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Research Article

Engaging Vietnamese American Communities in California in Environmental Health and Awareness

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Abstract

Vietnamese immigrants tend to cluster in targeted geographic areas and occupations with resulting disproportionate exposure opportunities to hazardous environmental chemicals and neighborhood stressors; yet there is little research on environmental health in this population. Vietnamese communities in Alameda, Marin, Santa Clara, and Orange counties in California conducted community mapping audits (i.e., collecting air-contaminant data, observational survey information, and photovoice documentation) in neighborhoods where they live, work, and play. This paper describes the community-based participatory research process that helped to raise awareness about the environment for participating communities, and looks at how community engagement can lead to action for change.

Introduction

The Asian American and Pacific Islander (AAPI) population has typically been stereotyped as a “model minority” with few socioeconomic and health disparities (Pew Research Center, 2012), ignoring its tremendous diversity and complexity. There has been little documentation of the disparities in environmental hazards faced by the many different AAPI communities. The environmental justice movement emerged in the 1980s in response to *environmental racism*, a term that reflects the notion that there are race-based differential exposures to environmental hazards. In the seminal report *Toxic Wastes and Race*, which sparked public awareness of the fact that communities of color bear a disproportionate

burden of exposure to toxic waste, it was reported that 50 percent of AAPIs were living in communities with one or more abandoned or uncontrolled toxic waste sites (United Church of Christ Commission for Racial Justice, 1987). The fact that there have been so few strides in research to further document how AAPI communities face many of the same hazards that other communities of color and low-income communities face speaks to the invisibility of the AAPI population and its health needs.

There has been some research, albeit very limited, documenting disproportionate environmental exposures for some AAPI groups. AAPI communities have been shown to be more likely to live near toxic waste sites (Hipp and Lakon, 2010; Lee, 1992; Scorecard, 2011), eat contaminated fish (Silver et al., 2007), and live in high-traffic areas (Liou and Hirota, 2005; Morello-Frosch et al., 2002) than non-Hispanic whites. The problem of AAPI invisibility persists both in terms of the environmental disparities these communities face and their contributions to the environmental justice movement (Sze, 2004).

While communities of color face disparate exposure to environmental toxins, affected communities have also used grassroots leadership to address these health disparities. In 1994, the UNOCAL oil refinery gas leak in Contra Costa County, California, left residents frustrated by the lack of information about what was in the air they were breathing. A low-cost bucket-based air-sampling device was developed by Communities for a Better Environment, environmental engineers, and residents of Contra Costa County to collect air samples to test for pollution around oil refineries and industrial areas within the county. The air-sampling buckets became a research tool for the "Bucket Brigade" to negotiate with government and industries to take control of their environment in the "Take Back Your Air" initiative, resulting in the government's present-day monitoring of Contra Costa refineries for environmental toxic release (Global Community Monitor, 2012). Similar efforts emerged in Louisiana where residents used the air-sampling buckets to collect air samples released by some fifty-three industrial facilities located in their community in 1998 (Louisiana Bucket Brigade, 2012). Across the nation, affected communities have and continue to use grassroots-based action to monitor, advance, and achieve environmental health.

There have been a few AAPI organizing efforts to draw more attention to the AAPI population's contributions to the environ-

mental justice movement. The Laotian Organizing Project of the Asian Pacific Environmental Network organized against the expansion of a Chevron refinery and for more accountability on toxic release warnings to the diverse, multiethnic, and predominantly low-income population in Richmond, California (Tai, 1999). In New Orleans, a small Vietnamese community protested the city for situating a landfill for Hurricane Katrina toxic debris less than two miles away from their community without an environmental impact study (Chiang, 2010). These two examples highlight admirable community organizing efforts by affected Southeast Asian communities in holding commercial manufacturers, policy decision makers, and regulators accountable for environmental racism and injustice.

The AAPI communities may face unknown environmental stressors that go unrecognized because they occur under the radar of scientists, regulators, manufacturers, and local communities. There are environmental exposures subtle enough not to set off any signals to residents, yet pronounced enough to subject residents to chronic exposures without knowledge or awareness of these hazards and their potential health impacts. Our environmental research study was not instigated by apparent or even suspected environmental disparities; our primary reason was to provide tools to community members to be able to monitor the neighborhoods where they live, work, and play and to create opportunities for increased community awareness of environmental hazards. It is on this premise that we conducted a research study with the Vietnamese communities in California to learn from residents how to identify nuances that may not always be captured in existing environmental monitoring, and whether increased awareness around environmental health in areas where they work, live, and play can promote actions to address ongoing and subtle environmental racism and move toward environmental justice.

The purpose of the study was to identify and characterize neighborhood-level environmental hazards in this new immigrant community to inform efforts for addressing health disparities. This work was built on our existing community-based participatory research (CBPR) initiative that looked at health risks from chemical exposures in the nail salon industry, an industry dominated in California by Vietnamese immigrant workers (Quach et al., 2008, 2010, 2011; Roelofs et al., 2008). Since 2005, the California Healthy Nail Salon Collaborative has worked to address health and safety

concerns in the salon community through an integrated approach using research, policy advocacy, and community outreach/leadership development strategies. This environmental study was part of the organization's overarching work to further build leadership, experience, and trust with this affected population (California Healthy Nail Salon Collaborative, 2010). In our prior work, we have noted that nail salon workers and owners may be willing to "sacrifice" their health for the sake of livelihood and to support their family, yet they are less willing to compromise the health of their family and community. Thus there was a need to expand our environmental health work to go beyond the individual level and to reframe the issue at family and community levels. By expanding the research from workplace exposures to include larger environmental exposure in neighborhoods where they live, work, and play, we were respecting cultural values that emphasize collective over individual well-being, and broadening the community's understanding of environmental health to include diverse and different tiers of environments.

Background

The Vietnamese population is the fourth largest among the Asian population groups in the United States, estimated to be more than 1.5 million nationwide (U.S. Census Bureau, 2011). This is a fairly recent immigrant group that arrived in great mass following the end of the Vietnam War in 1975. As refugees, many Vietnamese immigrants arrived unprepared for their new environment, with few resources, and faced significant financial obstacles and sociocultural barriers.

Vietnamese immigrants tend to cluster in targeted geographic areas and occupations with resulting disproportionate exposure opportunities to hazardous environmental chemicals and neighborhood stressors. The largest Vietnamese population is in California, with San Jose, Garden Grove, and Westminster ranking among the top ten cities (U.S. Census Bureau, 2011). There have been historic environmental concerns in all of these areas: Santa Clara County, which includes San Jose, has the most Superfund sites of any county in the entire United States (Scorecard, 2011) while Orange County, which includes Garden Grove and Westminster, has been shown to be an area susceptible to increased lead paint degradation (Cohan et al., 2009) and other air-quality issues. As a group with linguistic and

cultural isolation and a distinctly different immigration experience and health profile than other Asian groups in the United States, the Vietnamese population has been understudied for health risks associated with environmental exposures. Thus a fuller understanding of the complex factors underlying the health disparities experienced by this immigrant population is needed to effectively address these growing public health problems.

Objectives

The objective of this project was to engage Vietnamese community members in California in research that would help to identify and characterize environmental hazards in neighborhoods where they live, work, and play, taking into account how these communities may frame environmental issues differently than other racial populations because of varying cultural interpretations, experience, and values (Sze, 2004). We convened training sessions for community members to prepare them for conducting community audits and environmental monitoring in their neighborhoods. Using a community organizing (Rothman, 2001) and CBPR approach (Israel et al., 1998), the study relied upon the participation and perspectives of Vietnamese community members to identify and prioritize elements of their community that potentially impact their health. Our guiding research question was: Does raising community awareness and consciousness through community engagement (especially in data collection) lead to action toward environmental justice? This paper focuses on the process of community engagement and offers insights into how our community research team evaluated the process against the principles of CBPR to demonstrate increased environmental health awareness among participants (Viswanathan et al., 2004). The process and data collected represent new information on environmental health issues and perspectives on environmental health from Vietnamese communities in California.

Methods

Vietnamese community members in four regions in California—Alameda, Marin, Santa Clara, and Orange counties—were recruited for this research study. These regions were selected because there is a sizeable Vietnamese community in each region based on census data and information from community agencies working in these areas. In each locale, community-based organizations that

have working relationships with the Vietnamese community were invited as partners to facilitate these community dialogues.

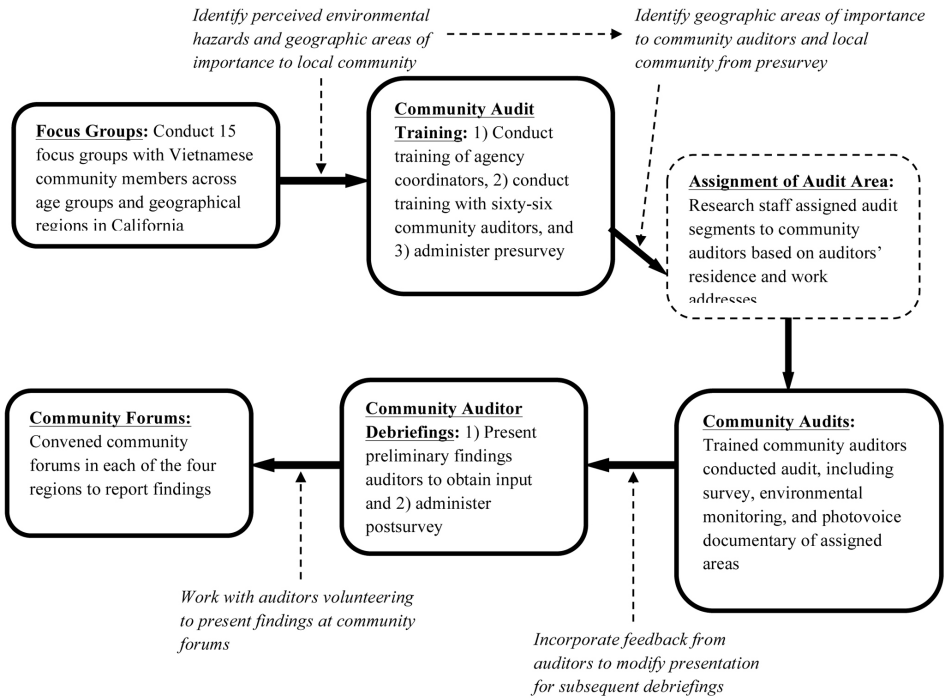
This CBPR project proceeded in multiple phases (shown in Figure 1). The first phase in the project was a qualitative assessment to identify environmental health issues in these Vietnamese communities. Sixteen focus groups were conducted with men and women living in these areas to identify community interest in environmental health and to identify the environmental issues and concerns of community members. The focus groups were stratified by general age categories (young adults, adults, and seniors) and regions. Findings from the focus group sessions led to the development of a training program involving local residents to characterize potential environmental issues in their neighborhoods.

In the second phase of the study, a training program was developed that engaged community participation in collecting data on environmental issues identified in the focus groups. The training used a community audit process, with the survey component adapted from an existing audit tool (Prevention Research Centers Healthy Aging Research Network, 2009). Included in the audit was the photovoice method (Wang and Burris, 1997), a camera for taking pictures of environmental features during the audit, a global positioning system (GPS) device, and a black carbon (BC) monitor to measure airborne components of incomplete combustion. The audit process was pilot tested with three community members to ensure community input in the final audit instrument.

Organizations in each of the four regions held separate trainings with a total of sixty-six participants between September 2010 and February 2011. To build upon our ongoing work on nail salon worker health and safety, community-based organizations recruited Vietnamese community members who were working in nail salons or had family members working in this sector to become community audit participants (referred to as community auditors).

Auditors were trained in Vietnamese by staff from the Cancer Prevention Institute of California (CPIC) and Asian Health Services. These two organizations have an ongoing community-research collaboration in environmental health. During the six-hour training, participants received a presentation on the purpose of the research study and hands-on practice regarding how to conduct an audit survey, which consisted of completing community audit surveys and recording observations on environmental health condi-

Figure 1: Iterative process of training, data collection, data analysis, and dissemination for community mapping project



tions; conducting photovoice, which documented the observations with photography using a digital camera; operating a GPS device; and carrying BC monitors to assess air quality. The training concluded with a practice audit in the respective local neighborhoods under the guidance of community coordinators and trainers. At the end of the training sessions, participants organized themselves into teams of two to three individuals in which they would be conducting the community audits.

One of the more novel elements of the community audits was the use of a portable real-time monitor for measuring personal exposures to BC, a marker of combustion sources such as diesel engines, biomass, and biofuels (Wallace, 2005). BC is the solid fraction of ultrafine particulate matter with a size of 1.0 micrometers or less ($PM_{1.0}$) that strongly absorbs light and converts energy into heat. As such, it is the second-largest contributor to global warm-

ing after carbon dioxide (U.S. Environmental Protection Agency, 2012). It is formed by incomplete combustion and emitted into the atmosphere as one of the components of airborne particulate matter (LaRosa, Buckley, and Wallace, 2002). BC is a marker for diesel exhaust, which is classified as a known human carcinogen (International Agency for Research on Cancer, 2012). Increased exposure to BC has been associated with increased blood pressure (Delfino et al., 2010; Wilker et al., 2010), acute changes in cardiac outcomes (Baja et al., 2010), and decreased cognition (Power et al., 2011; Suglia et al., 2008). Community auditors carried this real-time personal BC aerosol monitor (microAeth Model AE51, AethLabs), which continuously collects aerosol deposit on a filter strip and interprets light attenuation at 880 nanometer as BC concentration. BC monitors were placed in a belt pack worn by the auditors with the inlet hose extended outside of the pack, drawing air from the area below the breathing zone. Research studies have used these BC monitors for assessing environmental exposures in the air (Delgado-Saborit, 2012; Richmond-Bryant et al., 2009).

A presurvey was administered at the beginning of the community audit training in each region to identify home and work addresses; places of interest for the local community (e.g., temples, shopping centers, and community parks); environmental concerns in the home and work neighborhoods; and participant opinions on how to address these concerns. Based on the geographical information from these presurveys, maps of audit areas were created and assigned for each audit group, with the intention of having auditors conduct audits of their own neighborhoods as well as other neighborhoods of those in their audit group. In total, auditors collected data from 276 audit segments, with each segment being about one city-block long.

Once the data were collected, CPIC staff analyzed the BC measurements and community audit surveys, and compiled the photovoice images with related notes that community auditors recorded with the images they took. Community auditors were then invited to a debriefing session in their respective region. The goals of the debriefing sessions were: 1) to share preliminary findings directly with auditors as a group; 2) to get feedback and promote group dialogue about the audit experiences; 3) to identify challenges encountered during the audits; 4) to identify whether the project changed participant perceptions about the environment;

and 5) to strategize with participants on how to use the data to improve environmental conditions and to best share the results to a larger audience in their regions. Participants were presented with major themes identified from the collected data and photovoice images they had taken, and discussed these results among the group. They were shown specific results from their own region's community audits as well as results from other regions' community audits to get a comparative look at results fared across the four counties. The group discussed plans for a community forum in each region, as well as identified a few community auditors to present the findings at their local community forum. A postsurvey was administered at the end of the debriefing session.

Our sources of information for evaluating changes in community awareness on environmental health through some of the CBPR principles included the pre- and postsurveys, notes taken from the debriefing sessions and the community forums, and personal communication with community auditors. The study was reviewed and approved by the Institutional Review Board of the CPIC.

Results

Presurvey results provided general demographic information about the community auditors. Table 1 details the demographic description of the community auditors. A total of sixty-six Vietnamese community auditors were trained and participated in the community audit process. The vast majority were women (83.3 percent) and nearly all were foreign born (98.5 percent). There was a diverse age range (twenty-two to sixty-nine years of age) with the mean age of forty-eight. Approximately 60 percent had a high school degree or less, with many of them receiving their education in Vietnam. The mean years of U.S. residency were 14.5 and ranged from one to thirty-six years.

Community auditors reported several environmental pollution concerns in the debriefing sessions and in the ample photovoice images taken during the data collection. Littering, including illegal dumping of used furniture and household goods, and graffiti were identified as major environmental concerns. The photovoice images in Figure 2 depict some of the littering and graffiti on the buildings of local businesses, temples, and various sites in the downtown areas that auditors witnessed in their data collec-

Table 1: Characteristics of Participating Community Auditors (n = 66)

| Participant Characteristics (n = 66) | Mean (Range) or No. (%) |
|--|-------------------------|
| County distribution | |
| Alameda County | 14 (21.2%) |
| Marin County | 15 (22.7%) |
| Santa Clara County | 20 (30.3%) |
| Orange County | 17 (25.8%) |
| Age | 48.0 (22.0–69.0) |
| Gender | |
| Male | 11 (16.7%) |
| Female | 55 (83.3%) |
| Birthplace | |
| U.S. born | 1 (0.5%) |
| Not U.S. born | 65 (98.5%) |
| Years of U.S. residency (n = 64) | 14.5 (1.0–36.0) |
| Highest education level | |
| Elementary school | 5 (7.47%) |
| Middle school | 8 (12.12%) |
| Some high school, GED, or high school graduate | 28 (40.9%) |
| Some college/vocational/tech school | 13 (19.7%) |
| College graduate | 8 (12.1%) |
| Missing | 4 (6.1%) |

Figure 2. Photovoice images of littering, graffiti, and idling trucks: 1) furniture littered on the street, 2) graffiti on Duc Vien Buddhist Temple, and 3) large truck in neighborhood.



tion. Auditors from Alameda and Santa Clara counties explained that graffiti and tagging was the communication method between rival gangs to mark their territories. Auditors noted that there were more graffiti and litter in neighborhoods often considered impoverished, racially mixed, and unsafe. In the discussion about graffiti, gangs, and drug-related activities, the communities highlighted neighborhood safety concerns and in doing so were consciously reflecting on the comprehensive definition of *environmental health*. This discussion underscored the fact that environmental issues are multifaceted, involving social, political, and economic factors.

In Orange County, auditors had a similar analysis about social, political, and economic factors impacting environmental health within the community. Auditors shared that Asian Americans, such as Vietnamese Americans, like to live in areas accessible to ethnic businesses, yet those areas also tend to be crowded. Consequently, residents are exposed to automobile exhaust due to high traffic, as depicted in the photovoice images that auditors captured in Figure 2.

Our environmental monitoring results emphasized differences in environmental exposures to BC concentrations when examining them at varying geographic scales. The California statewide mean levels, which are based on a few stationary BC monitors at fixed sites, was $0.737 \mu\text{g}/\text{m}^3$ in 2011 (California Air Resources Board, 2011). However, our community-collected BC concentrations at the regional level were two to three times higher (range: $1.7\text{--}1.9 \mu\text{g}/\text{m}^3$). Additionally, there were select neighborhoods in each of the four regions that were as much as five to ten times higher (range: $4.8\text{--}9.0 \mu\text{g}/\text{m}^3$) than the statewide mean and higher than other neighborhoods. Participants were asked to identify potential sources of the BC for these areas with higher BC measures and any known health conditions of local residents. In these conversations, participants identified race and class as two factors that impact a person's environment and exposures to environmental toxins. In Marin County, the community auditors noted that there were higher levels of BC in neighborhoods within an area they call "the Canal area" relative to other neighborhoods where audits were conducted. Auditors reported that the area had a high number of school buses transporting students from a nearby elementary school, many auto repair and paint shops, used drug syringes scattered along sidewalks nearby, and nondraining sewers. This

area, in an otherwise affluent county, is where a large number of the Vietnamese and Latino community members live and is considered, as one auditor described it, “the worst area for the poor” (Marin County Community Auditors, 2011).

These environmental concerns reported in the debriefing sessions and in the data collection were also captured in the pre- and postsurveys. Table 2 provides a summary of the environmental concerns that participants listed at the time of the presurveys and subsequently at the postsurveys after having participated in the community audit process. Key environmental concerns were air quality, auto repair shops, pollution from factories, litter, and traffic-related pollution. Overall, the vast majority of auditors responded positively in the pre- as well as the postsurveys that they believe the environment can affect human health and that there is something they can do to improve environmental conditions where they live and work. Of the ten respondents who indicated that they do not believe they can improve the environment, half explained that they cannot individually change the environment around them, but that improvements require collective capacity and investment from businesses and residents from the community. Approximately one-third of the respondents considered this research study as a tool to make policy and regulatory recommendations for changes. An equally important postsurvey result was that approximately 75.8 percent of participants reported being more concerned about environmental hazards after participating in the project, conducting the audits, and engaging in the debriefing discussion.

Table 3 provides a more detailed summary of quotes and responses from community auditors in debriefing sessions and is organized into three emergent themes: greater awareness about the environment, collective-based data sharing, and proposed uses of the study findings. We highlight some of these quotes and their relevance to the project in the following text.

Debriefing discussions and postsurvey results all pointed to an increasing sense of pride and community identity that auditors felt as a result of participating in the research. Auditors were shown data results from other counties during the debriefing sessions. The ability to compare their local results within the larger context of the research helped auditors build a regional and collective sense of identity with the other auditors participating in this

Table 2: Environmental Concerns Identified by Community Auditors (n = 66)
by Region from the Pre- and Posttraining Surveys

| Environmental Concerns | Alameda County | | Marin County | | Orange County | | Santa Clara County | |
|------------------------|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|----------------------------------|-----------------------------------|
| | Presurvey No. (%) (n = 13) | Postsurvey No. (%) (n = 12) | Presurvey No. (%) (n = 15) | Postsurvey No. (%) (n = 15) | Presurvey No. (%) (n = 17) | Postsurvey No. (%) (n = 17) | Presurvey No. (%) (n = 20) | Postsurvey No. (%) (n = 17) |
| Air quality | 1 (8) | 2 (17) | 1 (7) | 1 (7) | 1 (6) | 3 (18) | 1 (5) | 1 (6) |
| Auto repair shops | 1 (8) | 2 (17) | 1 (7) | 2 (13) | 3 (18) | 3 (18) | 3 (15) | 6 (35) |
| Chemical factories | 2 (15) | 2 (17) | 1 (7) | 5 (33) | 2 (12) | 3 (18) | 3 (15) | 2 (12) |
| Dry cleaning shops | 0 (0) | 2 (17) | 1 (7) | 0 (0) | 0 (0) | 1 (6) | 2 (10) | 0 (0) |
| Gas stations | 5 (38) | 2 (17) | 1 (7) | 4 (27) | 1 (6) | 0 (0) | 5 (25) | 2 (12) |
| Litter | 4 (31) | 10 (83) | 6 (40) | 6 (40) | 7 (41) | 0 (0) | 7 (35) | 7 (41) |
| Nail salon chemicals | 2 (15) | 0 (0) | 0 (0) | 0 (0) | 2 (12) | 10 (59) | 0 (0) | 0 (0) |
| Neighborhood safety | 0 (0) | 3 (23) | 0 (0) | 0 (0) | 1 (6) | 0 (0) | 0 (0) | 1 (6) |
| Noise | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 2 (12) | 2 (12) | 3 (15) | 2 (12) |
| Secondhand smoke | 0 (0) | 1 (8) | 0 (0) | 3 (20) | 5 (29) | 5 (29) | 1 (5) | 1 (6) |
| Traffic | 5 (38) | 3 (25) | 5 (33) | 7 (47) | 7 (41) | 9 (53) | 10 (50) | 10 (59) |
| Water | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 3 (18) | 2 (12) | 1 (5) | 0 (0) |

Table 3: Quotes from community Auditors During Debriefing Sessions When Presented with the Preliminary Results of Community Audit Data, Including Audit Survey and Black Carbon

| | Greater awareness about the environment | Collective-based data sharing | Proposed uses of the study findings |
|----------------|---|---|--|
| Alameda County | <p>After the audit and taking pictures, I noticed environmental issues more. I feel more responsible about the environment.</p> | <p>With this presentation of all the data, now we can compare the results across the areas. When we do the audit, we only know of the specific audit segments we went to.</p> | <p>I like doing this project because we have collected data to point out areas that need improvement so that the government would know what to do. The data allows the community to have information to give to the city on what needs to be improved upon.</p> |
| Orange County | <p>After doing audit, I notice the environment more. The research helped me to understand my everyday life better.</p> | <p>It's fun to do and I met Vietnamese people who asked about the reason why I was auditing. They liked the research very much.</p> | <p>The government should get trucks that don't release diesel, or limit the times when the trucks can deliver. Invite City Council officials, ethnic media, health departments, doctors and community leaders to the community forum to learn about this research project! We need evidence to show people how to effectively create change.</p> |

| | | | |
|---------------------------|---|---|---|
| <p>Santa Clara County</p> | | <p>It has to be a collective effort to stop graffiti. We need to watch and speak up about this.</p> <p>Whoever attends the community forum should participate in the presentation; even if to only say a few words, to share our experience.</p> | <p>There is a power plant next to a residential area; is there possibility of moving the power plant? Not until doing this program did I become aware of this issue. You should look into this issue for future research.</p> |
| <p>Marin County</p> | <p>The high black carbon rate made me feel concerned that it could affect my health, especially since this is a Vietnamese community.</p> <p>Seeing the results made me feel proud that I was a part of the research team.</p> <p>What I liked the most is that I became aware of things around me upon every step. Before I didn't pay attention to this or that on the street...I learned about the environment and can advise others to take care of the environment, such as not changing oil for the cars at home, especially when it rains, because the oil could get into the streets and then into ocean.</p> | <p>We should have the community forum at a community center, like the one near the Pickleweed Park in the Canal area.</p> <p>The auditing project was useful because it let me know what kind of environment I was living in and what kind of air I was breathing in. Not only did the project improve my knowledge, but it could also help others. I think this would be helpful for others to also know about the results. I am thankful that this project provided me with all this information.</p> | <p>We need good proof before talking to the city officials.</p> <p>The black carbon results might not be wrong because the carbon monitor does the measurement so high carbon results are not necessarily a human error.</p> |

project across the other regions. This local and interregional sense of identity was noticeable in the way auditors affirmed each other within their group as well as how they expressed deep interest and excitement when presented with results from other regions and how each fit into the larger body of research. One auditor from Alameda County commented, “With this presentation of all the data, now we can compare the results across the areas. When we do the audit, we only know of the specific audit segments we went to” (Alameda County Community Auditors, 2011).

In the debriefing sessions, auditors across the four regions expressed pride and empowerment for participating and contributing to the research project. They acknowledged their own collective expertise in environmental health, which they bring as residents and community members, noting the importance of their lived experiences. One auditor from Marin remarked with a great sense of pride, “Seeing the results made me feel proud that I was a part of the research team” (Marin County Community Auditors, 2011).

In some of the counties, in order to examine reliability in the data, community auditors and agency coordinators volunteered to conduct repeated measurements at the same street segments near certain geographic “hot spots” where there were higher measured levels of BC. Several of the auditors took on the task in earnest. Auditors believed that the second round of measurements would improve the reliability of the study and produce higher-quality data, which would be essential before presenting the environmental issue to the city council. These repeated measurements were used in the BC data analyses by averaging the repeated measures to balance out any outliers.

The community forums to share the data results to broader audiences in the respective regions were a key phase that provided an opportunity for auditors to take ownership of the data and the research study. In preparation for the community forums, auditors played an active role in providing feedback and recommendations on best methods to share the results with the community. Auditors suggested “showing these pictures as proofs” and inviting community leaders, city council members, local ethnic media, local health departments, environmental groups, and prominent health practitioners in the community to attend and speak at the forum to attract a wide audience (Santa Clara County Community Auditors, 2011). In each county, several auditors volunteered to share their

auditing experience and copresent the results at the forums. There was a consciousness-raising as these auditors took active roles in the dissemination of the results. The auditors perceived the dissemination of the research as a beneficial and crucial step in improving the environmental conditions in their neighborhood, as reflected in a statement by an auditor from Marin, "The auditing project was useful because it let me know what kind of environment I was living in and what kind of air I was breathing in. Not only did the project improve my knowledge, but it could also help others. I think this would be helpful for others to also know about the results" (Marin County Community Auditors, 2011). Results from the postsurveys showed that 99 percent of the auditors would be willing to participate in this research in the future again. One auditor summed up the experience as, "It's fun to get together and do something good for our community" (Orange County Community Auditors, 2011).

Discussion

The Vietnamese population has been relatively understudied, particularly when it comes to environmental health impacts. This newer immigrant population has been exposed to multiple environmental stressors, both here and in Vietnam (Schechter et al., 1995, 2002, 2003). Like other communities of color, especially immigrant populations, the Vietnamese population has tended to aggregate in select geographic locations, including in Garden Grove, Westminster, and San Jose (U.S. Census Bureau, 2011). In addition, there are small enclaves in other areas, like Marin County, with clusters of Vietnamese people that would not have been evident if we did not have the established relationships with community-based organizations working with these local communities. The Vietnamese communities in these different regions share some common environmental concerns as well as differences in issues that impact them environmentally.

In this paper, we focus on sharing the research study as an intervention to raise awareness and consciousness on environmental hazards within the Vietnamese community so that they can take necessary actions to address ongoing and subtler environmental racism. We evaluated whether the study and the process of community engagement had helped raise awareness on environmental health and measured responses from the community participants using pre- and postsurveys, debriefing session notes, and personal

communications with participants. The study and community engagement process helped raise participant consciousness on environmental health in several ways.

First, community participants reported a heightened sense of awareness of environmental issues. Comments in the debriefing sessions and postsurveys indicated that the firsthand observations and interactive data-collection methods; the study results presented to them during the debriefing session; and the rich debriefing discussion on major themes identified from the collected data, photovoice images, and BC data helped increase participants' knowledge and awareness about environmental health issues in their community. The majority of auditors expressed a higher level of concern about environmental health hazards after participating in the research. What is also worth noting is auditors' acknowledgment of how low-income communities of color are most impacted by environmental health hazards because of the limited choice in where they can live, which is crucial in raising auditors' consciousness about the social structures, political factors, and economic constraints influencing the health outcomes and environmental conditions in which community members live and work.

Empowered by a greater understanding of environmental issues, participants showed concern and responsibility toward the environment in which they live, work, and play. This behavioral change toward their living environment was expressed in the postsurveys that captured participants' personal commitments to advise their peers against littering, sharing the study results and educating others in their community about environmental hazards. The project also created an opportunity for auditors to visit and actively understand the environment of areas in their community that they had not been to before. When auditors were shown data results from other counties during the debriefing sessions, they compared their local results within the larger body of this research. Auditors not only expressed deep interest and excitement in the regional and collective sense of identity with the other auditors participating in this project across the other regions, but auditors also learned environmental health conditions impacting Vietnamese communities across the state through the cross-regional environmental assessment.

Second, auditors felt they gained greater knowledge about the environment through the process of being primary data collec-

tors within their communities. Through the process of collecting BC readings, completing audit surveys, and gathering photo data, they recognized their expertise as community members with lived experiences and knowledge of their neighborhoods, which contributed significantly to better data collection and analysis. When the research results were brought back to auditors in the debriefing sessions and auditors were shown differences in the reporting of environmental hazards within their local areas, auditors were the ones who explained to researchers the sources accounting for the differences in presence of environmental hazards. Auditors were also the ones who identified street intersections for audit segments that showed higher reading of BC and the reasons for those elevation levels. In Marin County, BC readings for the Canal area were high, which did not come as a surprise for auditors in the group who were well aware of the high volume of traffic and auto repair and paint shops in the area. Auditor participation and engagement in data collection and debriefing of results helped provide invaluable lived context for the results, and conversely, these were opportunities for auditors to reflect, share, and learn more about neighborhoods that they frequent.

The data-sharing process emphasized colearning among the research team and study participants, especially in interpreting and understanding the impact of the data on the community, and this is an important value throughout the community engagement that provided opportunities for participants to increase knowledge about the environment. In CBPR, one key factor is multidirectional learning. The different entities in our project, including the research partner, community-based organizations, and community participants, came to the table with different expertise. There was a consensus that all different entities had a wealth of knowledge that needed to be shared. The process was iterative and changes were made during the research project based on what was learned at previous phases. Colearning was a key part of the process, as well as having a process where community involvement was present at all phases in the project. The rich debriefing session with participants provided a contextual background for our data analysis, helped illuminate the possible causes for higher levels of BC for some areas, and offered additional knowledge not available to those who were not familiar with the areas. The knowledge gained from this process has mutual benefit to all partners.

The data-sharing process also illuminated the leadership that had developed within the various groups and their investment in and ownership of the data that were collected. At each of the debriefing session, several participants volunteered to present the data at the community forums. Participants felt that the data provided evidence for and would bring awareness to other community members and policy makers about the need to improve certain areas in their communities at the collective community level and the policy level. This consciousness-raising and call to action was demonstrated by the participants' suggestion to invite local policy makers, community leaders, ethnic media, and other communities of color to the community forum in order to address the environmental concerns in their area. Auditors initiated the process of identifying local legislators and staff from organizations that can assist in regulating environmental health as steps toward taking action to promote social change.

We observed participants taking ownership of the data in the process leading up to the community forum. This theme was reflected in their responses when we presented the preliminary data to the participants during the debriefing session. Participants made comments and actively participated in the discussion, providing critical feedback, such as additional ways to analyze and present the data. Participants also took ownership of the process, as demonstrated in how participants volunteered to redo audit segments and requested for further dissemination of the study findings to their community as well as continuation of the study to expand the covered area and examine health impacts. This ownership of the research process also ties with the overall sense of community building among participants and their desire to expand the scope and reach of the study to better understand environmental health impacts within their community.

To our knowledge, this is the first research study to engage Vietnamese community members to assess environmental stressors in their own neighborhoods using a community mapping approach. As a result, the communities we worked with are more aware of and receptive to environmental justice research, which is an important foundation from which future research efforts can build upon. The purpose of this paper was to describe the research study and community engagement process. The study showed that there was increased knowledge and consciousness-raising around environ-

mental factors (e.g., trash, litter, air quality, and chemicals) in communities. Training and education, through a community-engaged and colearning process, helped to develop ownership of the issues in communities and eliminated barriers that have traditionally stood in the way of community members participating in research. The increased knowledge and consciousness led some individuals to change their own behaviors and to encourage behavior change in others; others felt that they were not able to make individual change but could influence environmental change through a collective process (such as engaging community and political leaders and decision makers). The knowledge and behavior changes that came out of this study speak to the shift in perception about how community members are seen as change makers, and more importantly how community members see themselves as change makers. The study is just the inception of the understanding of how training and education can lead to action for change, especially among a Southeast Asian population in addressing environmental health.

We recognize that the lessons learned and the successes from this study in raising consciousness on environmental health within the Vietnamese communities in these regions are not necessarily generalizable to all other communities and may not replicate exactly in other settings. Nonetheless, the lessons learned and the increased awareness of environmental health that came out of the community empowerment process highlights the value of community-partnered efforts to create and sustain social change. Additionally, we collected information in different forms in order to help our team assess general changes in attitudes and perceptions regarding environmental stressors as well as to provide notes to help guide our team through a very iterative process. The information was not originally collected in order to do a formal CBPR evaluation. Thus the sources of information, especially the meeting notes, were not recorded and transcribed. Instead, they were in the form of summary notes for staff review. However, over the course of the study, the community-based organizations expressed increasing satisfaction with the community-based nature of the study and voiced the need to share our successful process as an example of how CBPR principles can help raise awareness and sense of agency for social change for affected communities. They also relayed the positive messages received from community participants. In fact, the community agency staffs who were intimately

involved in the study took the lead in describing the process of community engagement and the responses from the community participants. This paper is designed to document the overall process in order to contribute to the limited literature on environmental health in this understudied population. In doing so this study offers a model of engaging the community in the research process that can be replicated in similarly underserved communities. It is important to note that Asian Health Services received a grant from the Environmental Protection Agency in 2012-13 to conduct a similar environmental assessment in the Oakland Chinatown area (California). Asian Health Services is using a similar community engagement model to train their patients and community residents to collect data necessary to prevent a freeway expansion and other developments that threaten to increase air pollution and pedestrian safety in neighborhoods of Oakland Chinatown.

There was a group consensus on the success in the community building process: all individuals involved felt they gained something out of the process. Importantly, the interactions and exchanges have built a foundation for further work and engagement of the community in future environmental health studies. Community transformation is not the result of one action, but is a result of a multitude of processes occurring concurrently within a community; as such it takes various efforts such as this to build a swell of momentum to create social change. It is the collective leadership from research partners, community-based organizations, and community residents that drives the momentum for change.

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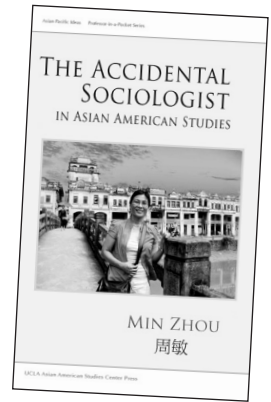
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