA and 9.1% are not. In the Asian communities, the number of CCA and non-CCA-treated wood structures were close with 15.6% and 16.9%, respectively. In the White communities, 19.5% of the structures are CCA-treated and 44.2% are not (figure 6).

Figure 5 depicts the locations of the same 77 tested playgrounds in relation to median family income. Here, 13% of the play structures in the low-tier of median family income are treated with CCA, while 18.2% are not. In the middle-tier, 24.7% are CCA-treated and 37.7% are not. In the high-income tier, 2.6% of the play structures are CCA-treated and 15.6% are not.

Discussion

The responses from the interviews indicate that the management and renovation of CCA-treated wood playgrounds are very strategically organized such that the actions that are taken to replace or seal the structures depends on scientific assessment of arsenic levels and the physical condition of the structures. However, through discussion with interview participants, it is also evident that several loopholes exist regarding politics, such as funding allocation and the amount of political influence certain communities may have over the matter. While scientific assessment determines what actions need to be taken, community involvement and funding availability determine the level of action that is taken as well as the location of where remediation can be carried out.

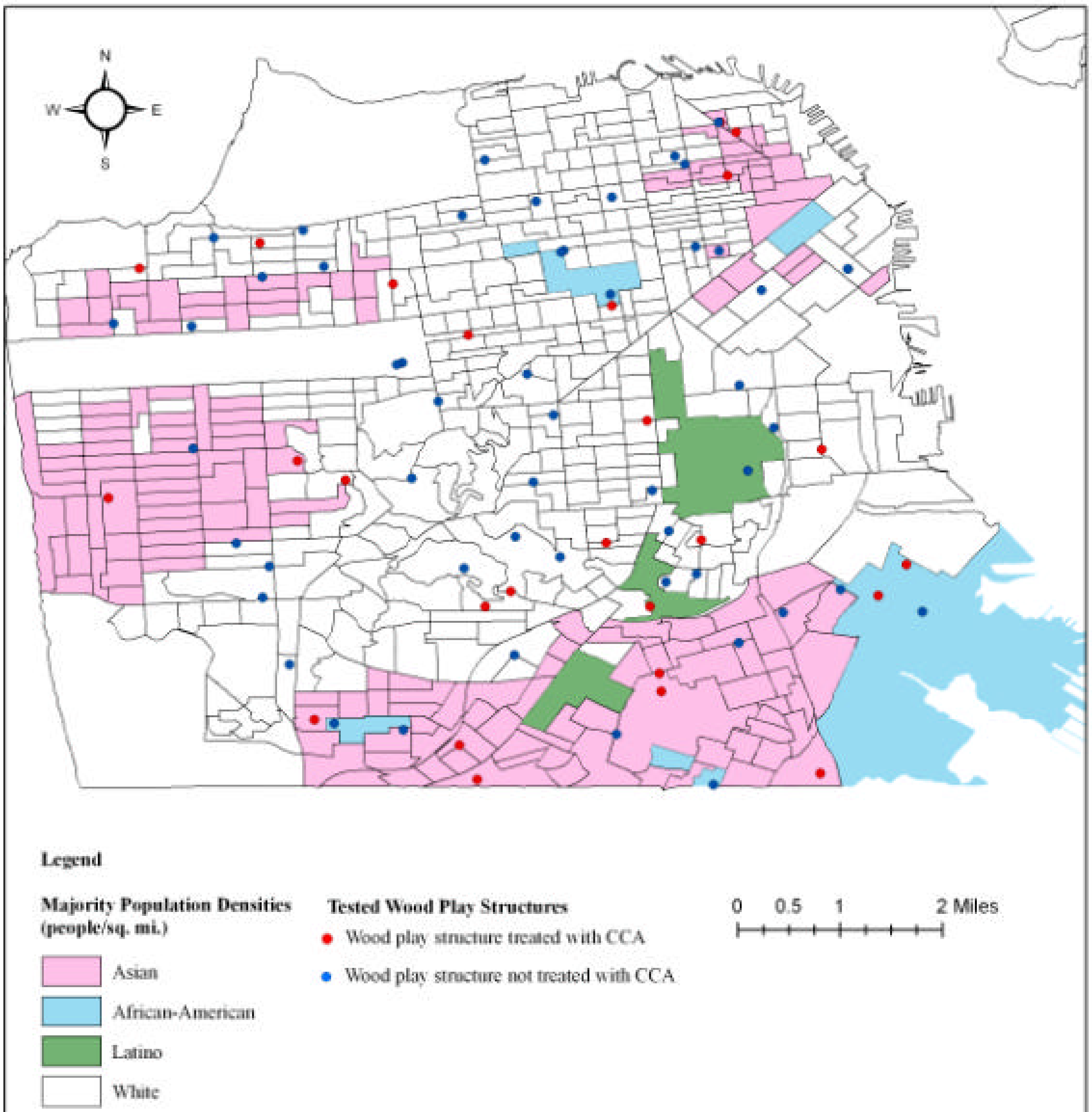

Figure 4. Map of major ethnic communities and playground locations

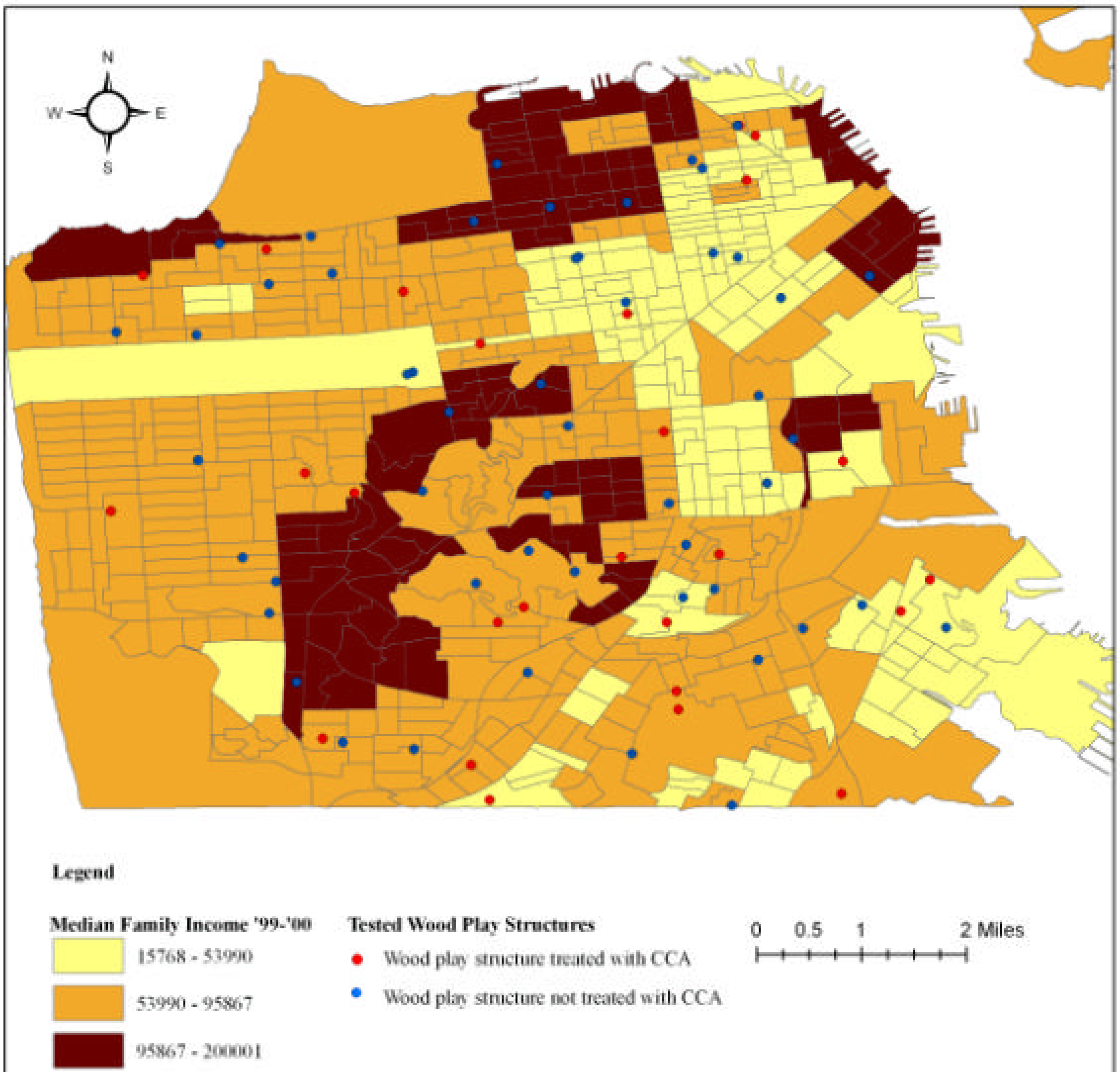

Figure 5. Map of median family income (based on natural breaks) and playground locations.

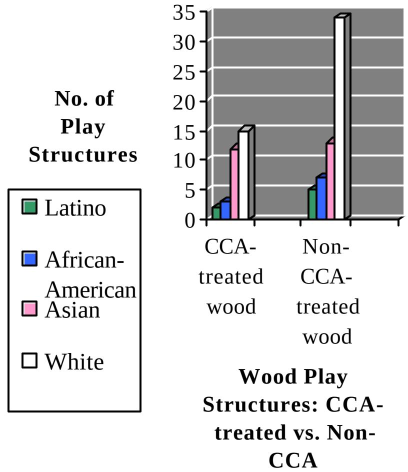

Figure 6. Number of play structures that are CCA-treated and non-CCA-treated in major ethnic communities.

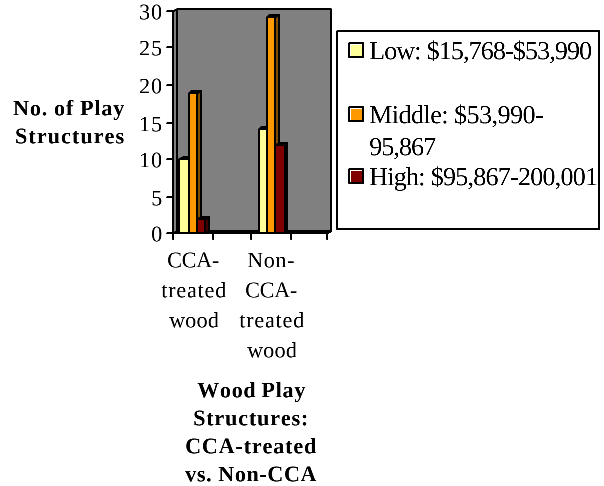

Figure 7: Number of play structures that are CCA-treated and non-CCA-treated in major median family income strata.

In addition, interdepartmental knowledge and collaboration between the departments that are involved in the Pressure-treated Lumber Management program is highly structured and compartmentalized. As a result of the separation in their roles in addressing the issue of CCA-treated playgrounds, there is no overlap of each department's work. Each department focuses on a certain aspect of addressing the issue and does not go beyond what they are called to do, which is most likely due to limitations resources and time that are specific to each department. The Department of the Environment is more policy oriented on the issue of CCA-treated wood play structures in that they research literature and hire specialists to perform scientific assessments to be able to communicate to the Board of Supervisors and to the Recreation and Park Department the situation at hand and recommend actions that need to be taken. In this way, the Department of the Environment is an informant. The Recreation and Park Department takes the advice of the Department of the Environment and carries out the actions that are recommended and put into effect by city and state regulations. Consequently, as the Recreation and Park Department attempts to carry out remediation efforts (playground replacement and/or sealing), they are directly involved with issues of funding and community involvement, unlike the Department of the Environment.

The GIS-maps illustrate the distribution of tested play structures in San Francisco in relation to major ethnic communities and median family income. The results of the number of play structures found in each ethnic community and income strata heavily depended on the size of these areas. That is, the larger the areas the communities resided in, the more parks and play structures that are likely to be located in that community. In addition, there are fewer CCA-treated wood play structures than wood play structures over all (29 CCA-treated wood structures versus 48 non-CCA-treated wood structures), proving reason to why the number of CCA-treated play structures found in communities are significantly lower than for those that are not treated with CCA. In addition, the ratios between the number of play structures treated with CCA and those not treated is the highest for the Asian community (0.92), contrasting the ratios for the other communities that all range from 0.40 to 0.44 (table 1). Because the ratios in the Latino and African-American communities are so close in range to that of the White community this information does not seem to reveal a unique distribution pattern of contaminated play structures strictly based on ethnicity. However, the results of the playground locations relative to income are more conclusive. The ratios of the number of play structures treated with CCA and those not treated with CCA in each income group is significant in that there is an observable pattern of distribution of playgrounds in each income strata. As expected, the ratios manifest a decreasing trend in the number of CCA-treated playgrounds relative to non CCA-treated playgrounds according to increasing median family income (table 2). It is interesting to note the wide gap between the ratios of the middle and high income groups. This illustrates the valuable role that funding allocation plays in renovating arsenic contaminated play structures, and how higher income areas my have more resources to be able to remove and replace play structures high in leaching arsenic.

Table 1. Ratios of the number of playgrounds treated with CCA and those not treated with CCA in major ethnic communities.

Major Ethnic Community	CCA: non-CCA
Asian	0.92
African-American	0.43
Latino	0.40
White	0.44

Table 2. Ratios of the number of playground treated with CCA and those not treated with CCA in income blocks.

Median Family Income	CCA: non-CCA
Low: $15,768-53,990	0.71
Middle: $53,990-95,867	0.66
High: $95,867-2000,001	0.17

These results manifest that it is not a matter of biases within the management program that cause differential treatment or skewed patterns of arsenic contaminated playground distribution, but one that involves money and politics. This study sheds light on the strong influences that politics and funding play in renovating contaminated play structures and the situation of low-income communities who have less political power to put their local playgrounds on top of the City's list of priorities and less funding allocated to the needs of their local public parks.

Due to the limitations of this study, it would be beneficial for future studies to do more extensive GIS work to perform spatial analysis in depth, and run statistical tests to assess if the results are statistically significant. It would also be useful for future studies to focus on a temporal analysis of the renovation of CCA-treated play structures in accordance with socio-economic factors to study whether increased funding also significantly expedites the process and schedule in which such play structures are renovated.

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