



Published in final edited form as:

Health Place. 2014 July ; 28: 31–37. doi:10.1016/j.healthplace.2014.03.004.

Place-Based Stressors Associated with Industry and Air Pollution

Michelle C. Kondo, Ph.D.^a, Carol Ann Gross-Davis, Ph.D.^{b,c}, Katlyn May^d, Lauren O. Davis^f, Tyiesha Johnson^d, Mable Mallard^g, Alice Gabbadon^g, Claudia Sherrod^h, and Charles C. Branas, Ph.D.^h

Michelle C. Kondo: mkondo@mail.med.upenn.edu; Carol Ann Gross-Davis: cg48@drexel.edu; Katlyn May: katlyn.may@duke.edu; Lauren O. Davis: lod25@drexel.edu; Tyiesha Johnson: ttj29@drexel.edu; Claudia Sherrod: clsherrod@sphinc.com; Charles C. Branas: cbranas@mail.med.upenn.edu

^aDepartment of Biostatistics and Epidemiology, Perelman School of Medicine at the University of Pennsylvania, 423 Guardian Drive, Blockley Hall Room 937, Philadelphia, PA 19104-6021 U.S.A. phone: +1-215-746-4028; fax: +1-215-898-0643

^bUnited States Environmental Protection Agency—Region 3, Air Protection Division, 1650 Arch Street Philadelphia, Pa 19103 U.S.A

^cDrexel University, School of Public Health, 1505 Race St., Philadelphia, PA, 19102 U.S.A

^dDuke University, Nicholas School of the Environment, 450 Research Dr, Durham, NC, 27708 U.S.A

^eDrexel University, Department of Chemical & Biological Engineering, 3141 Chestnut St, Philadelphia, PA 19104 U.S.A

^fRight to Know Committee, 1225 S. 26th St, Philadelphia, PA, 19146 U.S.A

^gSouth Philadelphia H.O.M.E.S Inc. & Point Breeze Community Development Coalition, 1444 Point Breeze Ave, Philadelphia, PA 19146 U.S.A

^hDepartment of Biostatistics and Epidemiology, Perelman School of Medicine at the University of Pennsylvania, 423 Guardian Drive, Blockley Hall Room 937, Philadelphia, PA 19104-6021 U.S.A

Abstract

Exposure to air pollution and its sources is increasingly viewed as a psychosocial stress, however its nature is not understood. This article explores the role of the concept of place on risk perception and community stress within data collected from eight focus groups in Philadelphia, USA. Discussions focused on air pollution, a nearby oil refinery, health, and a proposal for air monitoring. We present a framework of place-based elements of risk perception that includes place identity, stigma and social control. Our findings indicate that air pollution contributes to physical and psychosocial conditions that act as community-level social stressors. Findings also suggest that programs which seek to change behaviors and gather or spread information on issues

Correspondence to: Michelle C. Kondo, mkondo@mail.med.upenn.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

such as pollution and other environmental concerns will be challenged unless they directly address: 1) the public's identification with a place or industry, 2) immediate environmental stressors such as abandonment, waste and odors, and 3) public perceptions of lack of social control and fear of displacement.

Keywords

air pollution; place; stigma; psychosocial and community stress; oil refinery

INTRODUCTION

There is an established relationship between air pollution exposure and poor health, including cardiovascular and respiratory disease (Brunekreef and Holgate, 2002; Dockery et al., 1993; Pope et al., 2002). Living or working in close proximity to heavily trafficked roadways or heavy industry has been associated with asthma and respiratory infection (Brauer et al., 2007), lung cancer (Attfield et al., 2012), and low birth weight or pre-term birth (Lin et al., 2001; Yang et al., 2002). Such evidence has been used to inform regulatory strategies on an individual-chemical basis, such as via the United States' Clean Air Act.

There is increasing evidence that communities exposed to higher levels of air pollutants may also be more vulnerable to the effects of this exposure. Environmental hazards are often co-located with non-chemical social stressors such as poverty and violence. These stressors can influence health by triggering negative emotions (such as fear, anxiety or depression), which affect physiological processes such as endocrine and immune systems and increase risk of disease (Cohen et al., 2007). Social stressors have been shown to affect respiratory disease, asthma, cardiovascular disease, cancer, depression, and HIV/AIDS (Astell-Burt et al., 2013; Cohen et al., 2007).

Exposure (to air pollution and its sources) itself can also be interpreted as a psychosocial stress on individuals (Atari et al., 2011; Atari et al., 2013; Bickerstaff and Walker, 2001; Chen et al., 2008; Clougherty et al., 2007; Cutchin et al., 2008; Gee and Takeuchi, 2004; López-Navarro et al., 2013; Luginaah et al., 2010; Luginaah et al., 2002a; Luginaah et al., 2000, 2002b; Shankardass et al., 2009; Yang and Matthews, 2010). Likewise, perceptions of air pollution have been shown to effect disease-status (Gee and Takeuchi, 2004; Piro et al., 2008). Yet exposure and risk assessment tend to focus on single pollutants, exposure pathways and health outcomes, and neglect to characterize or incorporate stress (Sexton, 2012). Many argue that risk assessments and environmental health interventions should be informed by social perceptions and local knowledge regarding pollution and risk (Corburn, 2003; Luginaah et al., 2010).

Risk theory offers a framework by which to understand the socio-cultural nature of air pollution. According to risk theory, Western societies have become increasingly aware and concerned about "modern" technology-based environmental risks (Beck, 1992a; Giddens, 1991). Multiple authors have called for an expansion of this theory to include the 'spatial organization of risk' (Beck, 1992b; Bickerstaff and Simmons, 2009; Giddens, 1991; November, 2004), in which environment and culture, people and places ('context' and

‘composition’) are viewed as contingent rather than distinct and separate (Cupples, 2009; Macintyre et al., 2002). Place indicates the physical aspects of locations as well as the social and emotional meanings tied to them (Tuan, 1977), and is a meaningful concept for risk studies because it underscores the role of space in the formation of identities (Twigger-Ross and Uzzell, 1996), feelings of belonging, defining of social boundaries or conflicts, and in other emotional processes.

Multiple studies have identified concepts tied to place relating to stress or risk perception. Day (2006) adapted a place-based framework developed by Curtis (2004) to explore the air pollution perceptions. Prior to this work, studies of risk perception and stress relating to air pollution have addressed place-based concepts, but only implicitly. In this study we apply three concepts to analyze the role of place in risk perception: place identity, stigma and social control. Place identity refers to the role of an individual’s physical surroundings in their self-identity (Proshansky et al., 1983). Wester-Herber (2004) suggested that place identity is related to risk perception; perceived risks to land and environments will necessarily threaten individuals’ perception of self. Others have demonstrated ways that at-risk environments are incorporated in to individuals’ identities (Atari et al., 2011; Luginaah et al., 2010). Related to place identity is the concept of displacement, which represents unwillful movement from a place, for example via gentrification, and disrupts well-being, community ties and attachments (Newman and Wyly, 2006).

Stigma is a second place-related concept related to risk perception (Wester-Herber, 2004). Negative images associated with places can affect individuals’ perception of self. Multiple studies have found stigma to play an important role in stress associated with living in proximity to industrial facilities or pollution (Atari et al., 2011; Bush et al., 2001). In addition, we investigate the role of social control in risk perception. Social control represents structural social and political hierarchies, often enacted or reproduced in spaces and places (Lefebvre, 1991; Massey, 1993). In the context of environmental hazards, lack of power and agency can act as determinants of risk perception (Bickerstaff, 2004).

This study questions the role of place in risk perception and community stress within analysis of qualitative data collected from eight focus groups conducted with 47 residents of the Point Breeze and Grays Ferry neighborhoods of Philadelphia, USA. These neighborhoods are adjacent to the Philadelphia Refinery, one of the oldest operating urban refineries in the US. The study is preceded by announcements by local officials of plans to begin a local air monitoring effort. Based on our analyses, we present place-based elements of risk perceptions in low-resource communities adjacent to an oil refinery, including: (1) place identity, (2) stigma, and (3) social control. We begin with a description of the project area, collaboration driving this project, methods and results from the study. We then describe how findings can influence public outreach, health interventions and risk assessment.

BACKGROUND

The Philadelphia Refinery began operation in Southwest Philadelphia in 1866 (see Figure 1). Sunoco Inc. purchased this refinery in 1988, and the Carlyle Group obtained partial

ownership in 2012. It currently processes 330,000 barrels of crude oil each day for retail throughout the Northeast Atlantic region of the United States. Approximately 1,000 individuals are employed in refining processes.

This refinery is the largest source of air pollution, by pound, in the greater Philadelphia area. In 2012, the refinery reported 762,000 pounds of chemical releases, which was more than 70 times higher than any other nearby facility. This refinery and other industrial facilities in the U.S. are subject to regulations under the Clean Air Act regarding air toxic releases. According to the Toxics Release Inventory (TRI; a mandatory, self-reporting program affecting certain facilities), the Philadelphia Refinery ranked 23 out of 134 similar facilities in the U.S. for total on-site releases in 2012.

In addition, the refinery has been out of compliance with at least one regulatory requirement (e.g. operating requirements, maximum emission rates or quantities) despite 28 Notice of Violations and \$740,000 in penalties since September of 2000.

There have been concerns about the unfair impact of heavy industrial activities, including oil refining, on nearby neighborhoods in the Philadelphia area. First, environmental hazards are more highly concentrated in communities bordering the Delaware River, which includes our study area (Sicotte, 2010). Second, the refinery is surrounded by vulnerable populations potentially exposed to physical and psychosocial stressors associated with poverty and the physical environment. According to the 2010 Census, of the 45,000 residents living in census tracts within 1.6 kilometers from the refinery (which includes the study area), 29% were white, 59% were black, 8% were Asian, and 4% were Hispanic or Latino. Thirty-two percent of residents live below the federal poverty level, 21% of residents age 25 and older have not graduated from high school and 41% have a high school diploma or equivalent (U.S. Bureau of the Census, 2009). Other studies document the presence and nature of stressors in Philadelphia neighborhoods, such as hazardous waste sites, traffic volume (Yang and Matthews, 2010), vacant properties and lots (Branas et al., 2011).

Third, health risks tend to be greater in areas with a higher percentage of non-white residents, and lower levels of education and income (Sicotte, 2010). The most recent National Air Toxics Assessment, conducted by the U.S. Environmental Protection Agency (U.S. EPA) and based solely on pollutant exposure, indicated high health risks in Philadelphia; an excess lifetime cancer risk of greater than one in a million from exposure to 12 different toxins, including benzene, formaldehyde, acetaldehyde, and arsenic compounds.

Multiple studies have documented compounding effects of air pollution exposure and stress on asthma (Chen et al., 2008; Clougherty et al., 2007; Gordian et al., 2005; Pittman et al., 2012; Shankardass et al., 2009). Residents in the study area suffer from high rates of asthma. The Asthma and Allergy Foundation of America ranked Philadelphia as having the fourth worst asthma rate in the country in 2013. The Philadelphia Health Management Corporation's 2012 Household Survey confirmed that residents of Philadelphia (24% of children; 19% of adults), and South/Southwest Philadelphia in particular (14% of children; 24% of adults), suffer from high rates of asthma compared to national averages (9% of children; 8% of adults) (Philadelphia Health Management Corporation, 2012).

Point Breeze and Grays Ferry are historically working-class neighborhoods. Both are located near to the central business district, major academic and health care-related employment centers in Philadelphia. Residents see rising real estate values, new construction and new residents moving in to the northern and eastern parts of the study area in particular. There has been a fight over neighborhood identity, symbolized by the re-naming of some areas of Point Breeze.

The South Philadelphia Air Toxics Community Engagement Project

This study is a product of a growing movement in the communities of Point Breeze and Grays Ferry to address air (in addition to water and soil) pollution concerns. This movement largely began with the formation of the Right to Know Committee provided in 1994 by former employees of the Defense Personnel Support Center in South Philadelphia. The Committee advocates and raises public awareness about environmental health issues through community-based research, community meetings and other outreach tools.

In part due to the Committee's advocacy, agencies have sought resources to document and address air pollution concerns in the area. In 2011, the U.S. EPA awarded the City of Philadelphia Public Health Department – Air Management Services (AMS) a two-year Community Air Toxics Monitoring Grant to purchase a multi-gas open-path air-monitoring system to sample for target compounds near the Philadelphia Refinery. These compounds included Benzene, Mercury, Naphthalene, which are known human carcinogens, and Ethyl Benzene and Styrene which is possibly carcinogenic to humans (World Health Organization International Agency for Research on Cancer, 2013). AMS began purchasing equipment and communicating with community organizations about their plans to record continuous real-time air toxic concentrations in 2012. The agency was interested in formulating a communication strategy that could be used after data collection began. Plans for the monitoring effort were shared during the focus group discussions.

U.S. EPA is also focusing resources on raising air toxics awareness in South Philadelphia. In 2012, U.S. EPA named Philadelphia as one of four sites for a Toxics Release Inventory Community Engagement Pilot Project. This project has resulted in a "Train-the-Trainer" session on EPA's MyRTK web-based search tool, and development of TRI factsheets for the area. This project also motivated questions about how to engage the local community on air toxics issues.

This study represents a collaboration between the Right to Know Committee and other community organizations such as South Philadelphia H.O.M.E.S., Diversified Community Services, Neighbors in Action, and Neighborhood Network Plus; agencies such as AMS and U.S. EPA Region III; and representatives from Drexel University and the University of Pennsylvania to raise environmental awareness, build capacity and reduce risk in the project area.

METHODS

The purpose of this research project was to qualitatively explore the thoughts, beliefs and perceptions of environment, pollution and risk in Point Breeze and Grays Ferry

neighborhoods, adjacent to the Philadelphia Refinery. We recruited adults above the age of 18 using snow-ball sampling and purposive sampling methods (Fred and Kerlinger, 1986). All recruitment and consent protocol were reviewed and approved by the Internal Review Board of the University of Pennsylvania, and co-approved by the IRB of Drexel University via an authorization agreement, and the U.S. EPA Human Health Subjects Research Review Official. Our main recruitment strategies were: announcements at community meetings, word-of-mouth to social networks of community contacts, notices in church bulletins, and flyer and email distribution to neighborhood businesses and organizations. Incentives included a meal and \$10 gift card to a local supermarket, and childcare during the discussion session.

Focus group procedures

We held eight focus group discussions with a total of 47 residents of the Point Breeze and Grays Ferry neighborhoods (or those living in the zip codes of 19145 and 19146) between March 8 and May 28, 2013. We selected a focus group methodology, over interviews or surveys, to better support participants' discussing topics in their own terms (Denzin and Lincoln, 1994).

We held focus groups at three separate locations. The first five were held at Vare Recreation Center at the recommendation of our community partners. Vare is located at the border between Point Breeze and Grays Ferry, and is considered to be on "common ground". The remaining three groups were held with regularly-scheduled gatherings at two separate churches.

The number of participants in each focus group ranged from two to ten (mean = 6). Out of 47 participants, 39 were self-reported as African-American and seven as white (and one did not report race); one was Hispanic; 40 of our participants were female and seven were male. We had one participant under age 24, five participants between the ages of 24 and 54, and the remaining 41 participants were over the age of 54 (three did not report their age). One limitation of this study is that we were not able to successfully recruit representative numbers of men, youth or participants from other racial, ethnic, or language groups.

The two PIs (Kondo and Gross-Davis) each facilitated half of the discussions. At least three assistants also attended each group, operated video and audio recording equipment, assisted with access to food and beverages, distributed and collected consent forms, demographic surveys, maps and gift cards, and took notes. Consent forms provided details about the purpose, duration, location, compensation, benefits and risks associated with the study. It also detailed terms of confidentiality. All (two PIs and six assistants) attended a practice training sessions, and attended at least three focus groups in order to receive adequate training and experience with each facilitation task. Focus groups lasted 60 to 90 minutes and covered the following questions:

- What do you consider to be your neighborhood?
- What do like and dislike about your neighborhood?
- How does your neighborhood support/harm your health?

- Are you concerned about pollution in the neighborhood?
 - (If air pollution is not discussed) How about air pollution?
- What are the sources of pollution here?
 - (If the refinery is not discussed) What are your thoughts on the refinery?
- What are the main health issues in your neighborhood?
- Has a physician treated you or any member of your family for asthma?

We pilot-tested questions with community contacts prior to implementation. Note-takers recorded observations of participants prior, during and after the actual focus group session. Observations included side conversations, gestures, body language, facial expressions, and other things that might be considered meaningful. During the session, the lead note-taker used a chart to categorize the notes with coded letters corresponding to the participants' comments. The focus group sessions were audio- and video-recorded.

Data analysis

Within two weeks of each session, we transcribed each focus group discussion in entirety. We then used constant comparison analysis methodology (Barney and Strauss, 1967), a form of grounded theory research, to analyze the data. The research team reviewed all of the transcripts and developed a list of independent codes collaboratively in an open coding process. We then arranged small units to broader themes (axial coding). The third author served as the primary coder, using QSR NVivo 10. The group met weekly to review and revise codes. We completed adding and revising new codes once theme-based saturation had occurred.

We then generated node reports (compilation of all quotes) and memos (summarizing and drawing connections between themes within each node). All authors reviewed and discussed these memos at team meetings. The major themes on which we report – residents' perceptions of the refinery, industry, air pollution, and environmental health through the lens of place – were derived from this iterative process of reports, memos and discussions.

RESULTS

Analyses of data collected from focus groups are arranged in three themes that emphasize the role of place in risk perceptions regarding an oil refinery.

Place Identity

Despite the fact that the study area is in the shadow of an oil refinery (most commonly referred to as "Sunoco"), participants did not voluntarily mention it, air pollution, or industry in five of the eight focus group discussions. Air quality, in a community adjacent to one of the oldest refineries in the country, was mentioned only 17 times across all focus groups.

Yet when prompted about air pollution and the refinery, the most common response was apathy. This response was motivated, in part, by the fact that the refinery had been there for

so long, and was just a fact of life. Many participants had lived in the area all their lives, and identified with the historic presence of the refinery. Long-time residents, or participants over the age of 65, shared stories about how the refinery had been a presence in their childhoods. One participant said that “I remember my father would drive through the back way, to take us out as kids.”

While none of our participants, or their relations, had been employed at the refinery, they expressed being “used” to the refinery because of its historic presence. One participant said, “The refineries they have there...After a while you get used to it.” Another participant replied, “Yeah, the refinery, the chemicals ... You learn to live with it, become immune to it.” Long-time residents also noted that technological advances had allowed the refinery to become less noticeable. One woman stated: “The refinery *used* to smell, black smoke *used* to come up” (emphasis added).

Another participant stated that smells from the refinery, and the sight of black smoke, are a part of living in this place. She likened these sights and smells to exposure to violence, such as the sound of gunshots:

“When you live with this stuff daily, it becomes part of your environment and your life and you really don’t think about it because it’s there all the time. And when you said pollution, yeah we’re inundated with it, but it’s with us, it’s like a natural thing. You breathe in the air, you don’t really think about it until you said something... Yes, the refinery, it has pollution. There are times when something is amiss at that Sunoco place and you do smell something, or there’s black smoke coming out of the stack. But you see it all the time and say ‘Well, alright.’ I mean just like gunshots, you hear them all the time, and just say ‘Yeah, okay’.”

Stigma

After initially expressing apathy, participants began to volunteer perceptions of pollution and its effect on their mental and physical health. Participants admitted being very aware of air pollution (which they attribute to the refinery and the interstate that bisects the community) through sights and smells. First, smoke or other visible emissions from smokestacks at the refinery are visual cues to pollution exposure. While emissions are less visible than they may have been 30 years prior, they still exist: “Sunoco. It’s amazing what fumes that comes out of there. It reaches all the way down.”

The presence of the refinery and the pollution and especially odors emitted from it was a source of stigma. In the third focus group, all participants agreed that South Philadelphia has a reputation for smelling of gas and oil: “You know about South Philadelphia, it’s always smelled, you smell gas and diesel.” One participant said that she became aware of the odors in South Philadelphia only after she moved away to another section of the city: “I moved up to North Philly when I first got married...and it dawned on me, I had gotten used to the smell, and North Philly doesn’t smell the same as South Philly.” Oil refining contributed to a negative reputation that reflected poorly on residents and their community.

A related, more visually and consciously present source of stigma (and stress) for residents was vacant properties and pervasive trash in their neighborhoods. Rather than air pollution, the most commonly cited environmental health concerns were trash or “dirty streets” and vacant lots, or physical disorder. Participants reported that 1) residents drop trash on to sidewalks, streets and alleys, 2) there is a lack of public trash cans in the neighborhood, and 3) garbage collectors often spill trash and neglect to pick it up. One participant stated: “There’s trash everywhere. You can’t take two steps without, ‘Dang, there’s another bottle!’”

Social Control

Pervasive trash, persistent crime and other social issues, lack of educational and employment opportunities as well as air pollution exposure were associated with feelings of lack of control and neglect by institutions within the neighborhood. Some participants asked why their neighborhood had been singled-out as a place of neglect. For example, while waste management problems are present in other areas of the city, the lack of trash in the adjacent more affluent neighborhood called Center City increased awareness of the problem in the study area. One participant described this contrast: “In center city where [people with] money are moving in, if you walk down their block they have the \$300 fine for littering. So there is no littering, the blocks are clean, people clean up the parks. I’m like ‘If they have that there why can’t we have it here?’”

Participants also associated unwilling exposure to air pollution and crumbling infrastructure with lack of social control. Discussions indicated that exposure to air pollution from nearby industry and the refinery contributed poor community health, including cancer and respiratory disease. Asthma and respiratory symptoms (such as bronchitis) among children and adult populations was the top health concern reported in focus groups. Participants linked the refinery, as well as cigarette smoke exposure, to asthma, for example: “I would say there’s a direct correlation between that refinery and all these children with asthma.” The next most-frequently mentioned health concern was cancer. They linked occupational air pollution exposure to respiratory disease and cancer in adult residents. One participant stated:

“A lot of [older residents] have died with a respiratory [disease], even cancer. Because a lot of them worked at these refineries, and these electric companies, and in the sewers, and so forth...So a lot of the illnesses that a lot of our parents and grandparents suffered and died from was because of the refineries and where they worked.”

One participant blamed neighborhood incidence of cancer, and cancer mortality, on air pollution: “That air that’s around us caused my breast cancer, my girlfriend had it, my other girlfriend died from it.”

Participants who live near the elevated rail line bisecting the neighborhood along 25th street (Figure 1) felt that the refinery placed them in imminent danger. These participants all reported that trains carry petroleum products, and that the railway is old, crumbling, and has no safety features; they feared that if a train derailed, the hazardous materials would spill on their houses and in their back yards. As one participant stated:

“They are transferring a lot of oil and gas through the neighborhood. And I just fear, we recently seen what happens when a train goes through a community and derails in New Jersey. Tons and tons [of oil] goes through our neighborhood and we don’t know exactly when an accident like that would happen and that concerns me.”

While participants suspected negative influences from outside forces, they also expressed a sense of powerlessness or lack of efficacy to counter those influences. For example, one participant stated: “The city fumes and garbage and everything else, you get immune to it because there’s nothing you can do about it. Our politicians aren’t doing anything, the mayor’s not doing anything. We can’t move, we’re stuck.”

Social Control and Displacement—Air monitoring campaigns are often assumed to be welcome advances to knowledge among experts, environmental and public health officials, and communities. Instead, many participants reacted with suspicion to the news of the monitoring effort. This suspicion was related to feeling vulnerable to negative influences of outside forces including surrounding industry, the city administration and other institutions. In particular, we found that the refinery, and the proposal to study and thereby reduce pollution, triggered feelings of discrimination, fear of displacement, or lack of security in ownership and belonging in their place of residence.

A major theme emerging from conversations before, during and after focus groups was unequal distribution of power and resources. Most focus group discussions started with questions of WHO was conducting the focus group study and the City’s air monitoring campaign, WHO were the funders, WHERE and to WHOM the resources were going, WHO was making decisions about how it was spent, and ultimately WHOSE interests were being served.

Air pollution for many participants is a symbol of discrimination, neglect, unfair burdening of some with risks, and unfair profit by others. The very existence of the focus group study, and of the city’s air monitoring campaign, indicated to participants that someone was giving and receiving money on the basis of air pollution in their neighborhood, and that someone was not them or any other resident.

While intentions of improving air quality in neighborhood such as these are good, residents suspected that these “do-gooder” actions were only motivated by selfish interests on the part of those who already have resources – including the city and public officials, universities and researchers. As one participant bluntly stated: “We’re suffering, and now you come in talk about money about the air, and you don’t give a darn about us. Really you don’t.”

Some participants asked directly, why grant money was not being spent on real needs, like providing opportunities and education for children in the neighborhood: “I think that it’s a sin and a disgrace that the city of Philadelphia received a grant for environmental and they have no concern about our children.”

The topic of air pollution, and the study of it, triggered fear of displacement for participants as well. Participants feared that talking about air pollution, and sanctioning public resources

spent on its abatement, contributed to residents' risk of being priced out of their homes. One participant demanded, "I'd like to know why all of the sudden we're concerned about Point Breeze and Grays Ferry when this place [the refinery] has been here since 1800s?" Concern and talk about "air pollution" and "the environment" was only in the interests of those with more resources, i.e. predominantly white residents that are moving in to the neighborhood. "Since there's a new population that's going to be moving us out and coming in, now there's studies on housing, and now air pollution is a big problem in the neighborhood." In one participant's opinion, people and agencies who want to help should "get off the environmental thing and get into more of the bigger community [issues]," which facilitators understood to mean lack of resources for youth, violence and disordered physical environment.

DISCUSSION

Exposure and risk assessments traditionally neglect the role of psychosocial stressors in the exposure-disease pathway, and in the formulation of possibilities for scientific, programmatic or regulatory response. Risk theory offers guidance toward understanding social dimensions of environmental hazards. We contribute to others' work expanding this framework to incorporate place-based concepts of place identity, stigma and social control. While multiple studies explore the role of place in risk related to air pollution, understandings are generally "fragmented" (Day, 2006). Through exploration of community concerns regarding a refinery and an air monitoring proposal in South Philadelphia, we provide a framework of ways in which place influences air pollution-related stress and risk perception. This framework is one of few that focuses on air pollution and takes a 'relational' approach to place; treating context and composition not as binary, but as contingent and mutually related (Cummins et al., 2007; Macintyre et al., 2002).

This study offers an in-depth look using qualitative data in two neighborhoods in Philadelphia. Participants were not randomly selected and their statements should not be seen to represent community-wide sentiment. The framework developed in this paper is grounded in specific issues emerging from South Philadelphia communities in the shadow of a large petrochemical refinery. While the findings cannot be generalized to represent experiences in other communities, they can suggest important questions to investigate using other methods in similar areas. In addition, not all aspects of place are included in this analysis, for example those that cannot be detected by use of qualitative methods, though they are worthy of study.

However, this study does provide evidence of a relationship between stress, environmental exposures and disease. Few studies investigate the relationship between the perception of air pollution and disease outcomes (Gee and Takeuchi, 2004; Piro et al., 2008). We join others in calling for further research on "stress-intoxicant interactions" (Couch and Coles, 2011; McEwen and Tucker, 2011), which may assist in understanding and reducing health inequality.

Our analysis revealed that South Philadelphia residents are aware of the nearby urban refinery; their awareness is triggered by visual cues and aromas. Yet they "absence risk"

(Bickerstaff and Simmons, 2009) due to place identities, and to protect themselves from fear of disease and displacement, feelings of stigma and discrimination. While they feel powerless to change it, they also fear that any effort to reduce impacts would not be in their best interest. Our findings align with others who have found that feelings of (lack of) social control causes individuals to constantly feel in danger, excluded from public spaces, activities and resources (Brownlow, 2006; Sparks et al., 2001).

Findings suggest that programs or studies which seek to change behaviors and gather or spread information on issues such as pollution and other environmental concerns will be challenged unless they directly address: 1) the public's identification with a place or industry, 2) immediate environmental stressors such as abandonment, waste and odors, and 3) public perceptions of lack of social control and fear of displacement. This reflects prior studies which have found that targeted behavioral health interventions are largely unsuccessful when they do not address immediate environmental threats (Ory et al., 2002), lack of trust (Scammell et al., 2009), and otherwise incorporate local knowledge (Corburn, 2003). In this case as in others (Couch and Coles, 2011), the study process could exacerbate the physical and psychosocial health impacts on communities.

Study results suggest that it may be possible to reduce impacts of pollution through mitigation of other related social and physical stressors. For example, place-based programs to improve environments, such as cleaning and greening of vacant lots, improving housing (Branas et al., 2011; Branas and MacDonald, 2014) or solid waste management could reduce vulnerability to effects of air pollution exposure.

In addition, our findings suggest that efforts to monitor pollution and exposure levels, document environmental injustice, and organize action, must be sensitive to power dynamics and fears that go along with neighborhood research and improvement. A community-initiated or community-engaged method will be fundamental to either of these types of efforts, in which researchers help answer questions derived from the community. It is essential that collaborative efforts seek and provide funding for outreach and education with and among neighborhood residents.

References

- Astell-Burt T, Maynard MJ, Lenguerrand E, Whitrow MJ, Molaodi OR, Harding S. Effect of air pollution and racism on ethnic differences in respiratory health among adolescents living in an urban environment. *Health and Place*. 2013; 23:171–178. [PubMed: 23933797]
- Atari DO, Luginaah I, Baxter J. “This is the mess that we are living in”: residents everyday life experiences of living in a stigmatized community. *Geo Journal*. 2011; 76:483–500.
- Atari DO, Luginaah IN, Gorey K, Xu X, Fung K. Associations between self-reported odour annoyance and volatile organic compounds in ‘Chemical Valley’, Sarnia, Ontario. *Environmental Monitoring and Assessment*. 2013; 185:4537–4549. [PubMed: 23014924]
- Attfield MD, Schleiff PL, Lubin JH, Blair A, Stewart PA, Vermeulen R, Coble JB, Silverman DT. The diesel exhaust in miners study: a cohort mortality study with emphasis on lung cancer. *Journal of the National Cancer Institute*. 2012; 104:869–883. [PubMed: 22393207]
- Barney, GG.; Strauss, AL. *The discovery of grounded theory: strategies for qualitative research*. Hawthorne, N.Y: Aldine de Gruyter, Hawthorne, N.Y; 1967.
- Beck U. *From Industrial Society to the Risk Society: Questions of Survival, Social Structure and Ecological Enlightenment*. *Theory Culture Society*. 1992a; 9:97–123.

- Beck, U. Risk society: towards a new modernity. Sage Publications; London: 1992b.
- Bickerstaff K. Risk perception research: socio-cultural perspectives on the public experience of air pollution. *Environment International*. 2004; 30:827–840. [PubMed: 15120202]
- Bickerstaff K, Simmons P. Absencing/presencing risk: Rethinking proximity and the experience of living with major technological hazards. *Geoforum*. 2009; 40:864–872.
- Bickerstaff K, Walker G. Public understandings of air pollution: the ‘localisation’ of environmental risk. *Global Environmental Change*. 2001; 11:133–145.
- Branas CC, Cheney RA, MacDonald JM, Tam VW, Jackson TD, Ten Have TR. A Difference-in-Differences Analysis of Health, Safety, and Greening Vacant Urban Space. *American Journal of Epidemiology*. 2011; 174:1296–1306. [PubMed: 22079788]
- Branas CC, MacDonald JM. A Simple Strategy to Transform Health, All Over the Place. *Journal of Public Health Management Practice*. 2014 (in press).
- Brauer M, Hoek G, Smit HA, de Jongste JC, Gerritsen J, Postma DS, Kerkhof M, Brunekreef B. Air pollution and development of asthma, allergy and infections in a birth cohort. *European Respiratory Journal*. 2007; 29:879–888. [PubMed: 17251230]
- Brownlow A. An archaeology of fear and environmental change in Philadelphia. *Geoforum*. 2006; 37:227–245.
- Brunekreef B, Holgate ST. Air pollution and health. *Lancet*. 2002; 360:1233–1242. [PubMed: 12401268]
- Bush J, Moffatt S, Dunn C. ‘Even the birds round here cough’: stigma, air pollution and health in Teesside. *Health and Place*. 2001; 7:47–56. [PubMed: 11165155]
- Chen E, Schreier H, Strunk RC, Brauer M. Chronic Traffic-Related Air Pollution and Stress Interact to Predict Biologic and Clinical Outcomes in Asthma. *Environmental Health Perspectives*. 2008; 116:970–975. [PubMed: 18629323]
- Clougherty J, Levy JI, Kubzansky LD, Ryan PB, Suglia SF, Canner MJ, Wright RJ. Synergistic effects of traffic-related air pollution and exposure to violence on urban asthma etiology. *Environmental Health Perspectives*. 2007; 115:1140–1146. [PubMed: 17687439]
- Cohen S, Janicki-Deverts D, Miller GE. Psychological stress and disease. *Journal of the American Medical Association*. 2007; 298:1685–1687. [PubMed: 17925521]
- Corburn J. Bringing Local Knowledge into Environmental Decision Making. *Journal of Planning Education and Research*. 2003; 22:420–433.
- Couch SR, Coles CJ. Community Stress, Psychosocial Hazards, and EPA Decision-Making in Communities Impacted by Chronic Technological Disasters. *American Journal of Public Health*. 2011; 101:S140–S148. [PubMed: 21836109]
- Cummins S, Curtis S, Diez-Roux AV, Macintyre S. Understanding and representing ‘place’ in health research: A relational approach. *Social Science and Medicine*. 2007; 65:1825–1838. [PubMed: 17706331]
- Cupples J. Culture, nature and particulate matter – Hybrid reframings in air pollution scholarship. *Atmospheric Environment*. 2009; 43:207–217.
- Curtis, S. *Health and inequality: geographical perspectives*. Sage Publications; London: 2004.
- Cutchin MP, Martin KR, Owen SV, Goodwin JS. Concern About Petrochemical Health Risk Before and After a Refinery Explosion. *Risk Analysis*. 2008; 28:589–601. [PubMed: 18643817]
- Day RJ. Traffic-related air pollution and perceived health risk: Lay assessment of an everyday hazard. *Health, Risk and Society*. 2006; 8:305–322.
- Denzin, NK.; Lincoln, YS. *Handbook of qualitative research*. Sage Publications; Thousand Oaks, CA: 1994.
- Dockery DW, Pope CA, Xu X, Spengler JD, Ware JH, Fay ME, Ferris BG, Speizer FE. An Association between Air Pollution and Mortality in Six U.S. Cities. *New England Journal of Medicine*. 1993; 329:1753–1759. [PubMed: 8179653]
- Fred, NK.; Kerlinger, FN. *Foundations of behavioral research*. New York: Holt, Rinehart and Winston, New York; 1986.
- Gee GC, Takeuchi DT. Traffic stress, vehicular burden and well-being: A multilevel analysis. *Social Science and Medicine*. 2004; 59:405–414. [PubMed: 15110429]

- Giddens, A. *Modernity and self-identity: self and society in the late modern age*. Stanford University Press; Stanford, CA: 1991.
- Gordian ME, Haneuse S, Wakefield J. An investigation of the association between traffic exposure and the diagnosis of asthma in children. *Journal of Exposure Science and Environmental Epidemiology*. 2005; 16:49–55. [PubMed: 16007113]
- Lefebvre, H. *The production of space*. Blackwell; Oxford, OX, UK; Cambridge, Mass., USA: 1991.
- Lin MC, Chiu HF, Yu HS, Tsai SS, Cheng BH, Wu TN, Sung FC, Yang CY. Increased risk of preterm delivery in areas with air pollution from a petroleum refinery plant in Taiwan. *Journal of Toxicology and Environmental Health Part A*. 2001; 64:637–644. [PubMed: 11766170]
- López-Navarro M, Llorens-Monzonis J, Tortosa-Edo V. The Effect of Social Trust on Citizens' Health Risk Perception in the Context of a Petrochemical Industrial Complex. *International Journal of Environmental Research and Public Health*. 2013; 10:399–416. [PubMed: 23337129]
- Luginaah I, Smith K, Lockridge A. Surrounded by Chemical Valley and 'living in a bubble': the case of the Aamjiwnaang First Nation, Ontario. *Journal of Environmental Planning and Management*. 2010; 53:353–370.
- Luginaah IN, Martin Taylor S, Elliott SJ, Eyles JD. Community reappraisal of the perceived health effects of a petroleum refinery. *Social Science and Medicine*. 2002a; 55:47–61. [PubMed: 12137188]
- Luginaah IN, Taylor SM, Elliott SJ, Eyles JD. A longitudinal study of the health impacts of a petroleum refinery. *Social Science and Medicine*. 2000; 50:1155–1166. [PubMed: 10714934]
- Luginaah IN, Taylor SM, Elliott SJ, Eyles JD. Community responses and coping strategies in the vicinity of a petroleum refinery in Oakville, Ontario. *Health and Place*. 2002b; 8:177–190. [PubMed: 12135641]
- Macintyre S, Ellaway A, Cummins S. Place effects on health: how can we conceptualise, operationalise and measure them? *Social Science and Medicine*. 2002; 55:125–139. [PubMed: 12137182]
- Massey, DSDNA. *American apartheid: segregation and the making of the underclass*. Harvard University Press; Cambridge, MA: 1993.
- McEwen BS, Tucker P. Critical Biological Pathways for Chronic Psychosocial Stress and Research Opportunities to Advance the Consideration of Stress in Chemical Risk Assessment. *American Journal of Public Health*. 2011; 101:S131–S139. [PubMed: 22021312]
- Newman K, Wyly EK. The Right to Stay Put, Revisited: Gentrification and Resistance to Displacement in New York City. *Urban Studies*. 2006; 43:23–57.
- November V. Being close to risk. From proximity to connexity. *International Journal of Sustainable Development*. 2004:7.
- Ory MG, Jordan PJ, Bazzarre T. The Behavior Change Consortium: setting the stage for a new century of health behavior-change research. *Health Education Research*. 2002; 17:500–511. [PubMed: 12408195]
- Philadelphia Health Management Corporation. 2012 Southeastern Pennsylvania Household Health Survey. 2012.
- Piro F, Madsen C, Naess O, Nafstad P, Claussen B. A comparison of self reported air pollution problems and GIS-modeled levels of air pollution in people with and without chronic diseases. *Environmental Health*. 2008; 7:9. [PubMed: 18307757]
- Pittman T, Nykiforuk CI, Mignone J, Mandhane PJ, Becker AB, Kozyrskyj AL. The association between community stressors and asthma prevalence of school children in Winnipeg, Canada. *International Journal of Environmental Research and Public Health*. 2012; 9:579–595. [PubMed: 22470311]
- Pope C, Burnett R, Thun M, Calle E, Krewski D, Ito K, Thurston G. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *Journal of the American Medical Association*. 2002; 287:1132–1141. [PubMed: 11879110]
- Proshansky HM, Fabian AK, Kaminoff R. Place-identity: Physical world socialization of the self. *Journal of Environmental Psychology*. 1983; 3:57–83.

- Scammell MK, Senier L, Darrah-Okike J, Brown P, Santos S. Tangible evidence, trust and power: Public perceptions of community environmental health studies. *Social Science and Medicine*. 2009; 68:143–153. [PubMed: 18995942]
- Sexton K. Cumulative risk assessment: an overview of methodological approaches for evaluating combined health effects from exposure to multiple environmental stressors. *International Journal of Environmental Research and Public Health*. 2012; 9:370–390. [PubMed: 22470298]
- Shankardass K, McConnell R, Jerrett M, Milam J, Richardson J, Berhane K. Parental stress increases the effect of traffic-related air pollution on childhood asthma incidence. *Proceedings of the National Academy of Sciences*. 2009; 106:12406–12411.
- Sicotte D. Some more polluted than others: unequal cumulative industrial hazard burdens in the Philadelphia MSA, USA. *Local Environment*. 2010; 15:761–774.
- Sparks R, Girling E, Loader I. *Fear and Everyday Urban Lives*. *Urban Studies*. 2001; 38:885–898.
- Tuan, Y-f. *Space and place: the perspective of experience*. University of Minnesota Press; Minneapolis, MN: 1977.
- Twigger-Ross CL, Uzzell DL. Place and Identity Processes. *Journal of Environmental Psychology*. 1996; 16:205–220.
- U.S. Bureau of the Census. *American Community Survey*. 2009.
- Wester-Herber M. Underlying concerns in land-use conflicts—the role of place-identity in risk perception. *Environmental Science and Policy*. 2004; 7:109–116.
- World Health Organization International Agency for Research on Cancer. *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*. 2013.
- Yang C-Y, Chiu H-F, Tsai S-S, Chang C-C, Chuang H-Y. Increased Risk of Preterm Delivery in Areas with Cancer Mortality Problems from Petrochemical Complexes. *Environmental Research*. 2002; 89:195–200. [PubMed: 12176003]
- Yang TC, Matthews SA. The role of social and built environments in predicting self-rated stress: A multilevel analysis in Philadelphia. *Health and Place*. 2010; 16:803–810. [PubMed: 20434389]



Figure 1. Overview Map Showing Philadelphia Refinery and the Greys Ferry & Point Breeze Neighborhoods