Assessing Strengths, Stressors and Environmental justice in SoutheaStern **(ASSESS)** Pennsylvania Community and Environmental Health Study
Summary Report

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Executive Summary

Numerous pollution sources and myriad of personal and community challenges overburden environmental justice communities in Southern Delaware County, PA. The Assessing Strengths, Stressors and Environmental justice in SoutheaStern (ASSESS) Pennsylvania Communities Study had two goals:

1) Collect data to improve our understanding of community strengths, stressors, and needs and
2) Describe the cumulative health impacts of both the chemical (e.g., exposure to air pollutants) and nonchemical (e.g., economic hardship) stressors.

To achieve these goals, we used a community-based participatory research approach. This means that impacted residents and community leaders participated in all phases of the research process. Together, we designed and implemented a community environmental health survey and conducted focus group discussions.

Key Findings

- Odors, air pollution, and noise were common environmental health concerns; participants noted direct impacts on their well-being and quality of life.
- Adverse physical symptoms were common and interfered with daily life. Self-reports of adverse physical health symptoms (i.e., congestion, headaches and cough) were more common than clinician-diagnosed physical health conditions (i.e., allergies, hypertension and asthma).
- Adverse mental health symptoms were common and interfered with daily life. Self-reports of mental health symptoms consistent with depression and anxiety were more common than professional medical diagnoses of these conditions.
- Asthma rates were high among children living in Southern Delaware County. More children experience symptoms consistent with asthma (e.g., wheezing and coughing) than have clinician-diagnosed asthma.
- Participants were proud of their communities and felt a strong connection and support from other community members.
- In addition to pollution and related environmental concerns, Southern Delaware County residents often faced many challenges (e.g., limited financial resources and food insecurity).
- Participants who faced more challenges in their lives tended to report having poorer health. Participants acknowledged the compounding burden of environmental, physical, and mental health challenges in their communities.
- There was a strong alignment between factors harming health and factors participants want policymakers to prioritize: pollution and chemical exposures, violence and crime, and food insecurity.

Based on our key findings, we have developed a series of recommendations for policymakers, community organizations and advocates, and academic researchers. Stakeholders should leverage our findings on community strengths to implement recommendations. Examples of these recommendations include:

For State and Local Regulators and Policymakers:

- Enact environmental justice legislation to address cumulative burdens in permit approval processes, which must:

    - Consider existing pollution sources as well community-level environmental and public health data

    - Require permit applicants to demonstrate how any proposals for new and expanding infrastructure will mitigate and not exacerbate existing environmental and public health stressors

- Prioritize community engagement, inclusion and transparency in any decision-making processes that affect fenceline residents before facilities and infrastructure are approved

    - Broaden consideration of community health and safety to be more inclusive of the full range of community concerns and needs

    - Leverage community strengths in discussions around community health and safety

For Community Organizations and Advocates:

- Organize and educate community members and grassroots community groups on key findings to empower change with policy and permitting procedures to be inclusive of cumulative burdens

- Educate local officials, community groups, and other residents about existing cumulative impact laws and policies in the United States[1]

- Empower residents to amplify their voices regarding cumulative burdens

For Academic Researchers:

- Expand consideration of health outcomes to include sub-diagnostic measures of health (e.g., symptoms rather than medical diagnoses alone)

- Broaden concepts of health to include measures of mental health and well-being

- Increase use of community-based participatory research (CBPR) approaches to improve the rigor, relevance, and reach of studies

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Background

Fenceline communities in Southern Delaware County, PA, breathe some of the most polluted air in the state.[2] These communities between I-95 and the Delaware River include Boothwyn, Chester Township, City of Chester, Eddystone, Linwood, Marcus Hook, Ogden, Parkside, Trainer, Twin Oaks, Upland, and Upper Chichester. This area is home to numerous industrial sources of pollution, including two trash incinerators, an oil refinery, and numerous chemical manufacturing and petrochemical processing facilities. The Reworld trash incinerator (formerly known as Covanta) located in the City of Chester, emits more $PM_{2.5}$ than any other such facility in the nation,[3] operates with the fewest air quality controls, and has a long history of violations and non-compliance with existing environmental regulations.[4]

Air pollution and health impacts have been reported over decades. Nearly thirty years ago, EPA recognized that a "clustering of waste treatment facilities have been permitted within 100 feet of over 200 Chester homes" and noted that the city had the highest infant mortality rates and certain cancers within Pennsylvania.[5] The Delaware County Health Department community health assessment [6] (2024) documented mental health, chronic disease and maternal and child health concerns. In 2023, the County Health Ranking and Roadmaps rated Delaware County health outcomes as below average compared to the state and particulate matter air pollution was higher than both the state and the US on average.[7] With the ongoing expansion of industrial facilities in Marcus Hook, Trainer, and Chester, residents have experienced increased health symptoms: burning eyes, sore throats, persistent headaches, nosebleeds, skin irritations, asthma, and other respiratory illnesses. According to 2022 data from the Behavioral Risk Factor Surveillance System, the rate of current asthma in children in southeast Pennsylvania (excluding Philadelphia) is 11%, higher than the rate in the US overall (7.7%). [8, 9]

In addition to environmental pollution, residents in Southern Delaware County often face numerous other challenges (e.g., poor housing conditions, food insecurity, lack of reliable transportation, and lack of access to healthcare). Southern Delaware County communities have high proportions of residents who live below twice the federal poverty level, lack health insurance, experience housing burdens (i.e., pay over 50% of their income on housing costs), and have low educational attainment.[10]

Cumulative impacts are defined as the totality of exposures to pollution and other sources of stress in a community (e.g., noise and structural racism) and their combined effects on health, well-being, and quality of life.[11] Policymakers must consider the co-occurrence of chemical and non-chemical stressors because people and communities facing additional burdens may experience more significant impacts from pollution exposure than communities facing pollution exposure alone. [12-14]

The Pennsylvania Department of Environmental Protection (PA DEP) uses a novel methodology called PennEnviroScreen to identify environmental justice communities facing the

highest levels of environmental pollution and social vulnerabilities.[2] As shown in Figure 1, most municipalities in Southern Delaware County are considered environmental justice areas. Despite this, PA DEP has continued to approve expansion plans for facilities in these areas in recent years. Proposals for the area include a new liquefied natural gas export terminal, a regional "hydrogen hub," and expansion to existing and associated petrochemical and gas infrastructure.
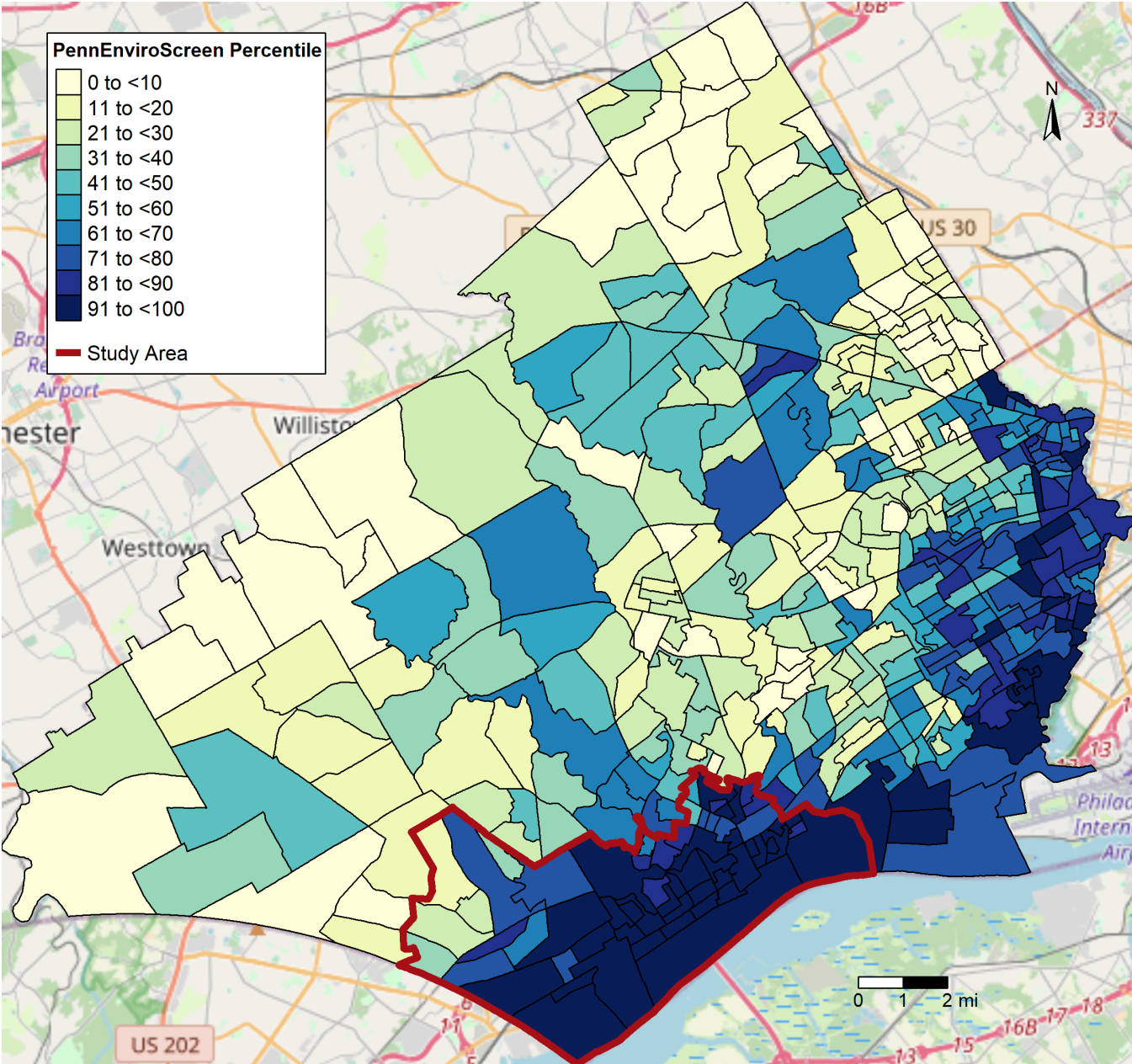
Figure 1. Map of PennEnviroScreen Percentiles in Southern Delaware County

The health issues associated with polluting infrastructure are well understood among residents and community advocates who experience the impacts of environmental injustice daily. No study of environmental health impacts in Southern Delaware County has been conducted in

nearly 30 years. [15] In addition, no study has investigated the cumulative impacts and lived experiences of both chemical and nonchemical stressors on residents.

Since 2021, researchers from Johns Hopkins University (JHU) have been working with the Clean Air Council (CAC), Marcus Hook Neighbors for Public Health (MHNPH) and Southern Delaware County residents to develop and conduct a community and environmental health study. This study aims to understand better the cumulative impact of pollution and other stressors on the physical and mental health of impacted residents and to provide residents with the data and tools necessary to advocate for meaningful policy solutions in partnership with local government and health agencies.

This study is unique because it uses a community-based participatory research (CBPR) approach.[16, 17] This means that the study has been designed and implemented by community co-investigators. These community co-investigators are impacted residents and community leaders who have joined a collaborative research process with Johns Hopkins University researchers. This CBPR approach moves away from a traditional model of academics conducting studies of and in impacted environmental justice communities. Instead, it provides a model in which the impacted residents guide research questions and participate in the scientific process. CBPR approaches help scientific studies address community priorities and/or concerns and that the resulting data are relevant and valuable to communities. All aspects of study design and implementation (e.g., funding acquisition, study design, data collection, data analysis, and interpretation) have been completed collaboratively by all co-investigators, culminating in the current written report.

All investigators hope this study and its findings will serve as a resource for residents and community leaders and bolster advocacy efforts to restore environmental health and achieve justice in Southern Delaware County.

Study Goals

The goals of the **Assessing Strengths, Stressors and Environmental justice in SoutheaStern (ASSESS) Pennsylvania Communities Study** were to:

1. Collect data to improve our understanding of community strengths, stressors, and needs, and
2. Describe the cumulative impacts of both the chemical (e.g., exposure to air pollutants) and nonchemical (e.g., economic hardship) stressors in Southern Delaware County Communities.

The researchers aimed to empower community research and advocacy through data-generating and capacity-building efforts and provide impacted residents and community leaders with current data and tools to support advocacy efforts. Finally, we aimed to foster engagement with the affected fenceline community members, community groups and community advocates and provide evidence-based policy recommendations to enhance future public health actions promoting a healthy quality of life and limiting any additional pollution and cumulative burdens for the residents of Southern Delaware County.

The ASSESS Community and Environmental Health Study is distinct from but complementary to other health assessments. For example, the Community Health Assessment (CHA) conducted by the Delaware County Department of Health is part of a planning process to inform the development of a county-wide Community Health Improvement Plan (CHIP). The ASSESS Community and Environmental Health Study gathered information on cumulative burdens of environmental, mental, physical, and social challenges in fenceline communities to empower communities to support advocacy efforts to mitigate the harms of pollution.

Study Area

The study focused on an approximate 20-square-mile geographical area in Southern Delaware County, Pennsylvania, sometimes called the "industrialized I-95 corridor." This includes all municipalities on both sides of route I-95 from the border with the State of Delaware north through Eddystone, PA.

These 11 municipalities—Boothwyn, Chester Township, City of Chester, Eddystone, Linwood, Marcus Hook, Ogden, Parkside, Trainer, Twin Oaks, Upland, and Upper Chichester—are hereafter referred to as "Southern Delaware County."
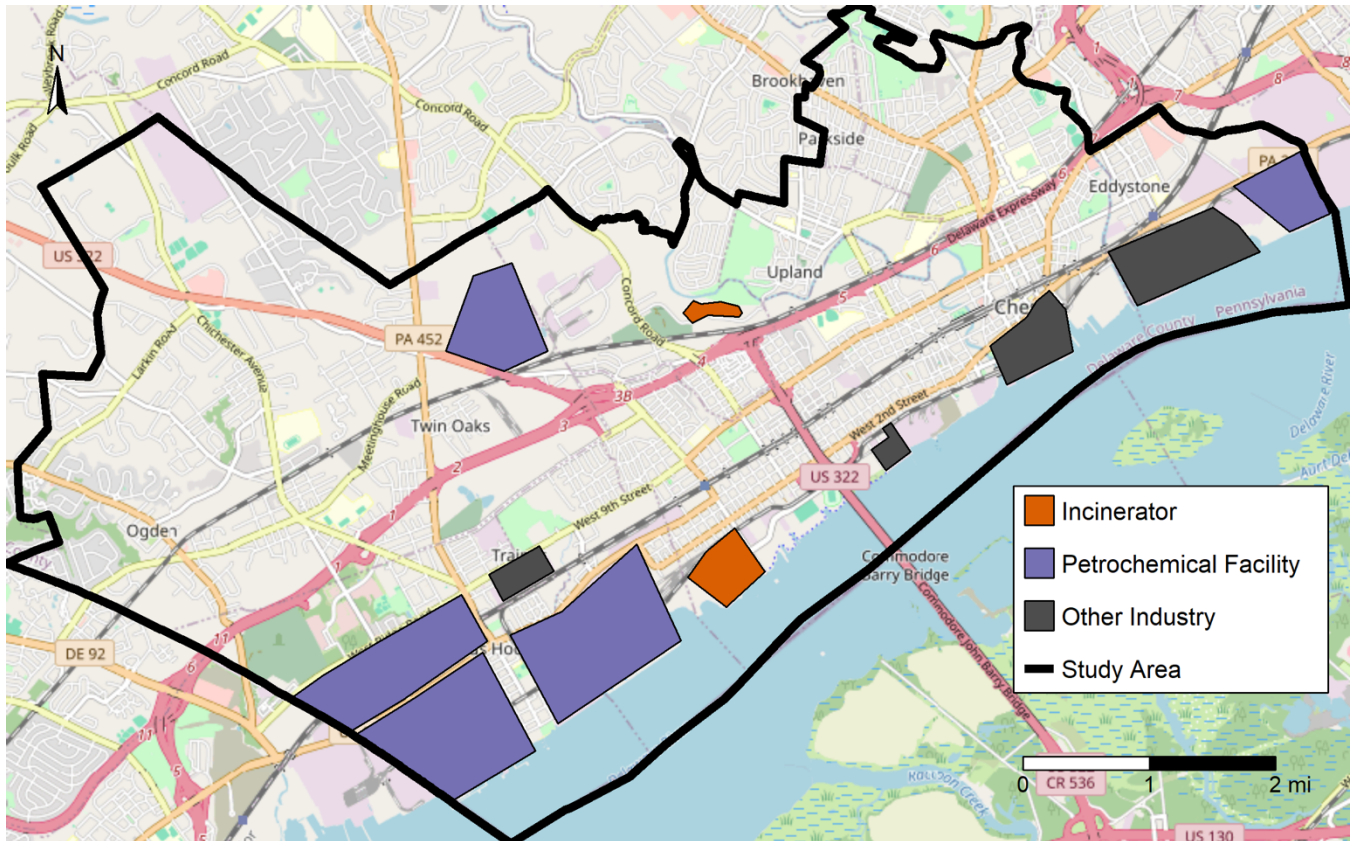
Figure 2. Map of Southern Delaware Country Study Area

The City of Chester is the first and oldest city in Pennsylvania, settled by William Penn in 1682, and the only city in Delaware County. A disinvested city, Chester is an urban/suburban area with 32,605 residents and a median income of $39,193.[18] Chester is a predominantly Black community, with 70%-85% of residents identifying as African American alone or with other ancestries. Chester is a historic municipality and home to a vibrant community of many churches, neighborhood businesses, and community centers. Many Chester families have lived in the community for generations and experience strong family, church, and community bonds. Chester, which sits on the Delaware River, is also home to a sewage sludge incinerator and the nation's largest waste incinerator, which burns up to 3,510 tons of municipal and industrial waste daily and several other major industrial facilities.

Marcus Hook Borough is a small working-class community with a population of 2,433 people, 65% of whom identify as White, and a median income of $47,594.[18] It is home to the Marcus

Hook Industrial Complex, a petrochemical plant that processes and stores ethane, propane, and butane, the Braskem polypropylene plant and the Marcus Hook Energy power plant. There is little distinction between industrial and residential zones in Marcus Hook Borough.

Trainer Borough is a small residential/ industrial community sandwiched between Marcus Hook Industrial Complex and the Trainer Refinery (Monroe Energy), an oil refinery that produces jet fuel for Delta. Trainer Borough is home to 1,976 people, 56% of whom identify as White. Trainer is a growing community that hosts many events, especially for children and families.[18]

Upper and Lower Chichester (including Ogden, Linwood, Boothwyn, Twin Oaks, etc.)
Upper Chichester Township (including Ogden, Boothwyn, and Twin Oaks) is home to 16,898 residents. This predominantly white community has a median household income of $84,825, with 30% of residents holding a bachelor's degree or higher. Upper Chichester has many residential neighborhoods of varying incomes and styles, from large new construction HOAs to -pre-1950s neighborhoods with many smaller cape and row homes. Upper Chichester houses the CSX railroad, the Twin Oaks above-ground storage tank farm, and pipeline compressor station. Lower Chichester, also called Linwood, is home to 3,425 people, only about 10% of whom have completed any higher degree. The median household income is $69,728, with most residents identifying as non-Hispanic White. Linwood is home to the Adelphia Pipeline Compressor station.

Other included municipalities: Chester Township, Upland Borough, Parkside, Eddystone
Several other municipalities surround this area, just north of I-95. Chester Township, Upland Borough, Parkside, and Eddystone are all unique communities with their own municipal leadership and represent three very different school districts. Demographics and community assets vary from one municipality to the next. All these communities share the common factor of being immediately adjacent to the I-95 corridor and just north and upwind of the industrial corridor along the river, from Marcus Hook up through Eddystone. Toxic air does not have municipal boundaries so these communities also experience the heavy industrial pollution burdens and impacts.

Study Participants

Residents (≥18 years) of the following municipalities: Boothwyn, Chester Township, City of Chester, Eddystone, Linwood, Marcus Hook, Ogden, Parkside, Trainer, Twin Oaks, Upland, and Upper Chichester were eligible to participate in the community environmental health study.

Survey Participants

One hundred forty-three participants completed the survey. The average age of the participants was 45 years old, and they resided in the community for an average of 30 years.
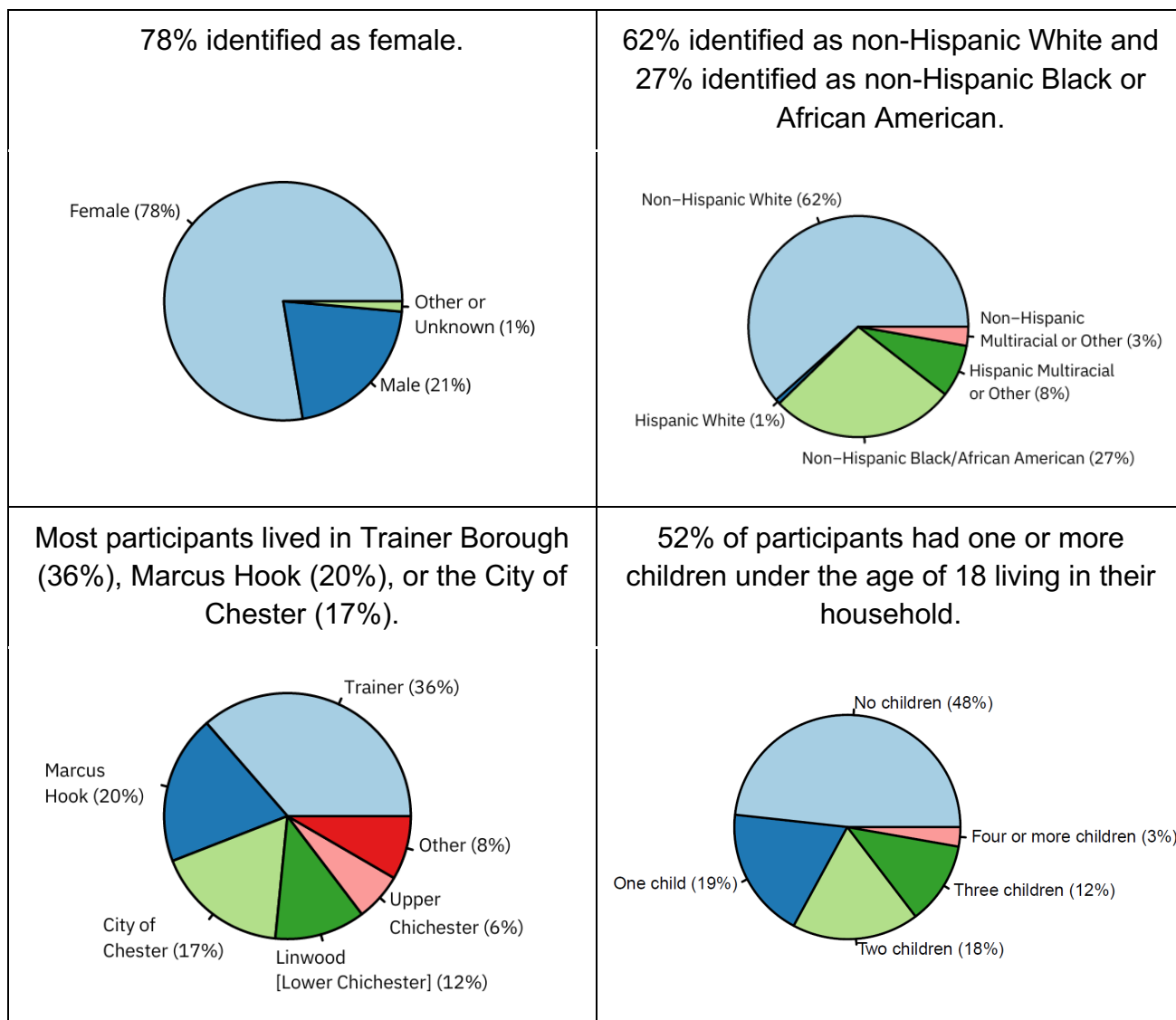
Figure 3. Summary of survey participants' demographic characteristics.

Focus Group Participants

All survey participants were invited to participate in a focus group. Twenty-two residents participated in the focus groups. The average age of focus group participants was 49 years old, and they resided in the community for an average of 28 years.

82% identified as female.	55% identified as non-Hispanic White and 32% identified as non-Hispanic Black or African American.
Female (82%) Male (18%)	Non–Hispanic White (55%) Non–Hispanic Multiracial or Other (9%) Hispanic Multiracial or Other (5%) Non–Hispanic Black/African American (32%)
Most participants lived in the City of Chester (29%), Trainer Borough (24%), Marcus Hook (19%) or Upper Chichester (19%).	50% of participants had one or more children under the age of 18 living in their household.
City of Chester (29%) Trainer (24%) Other (10%) Marcus Hook (19%) Upper Chichester (19%)	No children (50%) One child (18%) Three or more children (14%) Two children (18%)

Figure 4. Summary of focus group participants' demographic characteristics.

Results

Environmental Health

Key Finding: Odors, air pollution, and noise were common environmental health concerns; participants noted direct impacts on their well-being and quality of life.

Perceptions of the Environment

When survey participants were asked to describe their local environments in three words or less, 64% used one or more negative words. Most commonly, survey participants described pollution, dirtiness, and odors. However, nearly 20% of participants described only positive aspects of their communities, such as the friendliness of residents and cleanliness. When asked whether they agree with the statement "My municipality is clean," most participants living in Trainer agreed (71%). In contrast, smaller percentages of participants in Marcus Hook and the City of Chester agreed (39% and 36%, respectively). The word clouds (Figures 5 and 8) visualize the participants' words. Those words shown in larger font were used more often.

Figure 5. Words used by survey participants to describe their environment.

Most survey participants reported feeling somewhat concerned (37%) or very concerned (51%) about pollution in their communities, whereas only 8% were not concerned. When asked how comfortable they feel letting their children play outside in their communities considering the pollution, 32% of survey participants reported they were uncomfortable, and 40% were comfortable. Most survey participants (57%) indicated that their municipality faces more risk from pollution and other chemical exposures than other communities, while 24% thought there was less or similar risk and 20% were neutral.

Over half of the survey participants (56%) first learned about pollution in their communities by noticing odors in the air (Figure 6). Other methods of learning about pollution, such as experiencing health symptoms, seeing smokestacks or flares, and talking to others in their communities, were each reported by 4% to 9% of participants. When asked how they believed they were being exposed to environmental chemicals, almost all survey participants (92%) selected outdoor air. In contrast, only 20% of participants believed they were exposed to indoor air. Dust and drinking water were also commonly identified by survey participants (44% and 36%, respectively).
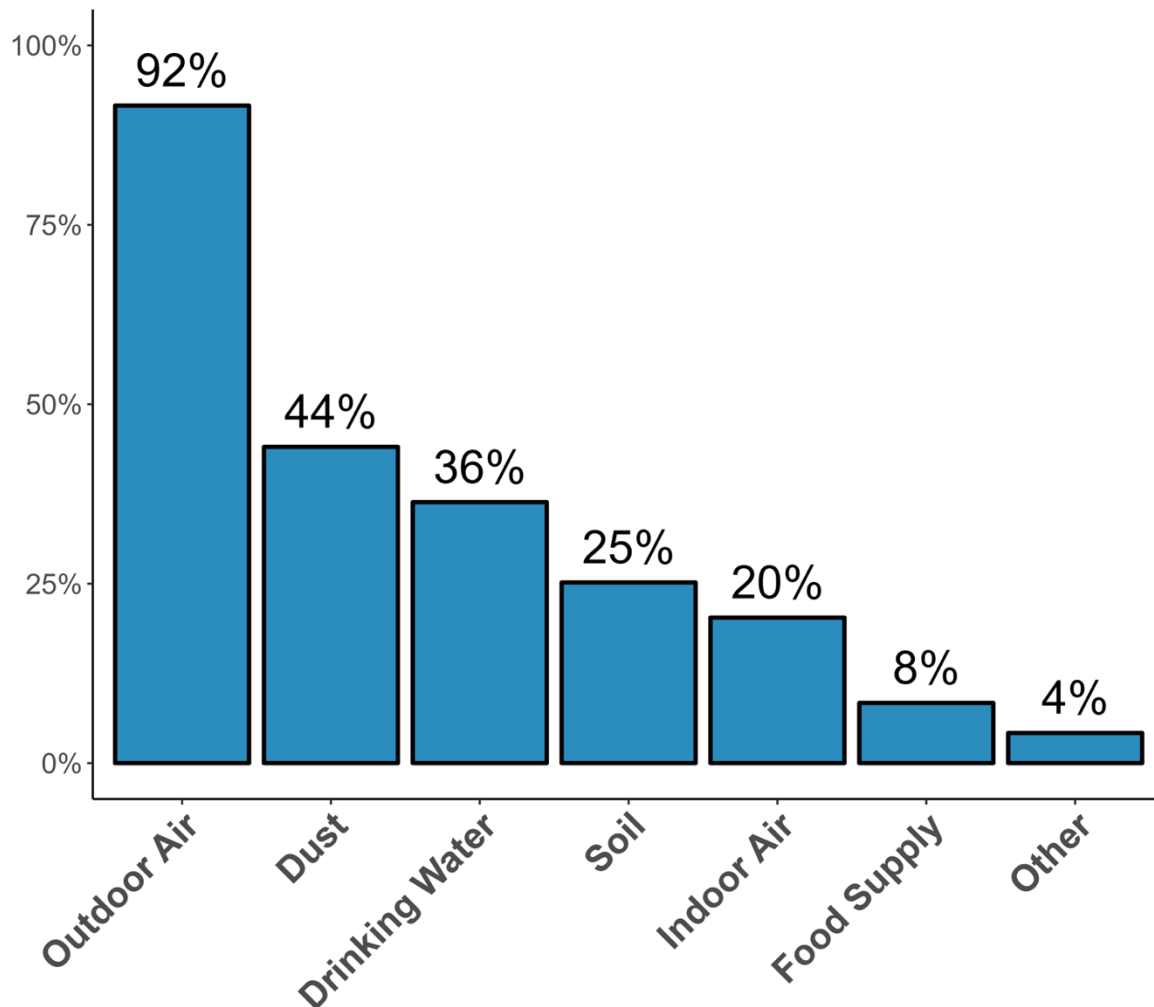
Figure 6. Percentage of survey participants who believed they were being exposed to pollution or harmful chemicals through various environmental media (e.g., outdoor air, dust)

When asked to name the specific facilities or other sources associated with pollution in their communities, most survey participants (57%) mentioned refineries. The next most common source of pollution identified was the trash incinerator (21%), followed by traffic (15%).

Odors and Air Pollution

Ninety-five percent of survey participants reported smelling odors in their communities. A higher percentage of Black participants noticed odors regularly than White participants (97% vs. 78%). In addition, 100% of participants living in the City of Chester reported odors regularly, whereas 85% of those living in Trainer and 82% in Marcus Hook did.

Odors and air pollution were identified by survey participants as key issues negatively impacting their health. Around three-quarters of participants reported negative physical health effects from odors and air pollution (74% and 69%, respectively), and around half reported negative mental health effects (52% and 45%, respectively) (Figure 7). Fifty-two percent of participants identified pollution and chemical exposures as one of the top three factors that most harm their health.
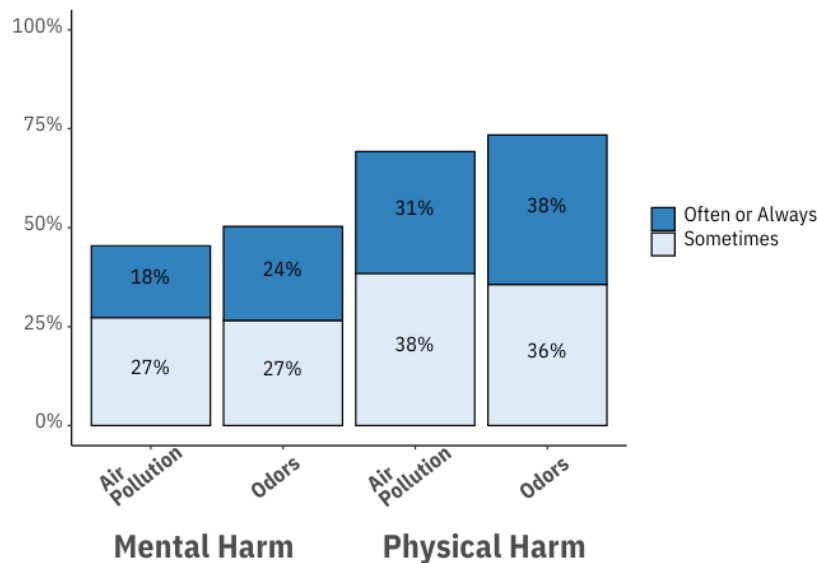
Figure 7. Percentage of survey participants who reported mental or physical harm from odors and air pollution and how often they experienced these harms

Focus group participants described odors and air pollution as inescapable and pervasive and having a significant impact on their activities of daily life, physical health, and well-being:

> *"It just smells so bad around here, like you gotta hold your breath…" - Participant 12*

> *"Sometimes the odors are really strong, you can get headaches… and even inside your house. If you have air filters… sometimes it helps, but sometimes even inside the house the odor's so strong. You can't open your windows. You can't, you know, leak your doors, [...] or anything like that, because [the odors] just come in. You smell it as soon as you pull into the neighborhood sometimes." - Participant 5*

"And then you're in a house because it's not even like it's a fleeting smell… It could be an hour. It could be three. So you're kinda putting your life on hold, trying to be as safe and healthy as possible." - Participant 22

Focus group participants also discussed how odors and air pollution impeded their ability to spend time outdoors.

"I feel like I need to travel somewhere other than here to enjoy the environment or outside. Be it to the beach or to the valley in Delaware, Pennsylvania. Beautiful areas, just to get a different view and a different area in which to go to, where you don't have to be so concerned with the environment and the air quality" - Participant 6
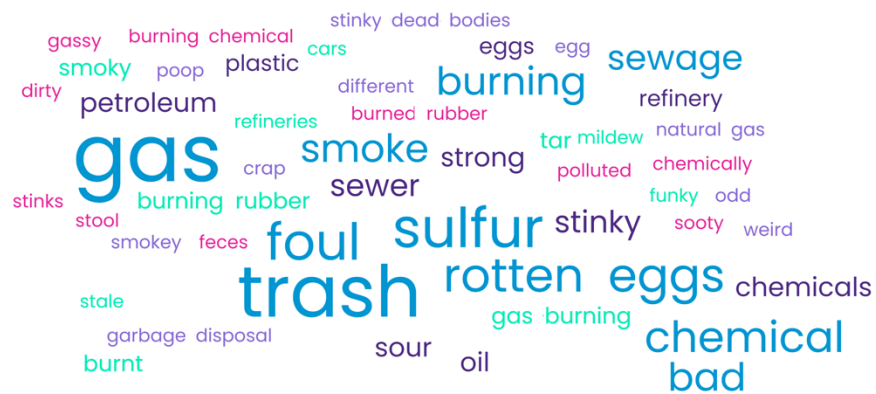
Figure 8. Words used by survey participants to describe odors in their community.

Noise

Around half of survey participants reported disruption of daytime activities (53%), sleep disruption (48%), or physical harm (56%) from noise in their communities (Figure 9) . A higher percentage of Black participants reported daytime disruption from noise than White participants (64% vs. 47%). In addition, more participants living in the City of Chester reported daytime and nighttime disruption (68% and 60%, respectively) than those living in Marcus Hook (46% and 40%) or Trainer (46% and 50%).
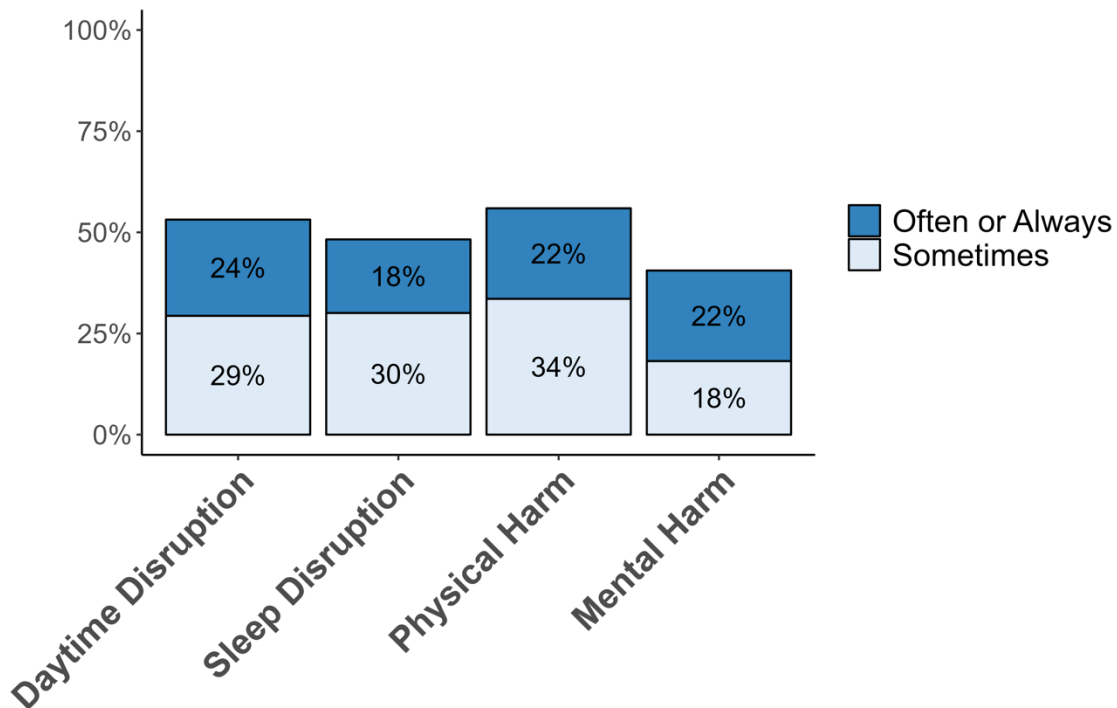
Figure 9. Percentage of survey participants who reported experiencing negative effects from noise in their communities and how often they experienced these harms

Focus group participants described noise as impacting their ability to sleep and get fresh air:

> *"[The noise] gets unbearable at times." - Participant 10*

> *"I'm on the train tracks, and the amount of dust and noise and smell that come from that constantly in the middle of the night, being woke up with loud boomings close by, when they're connecting trailers and stuff like that… I can't [open my windows] in the springtime, you know. You don't want to run your heat and air all the time. You like to open your windows as soon as the weather gets nice, and you can have a nice breeze blowing through. I can't do that. It's way too loud. Way too loud." - Participant 17*

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Access to Green Spaces

Overall, survey participants tended to agree with the statement, "People in my municipality live within a mile of a dedicated green space (e.g., park, garden)" (51% agreed, 24% disagreed, and 24% were neutral). However, when we examined opinions by municipality, we found that participants in the City of Chester were more likely to disagree (52%) than those living in Marcus Hook (18%) or Trainer (12%). Several focus group participants emphasized the lack of accessible green spaces in their community.

> "As far as trails, and we don't have a whole lot of open space here. Which is an issue, but it would be, you know, it's a pipe dream. Have things like that closer by that we'd be able to use?" – Participant 1

Safety of Local Environments

When asked about eating locally grown produce, 33% of survey participants felt it was unsafe, and 24% felt it was safe (Figure 10). One-quarter of survey participants reported having a home garden where they grow food for their household. Of these participants, none reported any testing of their soil for contaminants, although over half used raised beds. Local waterways were widely viewed as unsafe: 64% of survey participants felt it was unsafe to eat locally caught fish, and 64% believed swimming in the waters was unsafe. Of the four survey participants who reported fishing in local waterways, only one ate the fish they caught. Only 4% of survey participants reported swimming in local waterways.
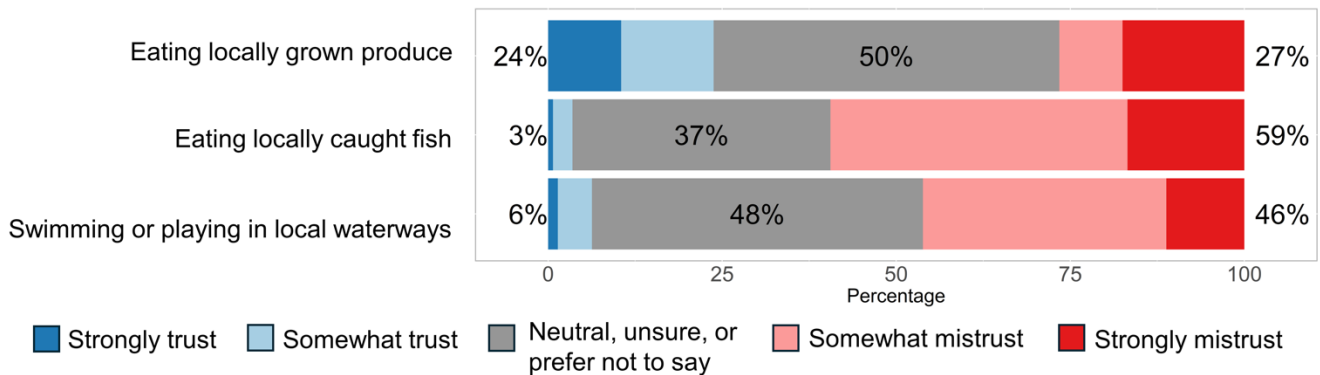
Figure 10. Percentage of survey participants who expressed differing perceptions of the safety of local soils and waterways

A few focus group participants emphasized the risk of unprotected pipelines near a busy street in their community, as they were concerned about a potential explosion or worse if a car accidentally hit the exposed pipelines:

> "...the fact that if there should be an accident, somebody comes off the road right at that curve where that auto operation is, they don't have far to go to hit those lines and

they're not protected… they're not buried. They're above ground. So where they are exposed, or in proximity to vehicular traffic. That, they need to be protected… we're we're just an accident waiting to happen in in this area of of Upper Chichester… Nothing... to me, doesn't gonna happen until something happens. Then you'll get everybody out here. Oh, well, "we should have done this, and we we should have done that". And and then that's when you'll get a fix when we actually have a catastrophe." - Participant 10

Perceptions of Industry and the Department of Environmental Protection

When asked if they trust local industrial facilities to adhere to best practices or pollution standards, around half of the survey participants (54%) indicated that they did not (Figure 11). Similarly, nearly half (49%) of survey participants felt mistrust regarding the Pennsylvania Department of Environmental Protection's efforts to oversee industrial facilities and hold them accountable for their polluting activities. 54% of survey participants were unsatisfied with the overall efforts of the government to protect their local environment (Figure 11). Only 18% of survey participants felt that their municipality was acting to protect people from climate change, while 40% thought these actions were not being taken, and 42% were neutral (Figure 12). Survey participants living in the City of Chester were more likely to express mistrust of industry and government (84% and 72%, respectively) than those living in Trainer (40% and 38%) or Marcus Hook (54% and 43%). Similar results were observed regarding satisfaction with government efforts to protect the environment: 84% of participants in the City of Chester were unsatisfied, whereas only 45% in Trainer and 54% in Marcus Hook were unsatisfied.
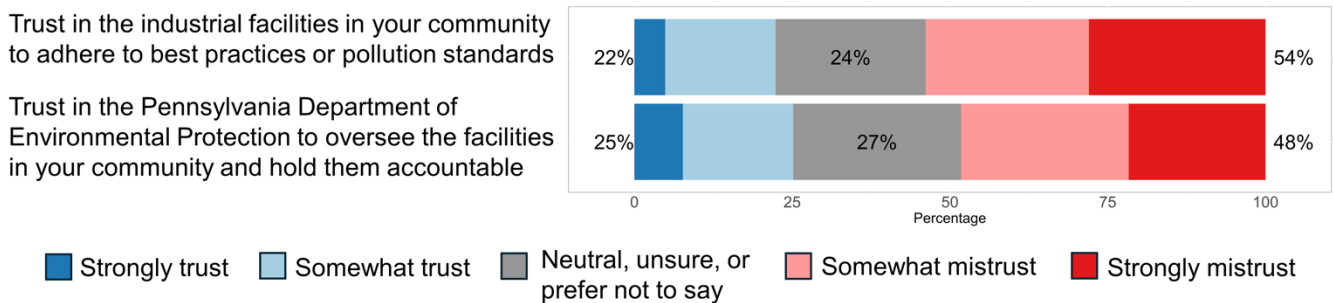
Figure 11. Percentage of survey participants who expressed various perceptions of trust in industry and governmental agencies
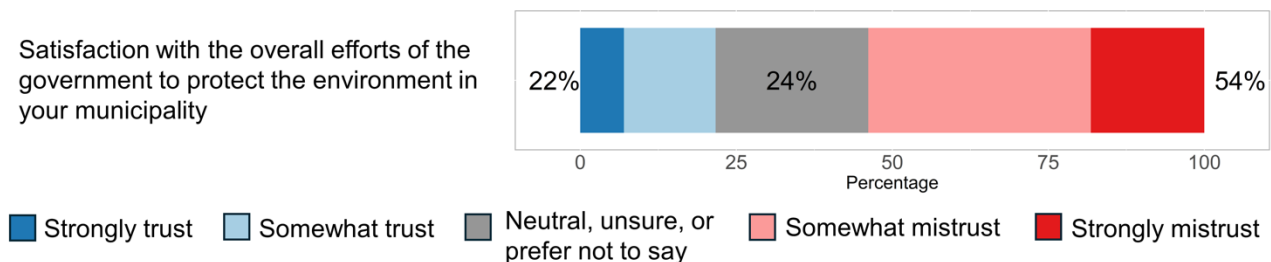
Figure 12. Percentage of survey participants who expressed various perceptions of satisfaction in governmental agencies

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In open-text responses, one survey participant stated that governmental agencies "have sold themselves to the industries they were to keep in line."

Focus group participants echoed these feelings of mistrust and doubted whether industries and refineries communicate the truth to the communities they impact. One participant identified an accountability gap:

> *"But nothing is harmful from what [industry] they say[s] to residents. But how you know how true that really is... No, I don't think anybody really knows."* - Participant 11

Physical Health

Key Finding: Adverse physical symptoms were common and interfered with daily life. Self-reports of adverse physical health symptoms (i.e., congestion, headaches, and cough) were more common than clinician-diagnosed physical health conditions (i.e., allergies, hypertension, and asthma).

Physical Health Diagnoses

Figure 13 shows the physical health conditions diagnosed by a doctor or healthcare professional while survey participants lived in Southern Delaware County. Allergies (43%), hypertension (26%) and asthma (25%) were the most common physical health diagnoses among survey participants. Of the 111 women who participated in the survey, 23% had suffered one or more pregnancy losses, including miscarriages or stillbirths. Physician-diagnosed long COVID was reported by 6% of survey participants. Nearly one-quarter (24%) of survey participants reported receiving no medical diagnoses while living in Southern Delaware County.
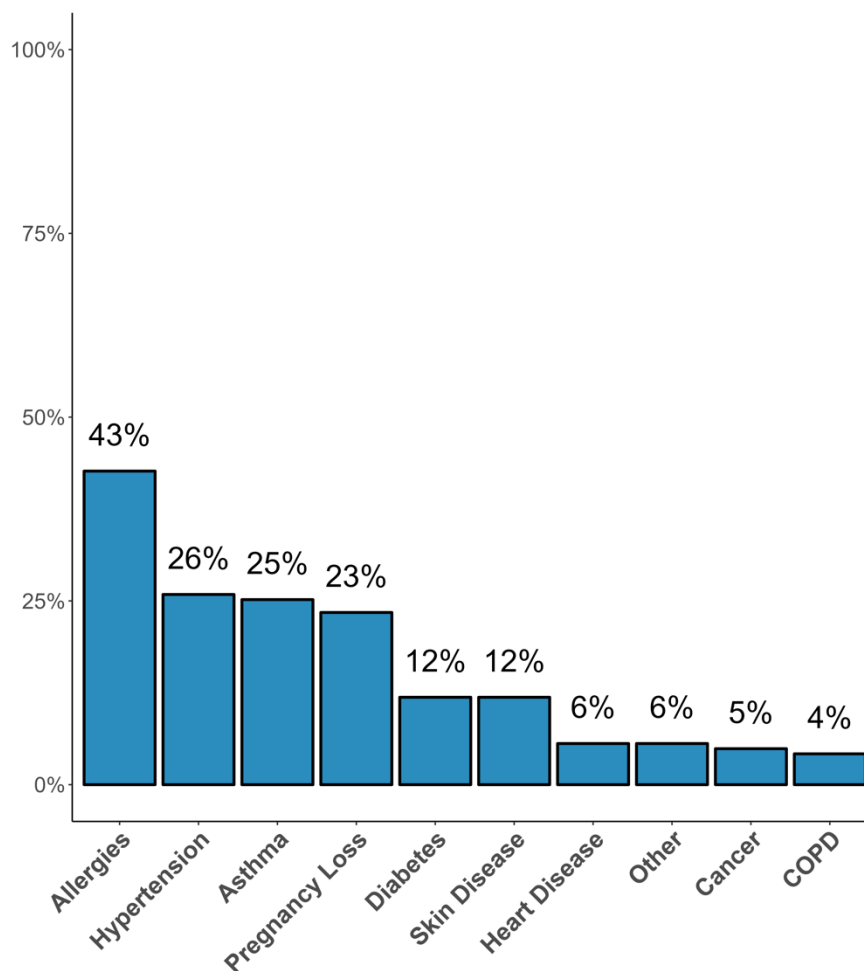
Figure 13. Percentage of survey participants who reported a medical diagnosis of various physical health conditions while living in Southern Delaware County

Focus group participants agreed respiratory health issues were a serious concern in their communities and identified cancer and diabetes as major physical health concerns.

> *"So I work in the healthcare field. There is a very [high] prominence of diabetes and respiratory [illness] whether it's asthma, COPD... I think cancer, too. I can't even tell you how many people in our community have been diagnosed with cancer within the past like 5-10 years. It's insane. I know more people than I have fingers... around here [who] have gotten cancer lately."* – Participant 4

> *"I know way too many people that have experienced that [mastectomies] in this community along with, oh my God, countless diabetics!"* – Participant 8

Self-Reported Physical Health Symptoms

Nearly three-quarters (72%) of participants rated their overall health as excellent, very good or good (instead of fair or poor). Most survey participants reported experiencing congestion (71%), headache (61%), cough (59%), or eye irritation (56%) within the past month (Figure 14).
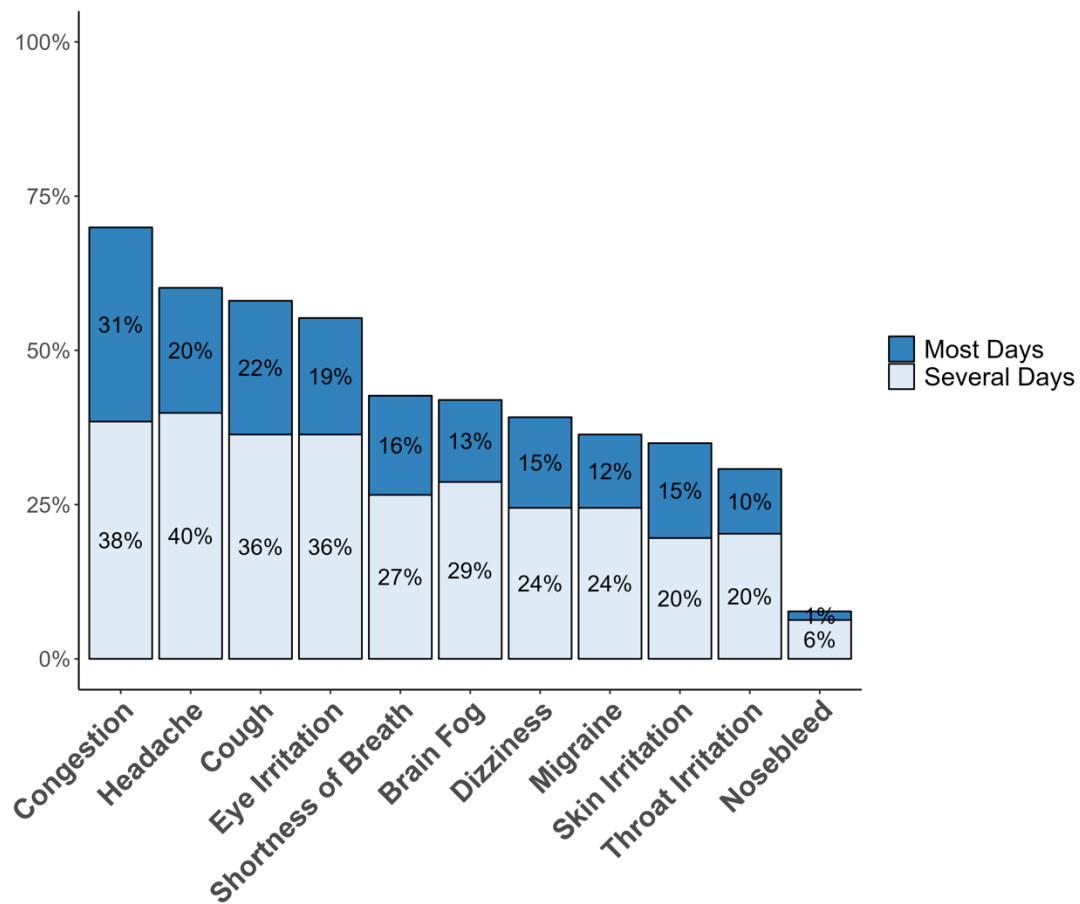
Figure 14. Percentage of survey participants who reported experiencing various physical health symptoms within the past month, and how often they experienced these symptoms (several days or most days)

When asked about long COVID-19, 10% of survey participants believed they were experiencing effects, and 8% were unsure. Self-reported symptoms of long COVID-19 were highly variable, but most included brain fog, shortness of breath, fatigue, and cough.

Impacts of Physical Health

As a result of their physical health diagnoses and symptoms, survey participants reported feeling like they accomplished less than they would like (50%), were limited in the types of work or activities they could engage in (33%), had difficulty performing work or other activities (33%), or cut down on the amount of time spent working (15%) (Figure 15).
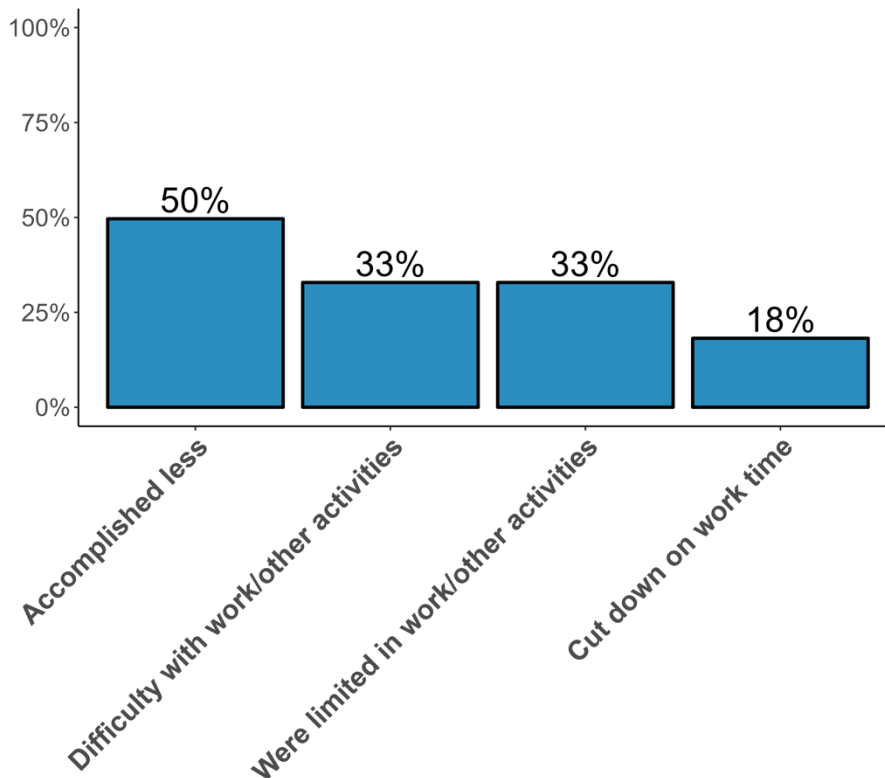
Figure 15. Percentage of survey participants who reported problems with work or other regular daily activities because of their physical health

Environmental Influences on Physical Health

Most survey participants reported experiencing physical harm from odors (74%) or air pollution (69%) (Figure 8).

Focus group participants explained how environmental health issues (i.e., odors and air pollution) directly impact their physical health symptoms and diagnoses.

"I think most of the issues that I have that would be caused from the environment would be just those bad odors, and then almost always having, like, you know, nausea or a headache on those days." – Participant 5

"Eventually, everybody's gonna have some type of respiratory issue with the bad, you know, air quality and the different fumes and stuff coming off of it, the refinery and all that [...] It's not healthy." - Participant 3

"I would say the same as lot of respiratory issues, and also lot of different types of cancers. I know that's like a number one cause, especially with, like the refineries and stuff along the waterfront. A lot of people have reported that they have been like being diagnosed with like lung cancer and issues like that." - Participant 20

Survey participants were divided on the statement "The infrastructure (e.g., sidewalks, lighting, trails) in my municipality makes it easy to be physically active." (41% agreed, 41% disagreed, and 19% were neutral). Several focus group participants described how their environments limit their ability to engage in physical activity:

"I think a big thing is the opportunity to go outside and have a space that you can be active in... But there isn't really a big park around here." - Participant 2

"We really don't have any walk paths or anything like that. So that's one thing that I wish that we would have... Getting back to physical activity... walking trails as [other focus group participant] said, bike paths, things of that nature would certainly, you know, help people stay healthy and active." - Participant 1

Other Influences on Physical Health

 Focus group participants highlighted other influences on their physical health, including the presence of frequent gun violence in their community. A few participants expressed concern over spending time outdoors and exercising due to the fear of gun violence.

"Yes, safety is definitely an issue and gun violence… And going back to the physical thing. You know, you don't want to go out and maybe jog in your neighborhood because you too afraid, you know, you're gonna get robbed." - Participant 21

Focus group participants also noted physical harm associated with the lack of accessible healthy foods in their communities.

"We don't have the proper stores to shop in to get fresh fruits, fresh items and processed food is part of part of what's killing us." – Participant 8

Mental Health

Key Finding: Adverse mental health symptoms were common and interfere with daily life. Self-reports of mental health symptoms consistent with depression and anxiety were more common than professional medical diagnoses of these conditions.

Mental Health Diagnoses

Twenty four percent of survey participants reported diagnosis by a doctor or healthcare professional of a mental health condition while living in Southern Delaware County. Survey participants were given the option to share specific mental health diagnoses if they felt comfortable. Depression (10%) or anxiety (14%) were the most common mental health diagnoses shared by survey participants.

Self-Reported Mental Health Symptoms

Using a validated screening questionnaire to assess symptoms of depression and anxiety [19], we found that 52% of survey participants reported feelings consistent with one or both mental health conditions during the past two weeks. Survey participants were more likely to report symptoms suggestive of anxiety disorder (49%) than depression (36%). Overall symptoms of anxiety or depression were classified as mild in 32% of survey participants, moderate in 13% and severe in 8%.
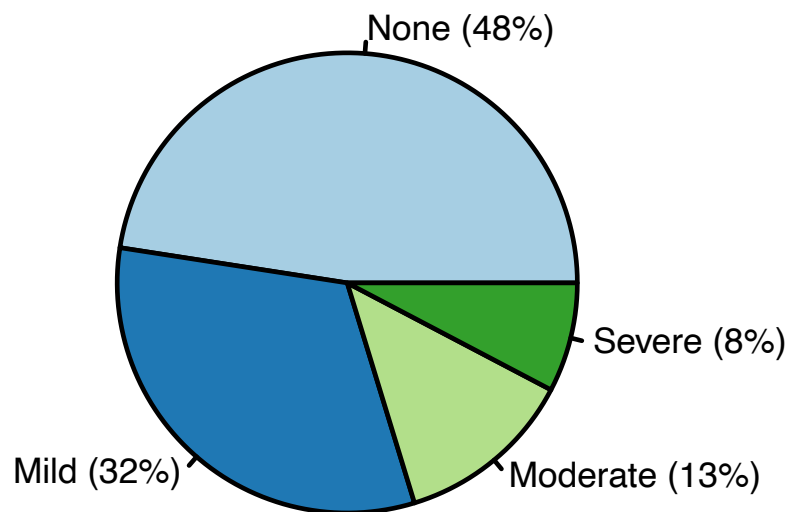
Figure 16. Percentage of survey participants who reported symptoms of depression and/or anxiety and the severity of these symptoms

Impacts of Mental Health

As a result of their mental health symptoms, survey participants reported feeling like they accomplished less than they would like (45%), did not do work or other activities as carefully as usual (30%) or cut down on work time (26%).

Many survey participants also expressed feeling that mental health conditions were not recognized or stigmatized in their communities (41% agreed, 24% disagreed, and 35% were neutral).

Focus group participants echoed these sentiments:

> "I think we have to get rid of the stigma of going to a provider to seek treatment. […] A lot of people will be like, "I don't need a therapist, that's crazy. I'm good". But in reality, like, I think we just need to get rid of that stigma. You know, that we don't need help, or that we shouldn't use providers." – Participant 22

Environmental Influences on Mental Health

Around half of the survey participants reported experiencing mental health impacts from odors (45%) or air pollution (51%) (Figure 8).

Focus group participants explained how environmental health issues (i.e., noise, odors, etc.) directly impact their mental health, illustrating how these factors often interact.

Figure 17. Percentage of survey respondents who reported problems with work or other regular daily activities as a result of their mental health

> "I like to open the windows and the shades and look out over the trees, and it's a cute neighborhood in which I live in. […] But once the train starts rolling by, I can't hear. I can't hear TV. I can't hear anything but that train, making that loud, loud noise constantly, and so then I shut the window and I close myself off to that, and mentally for me that that's not good, because I am so confined to my home environment at this point that any kind of outside air or enjoyment of birds and nature is cut off... it's cut off immediately." - Participant 17

> "I feel like factors pertaining to this that influence my mental health is just freedom, like being able to go out when I want to have my grandkids be able for us to walk, go to the park and play, but if it smells kind of bad" - Participant 22

Other Influences on Mental Health

Focus group participants identified many aspects of their communities and their life circumstances that can negatively impact their mental health. Many participants noted that lacking financial and other resources to support health is a significant source of stress in their lives.

> *"Not having a job, you know, not being able to afford your rent and stuff, that could also lead to depression. You're just trying to figure things out pretty much, and you can cause yourself to be anxious."* – Participant 20

> *"It's hard to have good mental health when you're stressing about health care.*" – Participant 13

Focus group participants expressed how the aftermath of the COVID-19 pandemic still impacts their mental health.

> *"I think the COVID has had a big issue with the community, and our mental health as well. We're much more isolated, or at least I am. I don't attend a lot of social indoor functions. I think that takes away from your support system."* - Participant 7

Some focus group participants also expressed overall mental health concerns due to the stress from having such busy lives and not having enough time to do everything they want to.

> *"We just don't have enough time to do everything. And you get stressed out trying to fit it all in."* - Participant 15

Many participants also highlighted the feedback loops between mental health and the prevalence of substance use, two factors that often impacted each other in their community.

> *"Drugs [are] really a mental health issue as well. It's a component, because people usually take start taking drugs because they can't cope with society. And so where I am, it's very big... It kind of goes under the radar still, because we're in the lower end of the county. But it's very large, and I think that again we won't see a real reduction in drug consumption until we can correlate that to the mental health and the mental health is a result of the societal pressures that people feel. you know. So they turn to something to escape, and that happens to be drugs."* - Participant 13

Children's Health

Key Finding: Adverse mental health symptoms were common and interfere with daily life. More children experience symptoms consistent with asthma (e.g., wheezing and coughing) than have clinician-diagnosed asthma.

Medical Diagnoses

Over half (58%) of children living in households of survey participants received one or more medical diagnoses while residing in Southern Delaware County. Allergies (30%) and asthma (22%) were these children's most reported medical diagnoses. In the past 12 months, 28% of children received medication treatment for asthma or other breathing issues, with 19% currently taking asthma medication daily.
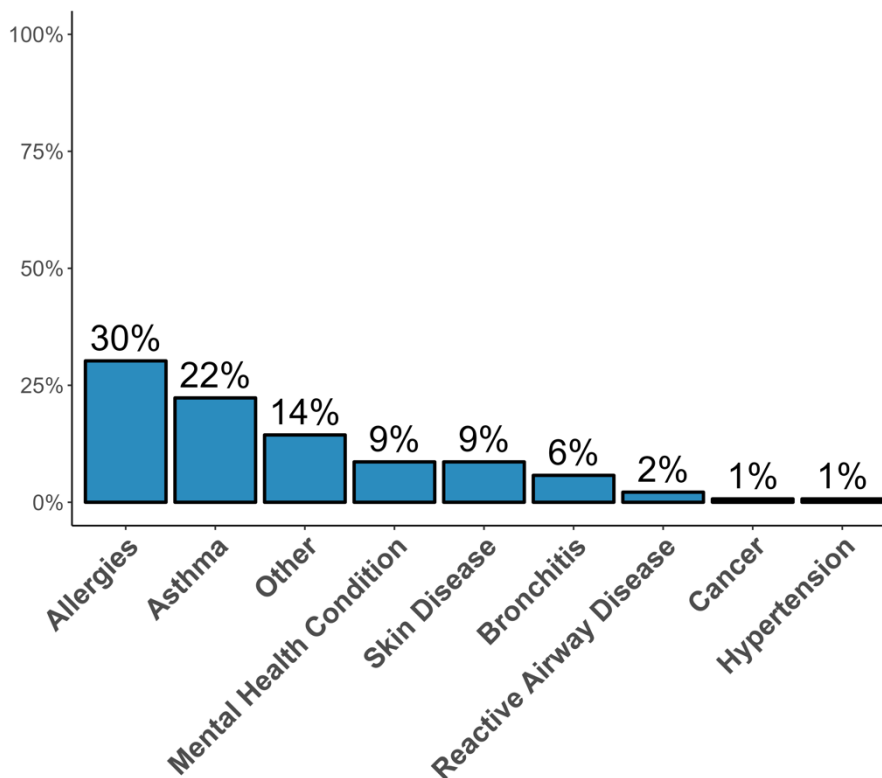
Figure 18. Percentage of children living in the households of survey participants who were reported to have various medical diagnoses

Nine percent of children were diagnosed with a mental health condition, most often anxiety or depression. Other diagnoses listed by survey participants included autism spectrum disorder, which was reported for 6% of children living in survey participants' households.

Reported Health Symptoms

Nearly half of children living in the households of survey participants experienced headaches (49%) and congestion (47%) over the past month. Eye, skin, and throat irritation were also

reported for 25 to 30% of these children. 14% of children experienced nosebleeds during the past month. One survey participant noted that nosebleeds were a recurring problem for her grandson:

> *"My grandson has experienced frequent nosebleeds for his entire life, sometimes several times in a single week. It has lessened in frequency in the last couple of years but still continues. Our home is less than 10 yards from the CSX train tracks."*
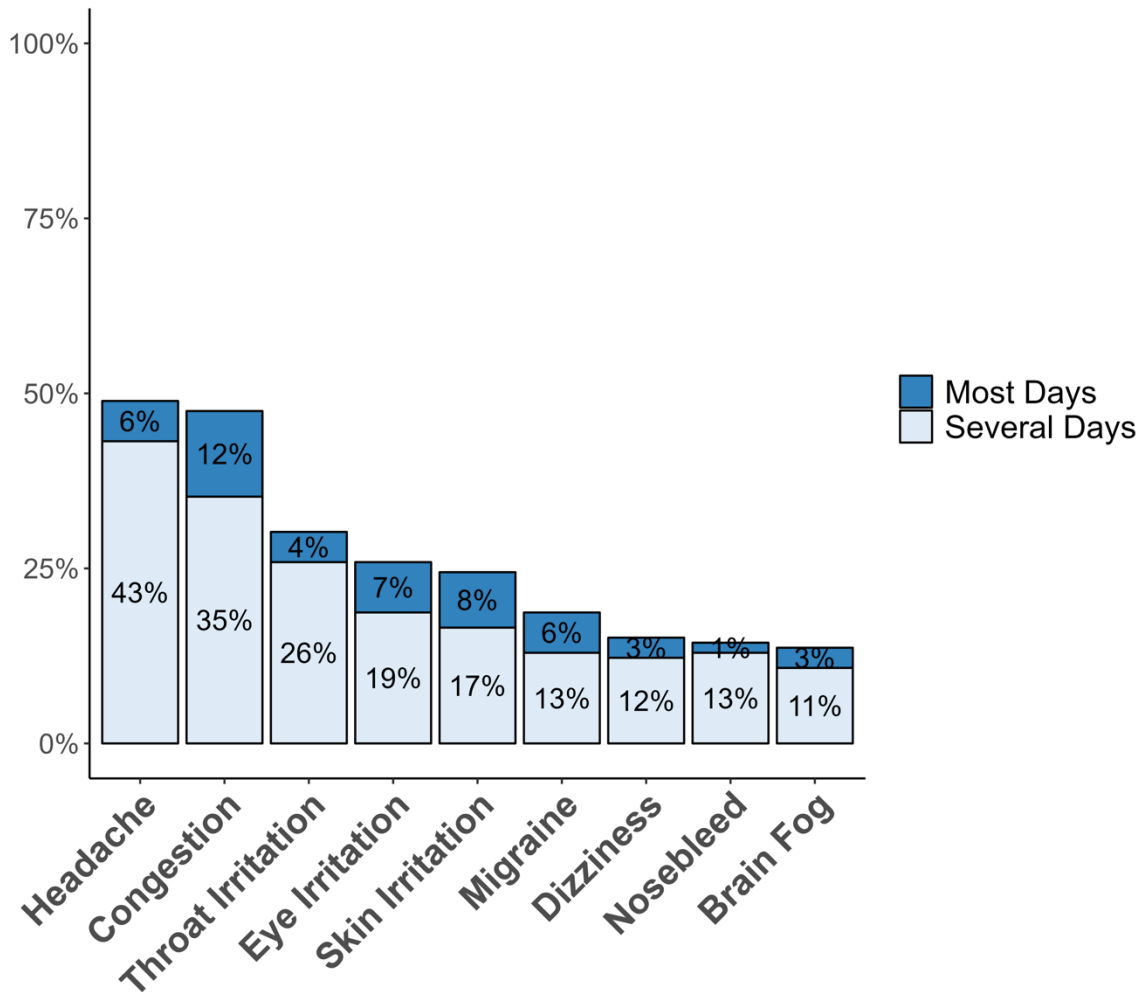
Figure 19. Percentage of children living in the households of survey participants reported to have experienced physical health symptoms within the past month, and how often they experienced these symptoms

When we rated reported respiratory symptoms in children (e.g., wheezing, coughing) using established diagnostic criteria for asthma, [20] we found that 41% of children met the criteria for asthma based on their symptoms (36% for mild intermittent and 5% for moderate to severe asthma). This suggests that there is a higher prevalence of asthma in children living in Southern Delaware County than indicated by medical diagnoses, which were reported for 24% of children. Across the U.S., the average prevalence of asthma in children is only 7%. [21]

Because of asthma symptoms, children were reported to have missed school 1 to 2 times per year (19%), 3 to 12 times per year (4%) or more often (2%). Survey participants reported having to miss work on a similar frequency.
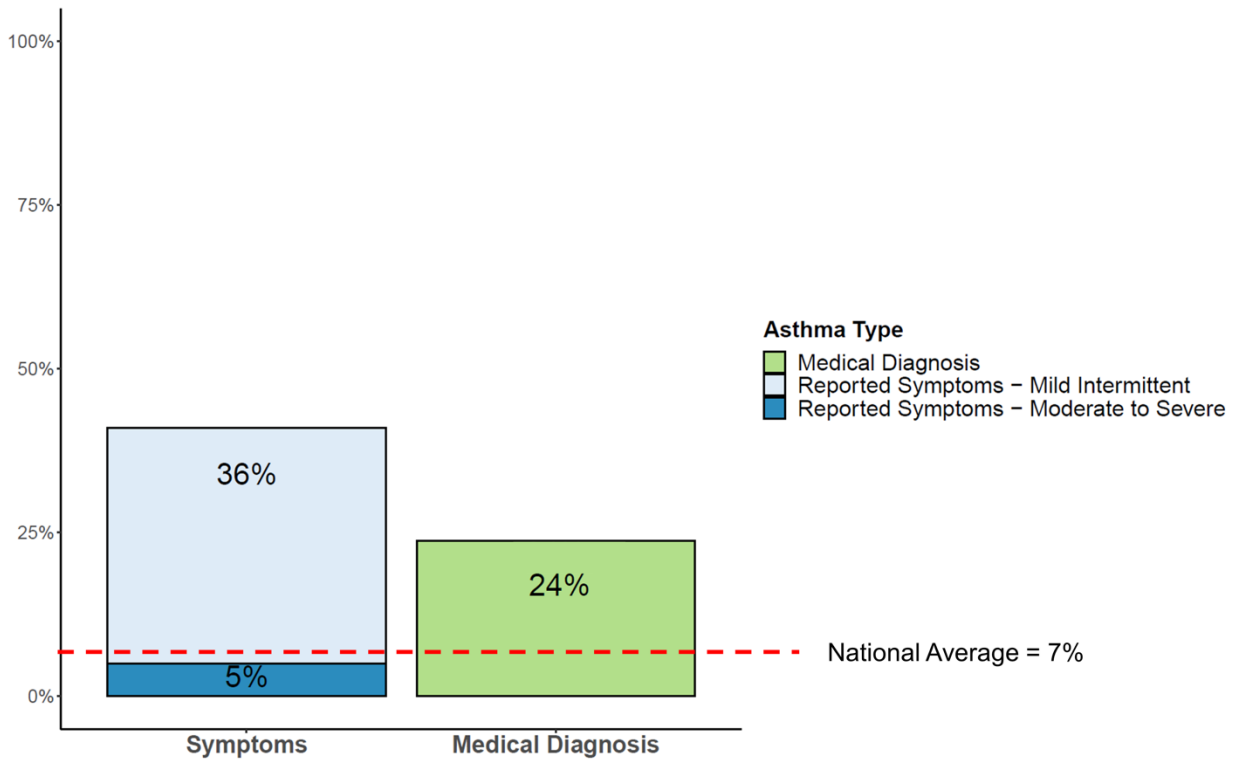
Figure 20. Percentage of children living in the households of survey participants who have asthma, based on reported symptoms and on medical diagnosis and compared to the national average

Environmental Influences on Children's Health

Sixty percent of survey participants felt that the children living in their households attended schools on busy roads or near high-traffic areas. Most participants (84%) felt that children had adequate access to clean and safe drinking water at home and school. When survey participants were asked whether there were safe and accessible green spaces (e.g., parks) in their community for their children to play in, 76% responded yes, and 15% responded no.

Focus group participants also noted how the pollution and lack of green spaces in their communities particularly impacted their children's quality of life:

"Another thing I'm thinking about, too, was activities for the children. They don't have a lot of places to go to" - Participant 9

"You wanna take your kids [for a] bike ride or you wanna go walkin[g], but you can't." - Participant 22

"It just doesn't seem safe, too, especially with [...] kids, you can't take them outside to play because you don't want them sucking up all this odor into their lungs, not knowing really what it is." - Participant 5

Other Influences on Children's Health

In addition to concerns surrounding children's environments, focus group participants also expressed other pressing issues impacting the health of youth in their communities including vaping and teen pregnancy.

"My grandson... in the fifth grade they were passing around vapes in the classroom and fifth graders, and the parents and teachers trying to figure out where they even obtained it and couldn't. But it was like a[n] issue every day... they would pass around and share it at that level. So it has become really big..." - Participant 8

"...and I think just seeing a lot of things with the youth... [like] teenage pregnancy..." - Participant 9

Community Strengths and Assets

Key Finding: Participants were proud of their communities and felt a strong connection and support from other community members.

Most focus group participants highlighted their pride in their community's diversity, small-town feel, and the care embedded in interpersonal community connections.

> *"I am so grateful to be here, and I'm really happy and proud about everything in our community."* - Participant 20

> *"What I'm proud about […] is the diversity that we have here."* - Participant 1

> *"I like how the neighbors, we share things together. We have a sense of community. We enjoy each other's company. We have a lot of parades and activities in the borough."* - Participant 7

> *"I am really a Chester addict, I guess. Because I know good people are born and raised here. So I'm proud of the community in which I come from, and the people who I really love and care about you in your neighborhoods. That's what I grew up when I was just telling someone that I grew up in a school full of teachers that loved you, that loved on you, and I'm proud of who they were to help me become who I am. And I really appreciate the educators and in the community as well as the people, neighbors."* - Participant 8

Community members in this area stay because when their neighbors experience the impact of various environmental, physical, and mental health factors, they show up for one another. Neighbors are swift in their responses to support their fellow community members. Most focus group participants noted the care shown by others in their boroughs and also emphasized how they felt very supported in their communities as they expressed a high sense of belonging and comfort.

> *"The community does really come together when there's events for families in need."* - Participant 4

> *"I have 2 kids that are both a part of Chichester School District, and honestly, probably the thing that I'm most proud of in our community is just how, if somebody needs something, everybody will rally around and get it for them. We've had, you know, people who have gone through medical issues, and the community just comes together. And they do beef and beers. They, you know, do 50/50 tickets. They will come together to,*

you know, make sure that everybody has what they need, and that's one of the big reasons why I stay here and why, my kids will stay here until who knows when. So yeah…" - Participant 2

"... Chester's small and everyone knows everybody. And for the most part, everyone looks out for each other" - Participant 20

Focus group participants even touched on the fact that it can be a privilege to be in a position to help someone else experiencing adversity, but that it is important to try and support others as much as possible.

"It's like the air, the airplane theory. We can't possibly help someone else [if] we can't breathe [ourselves]. If the oxygen gas comes down, we have to help ourselves first in order to be able to help someone else, and that's kind of where we are... I do realize that there are some people in a better space or position than others, and where we can give and help. It's important that we do." - Participant 8

These sentiments of community pride and connection reflect the resilience of fenceline communities. Participants continue to reside in their homes because they are proud of the connections to others in their communities and the support they provide in response to the onslaught of daily environmental, physical, and mental health burdens.

Other Personal and Community Challenges

Key Finding: In addition to pollution and other environmental concerns, Southern Delaware County residents often faced many other challenges (e.g., limited financial resources, food insecurity).

Number and Type of Challenges

Survey participants reported numerous personal challenges. As shown in Figure 21 Panel A, over half of the survey participants reported issues with the quality of their current housing (62%) or with food insecurity (58%), and nearly half reported experiences of racism or discrimination (43%) and financial insecurity (39%). Moreover, most participants (80%) reported currently experiencing more than one challenge (Figure 21 Panel B). Specific personal and community challenges are discussed in further detail below.
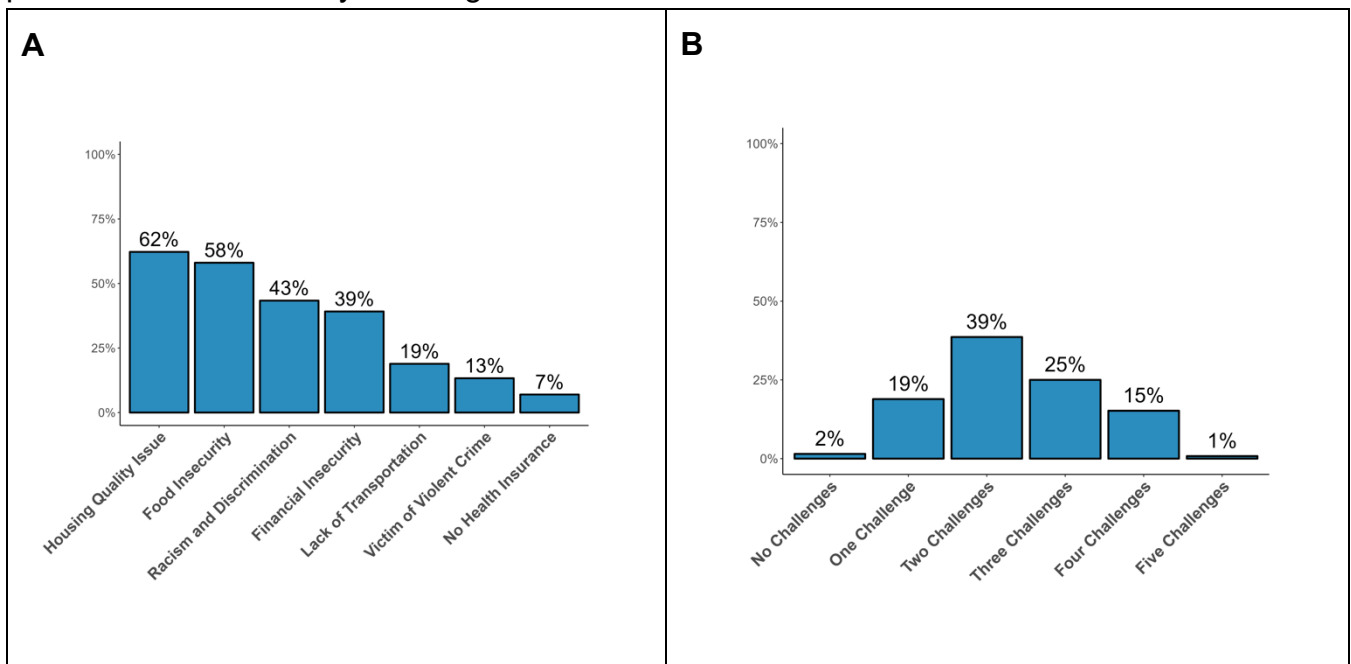
Figure 21. Percentage of survey participants who reported various types of personal challenges (Panel A) and different numbers of total personal challenges (Panel B)

Housing

Nearly two-thirds of survey participants (62%) reported one or more issues with their current housing situation, most commonly the need for minor repairs (28%), bugs or rodents (24%), need for major repairs (22%), or mold (18%) (Figure 22). Survey participants were slightly more likely to own (45%) than rent (39%) their homes. Eight percent of survey participants reported having trouble affording the cost of their home. Of the 56 renters in our study, 9%

reported being at risk of being evicted from their rental properties. Three percent of survey participants did not have a steady place to live.
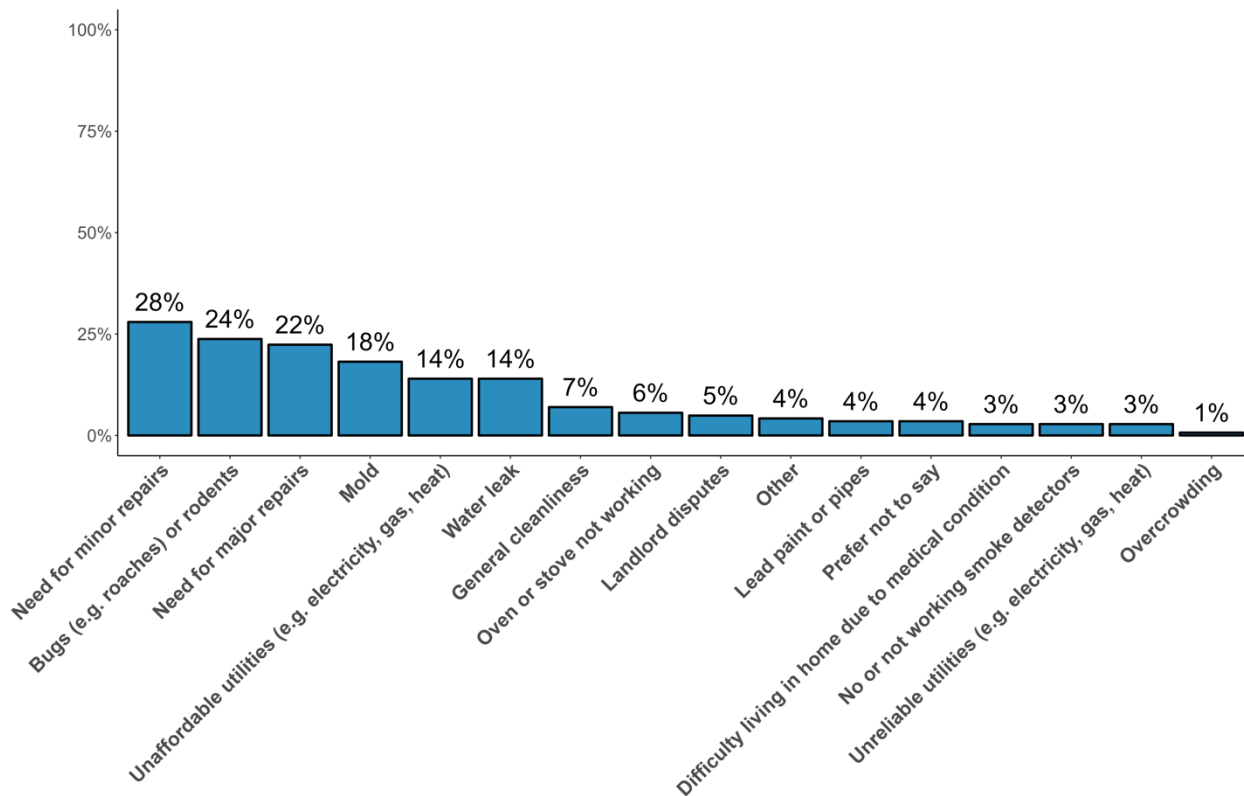
Figure 22. Percentage of survey participants who reported various issues with their current housing

Only 24% of survey participants believed that safe housing (e.g., free from mold and other issues) is available and accessible to everyone in their community. In comparison, 39% felt there was a lack of safe housing, and 36% were neutral. Even fewer survey participants (21%) thought that everyone in their communities has access to affordable housing (54% indicated that housing is not affordable for all, and 25% were neutral). A smaller percentage of participants in Chester (8%) agreed that safe housing is accessible than in Marcus Hook (25%) and Trainer (27%). In comparison, a smaller number of participants in Marcus Hook (7%) agreed that there is access to affordable housing than in Chester (20%) and Trainer (29%).

One focus group participant highlighted the paradox between the presence of abandoned homes and the barriers to purchasing them.

> *"Yes. And then when you ask questions about them [abandoned homes in their community], they [the city] act like you can't even purchase the […] homes and all that. It's like we have all these abandon[ed] buildings, but they [the city] don't let them be available for people to purchase… I know, we have asked about a lot of different vacant places like right by our church, but they […] will say that always "owned by somebody". But you never see any, any activity, nothing ever done with the places or the area. Like,*

how do we... how can we actually purchase places in our own community?" - Participant 9

Food Security and Access

Fifty-eight percent of survey participants were at risk for food insecurity. This means that within the past 12 months, they were worried about running out of food or could not buy sufficient food.[22] Most survey participants (57%) disagreed with the statement that "healthy foods are affordable for all" (22% agreed, and 20% did not state an opinion). A greater percentage of participants living in Chester disagreed (84%) than those in Marcus Hook (54%) and Trainer (35%).

Overall, forty-eight percent of survey participants disagreed with the statement, "People in my municipality live within a mile of a grocery store that carries fresh produce.". At the same time, 36% agreed, and 15% were neutral.

Many focus group participants noted that access to healthy foods was limited in their community:

> *"...so we haven't had a supermarket for decades. And so it's a challenge. And to get healthy things that can sustain life… So even when you can go and you have a vehicle, or you can get on the bus to go to get healthy things. They're gonna be priced usually out of your out of your range."* - Participant 13

Racism and Discrimination

When asked about personal experiences of racism or discrimination while living in Southern Delaware County, over 40% of survey participants reported these experiences regularly. Black participants reported encountering racism more frequently than White participants. Survey participants were divided on whether systemic racism in Southern Delaware County has increased in frequency over the past five years (Figure 23). Twice as many participants thought that systemic racism was somewhat or very serious (39%) than thought it was somewhat not serious or not at all serious (18%) (Figure 24).
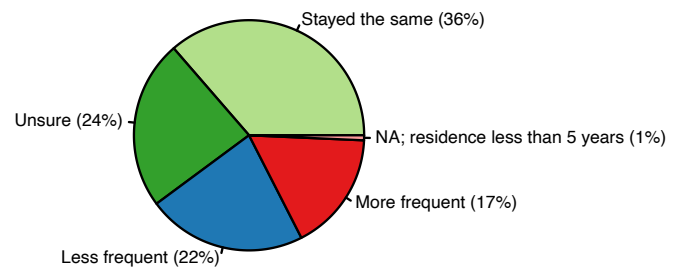
Figure 23. Percentage of survey participants who expressed various opinions on the frequency of systemic racism (as compared to 5 years ago)
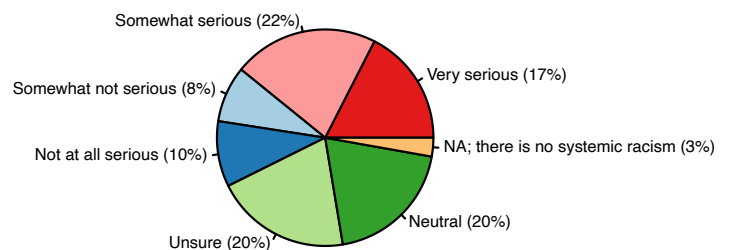
Figure 24. Percentage of survey participants who expressed various opinions on the severity of systemic racism in Southern Delaware County

Financial Status

Twenty-nine percent of survey participants had "medium low" financial well-being, indicating minimal savings, difficulty making ends meet, and issues with obtaining credit. A further 18% had "medium high" financial well-being, characterized by saving into retirement accounts, paying off credit cards, and having low frequency of food insecurity. The remaining survey participants were approximately equally distributed throughout the other categories (Figure 22), which are defined by a well-established methodology used by the Consumer Financial Protection Bureau documentation. [23]
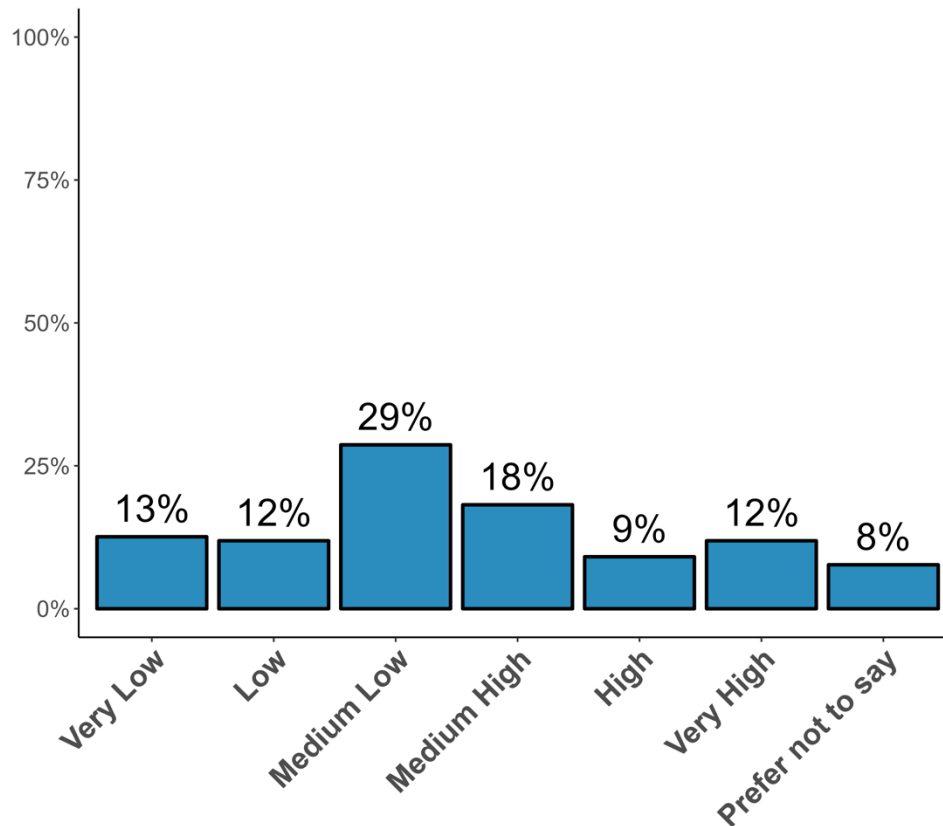
Figure 25. Percentage of survey participants with various financial well-being categories

Focus group participants also discussed financial difficulties among community members.

> *"I know personally several families in the neighborhood that struggle with that [economic] decision every payday. You know, what are they gonna do with this money or they're paying bills. They're overdrawing their account. And you know, by the next week their paycheck is just compensating for the money that they lost."* – Participant 5

Transportation

Around 10% of survey participants did not have consistent access to reliable transportation in the past 12 months, which kept them from medical appointments or filling medications (9%) or work, non-medical appointments or obtaining other needed items (13%). Nearly half of the survey participants felt that people of all ages and abilities had access to reliable public transportation (48% agreed, 17% disagreed, and 35% were neutral) and safe (42% agreed, 23% disagreed, and 35% were neutral). Opinions on public transportation were similar in the City of Chester, Marcus Hook, and Trainer.

Crime and Safety

Thirteen percent of survey participants identified as victims of a violent crime while living in Southern Delaware County. Black participants were significantly more likely to be victims of crime than White participants. Crime and violence were identified by 27% of survey participants as one of the top three factors negatively affecting their health. Overall, survey participants were divided on the statement: "There is not a lot of crime in my municipality," as 40% agreed, 26% disagreed, and 24% were neutral (Figure 26). However, when we examined agreement with this statement by municipality, we found that a greater proportion of participants in the City of Chester disagreed (80%) than those in Marcus Hook (29%) or Trainer (12%).

In general, more participants agreed than disagreed that people feel safe in their communities (44% vs. 35%) and that existing infrastructure (e.g., sidewalks) makes their community safe and accessible for everyone to navigate (41% vs. 34%). Approximately equal proportions of participants agreed and disagreed that their community is free from graffiti and vandalism (37% vs. 39%). Participants living in the City of Chester again were more likely to disagree with each of these statements (76% to 88%) than those in Marcus Hook (21% to 39%) or Trainer (10% or 21%).
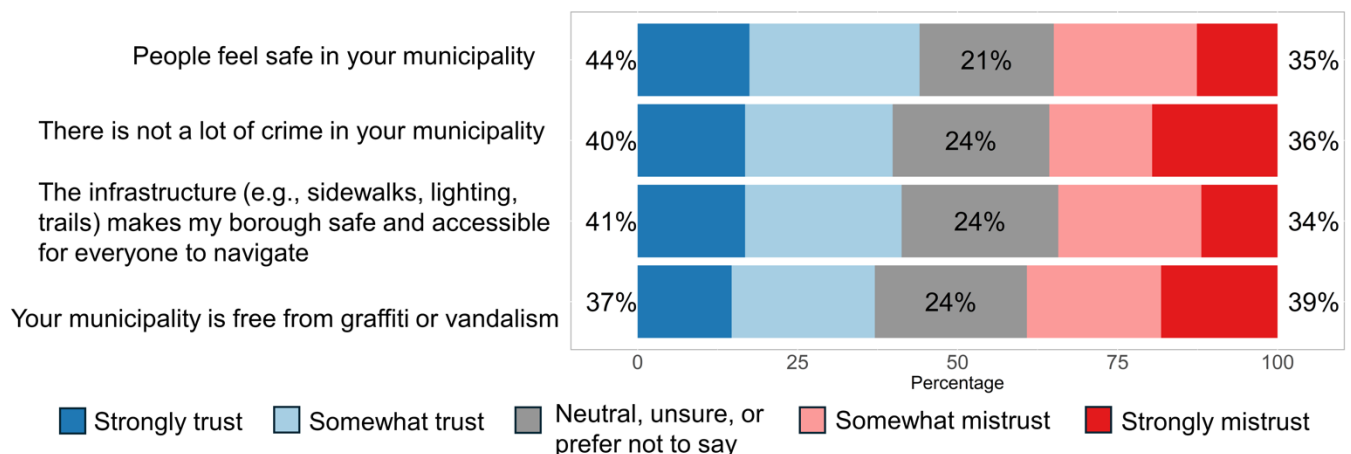
Figure 26. Percentage of survey participants who expressed various perceptions of crime and safety

Healthcare

Most participants had health insurance (93%), and a few (7%) reported being denied insurance coverage in the past three years. However, some survey participants reported waiting three or more months for a medical appointment (29%) or refusing recommended medical treatment or medications because of the cost (21%) within the past three years.

More survey participants agreed than disagreed that people in their communities have access to basic healthcare services (42% vs. 27%). The opposite was true for specialized healthcare services (27% agreed people have access while 38% disagreed) (Figure 27). Only 17% of survey participants felt that mental healthcare services are accessible to everyone in their communities (Figure 27).
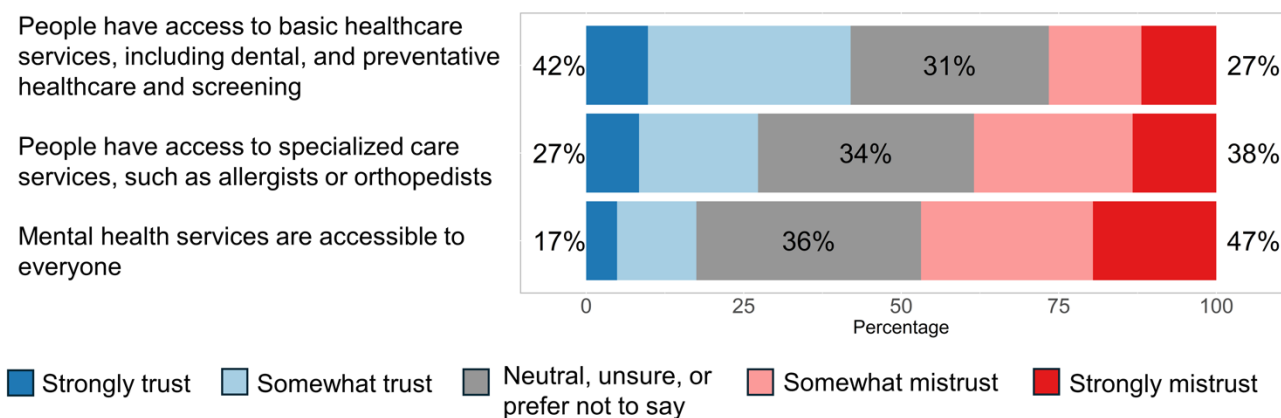
Figure 27. Percentage of survey participants who expressed various perceptions of healthcare access

Healthcare accessibility was raised by focus group participants as well:

> *"I have patients that are waiting months to just get in with behavioral health. […] A big block that a lot of people have is not having insurance, and even when they do have insurance, you know Medicaid is not accepted everywhere. And so there is very long waiting list, and not enough providers to help support these patients that need help."* – Participant 4

Overall, opinions regarding healthcare access were similar across municipalities. However, a smaller percentage of participants in Chester (16%) agreed that specialized healthcare services were available than in Marcus Hook (29%) and Trainer (31%).

Employment and Education

One-quarter of survey participants reported they could not complete the desired education or career skills training because of costs or other barriers. Survey participants had negative perceptions of employment opportunities in their communities: only 17% thought people could easily acquire full-time employment, and 12% thought they could earn $15 per hour or more (Figure 28). Similarly, only 15% of survey participants believed there were opportunities to build generational wealth in their communities. More survey participants disagreed than agreed that people in their communities have access to career skills training (42% disagreed and 26% agreed) and to quality education (38% agreed vs. 29% disagreed). A greater percentage of participants in the City of Chester (76%) disagreed that quality education was available than in Marcus Hook (29%) or Trainer (23%).

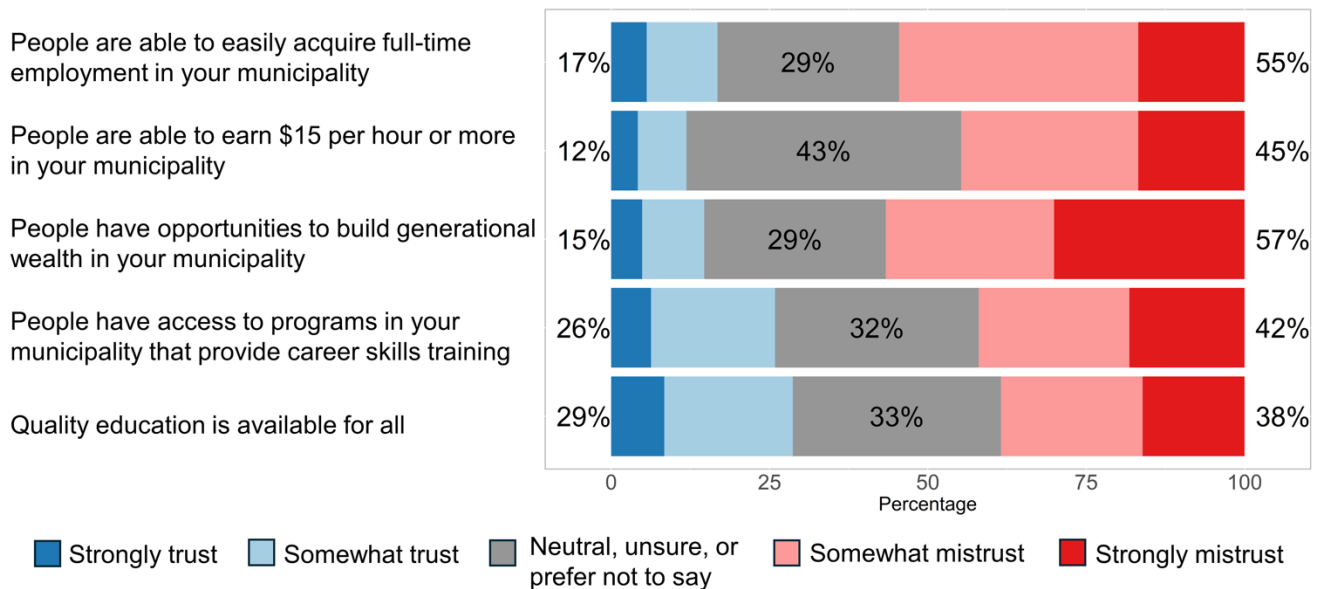*Figure 28. Percentage of survey participants who expressed various perceptions of employment and educational opportunities*

Cumulative Impacts

Key Finding: Participants who faced more challenges in their lives tended to have poorer health. Participants keenly acknowledged the compounding burden of environmental, physical, and mental health challenges in their communities.

Many focus group participants communicated that environmental, physical, and mental health challenges are not isolated but connected and overlap. Building on the idea that environmental, physical, mental, and non-health challenges are connected, some focus group participants highlighted the nuance of the compounding effects of these influences on their well-being. Several participants described multiple challenges as having a domino effect, with cascading harms to their well-being.

> *"If you're not physically healthy, your mental health is affected, and vice versa: if your mental health is not healthy, can affect your physical health, which also ties into, you know, being able to sustain a job to get that income that you need to obtain the resources to be healthy. It really just all ties in together. We always separate the two [physical and mental health], but it really is a combination that is a domino effect each way..."* - Participant 4

> *"I mean, if everything's going right, your mental health is also... It also comes into play, which you know kinda goes hand in hand with your physical health cause if you're not mentally healthy, you're definitely not physically healthy."* - Participant 15

> *"I think that's how like it all comes together. It's like in a circle. Like a domino effect. The air is bad. You become sick. Your family becomes sick, you can't work. and you can't go to work because you can't pay anybody because you keep calling off from work..."* – Participant 22

To examine how the multiple personal challenges displayed in Figure 21 might affect the health of survey participants, we first categorized participants as having low (0 to 1), medium (2) or high (3 or more) challenges. We found that most participants had medium (39%) or high (41%) numbers of challenges, whereas only 21% had low challenges. We then looked at the proportions of participants in each challenge category who experienced any physical health symptoms or any medical diagnoses. As shown in Figure 29, a smaller percentage of participants in the low challenge category (33%) experienced physical health symptoms in the past month than those in the medium (41%) or high (54%) categories, suggesting that multiple challenges combine to harm health. Similarly, while 59% of participants in the low challenge category had any physical health diagnoses, this percentage was increased in the medium (82%) and high (80%) challenge categories.
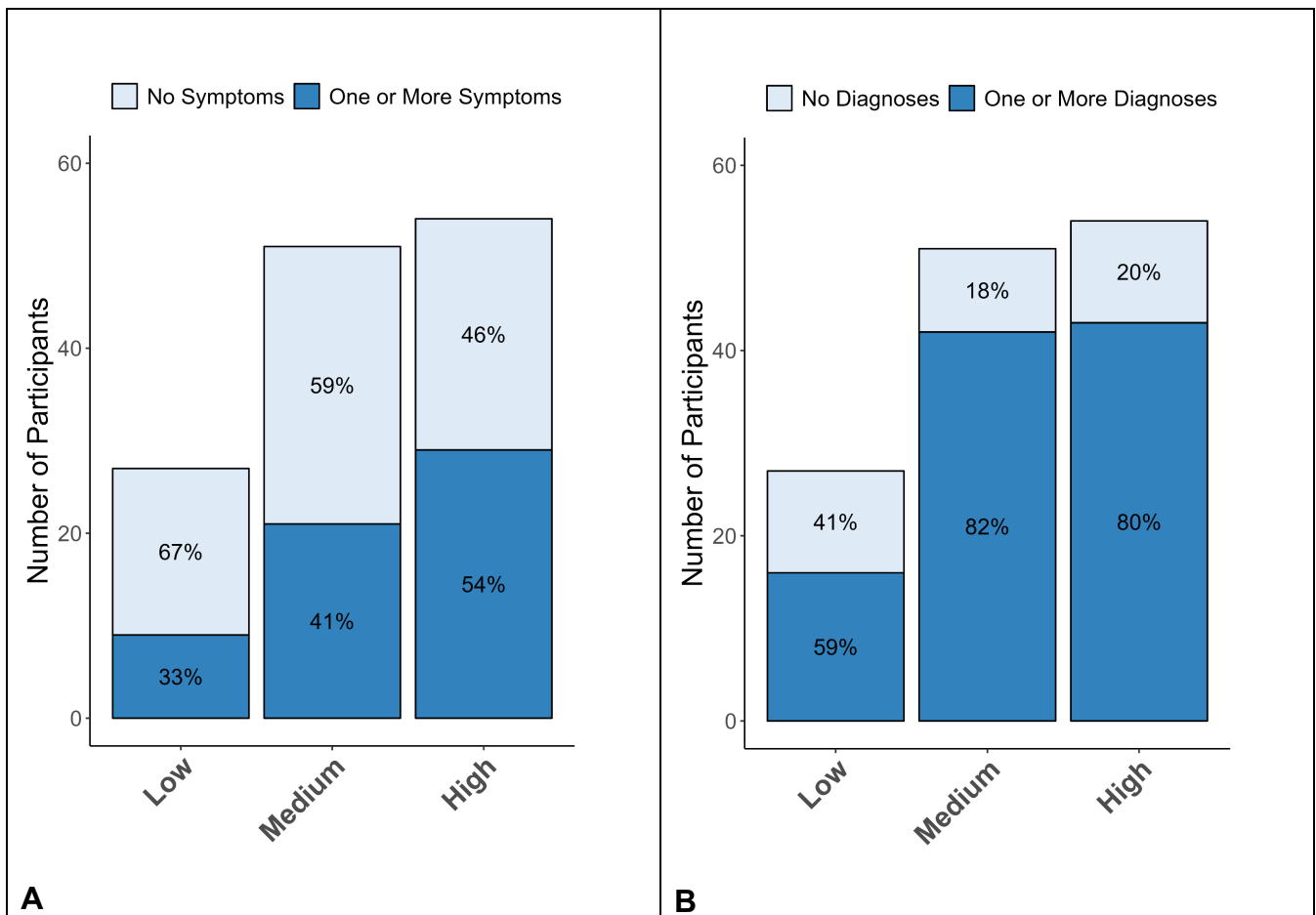
In both panels, the total height of the bars shows the number of participants categorized as having a low, medium, or high number of challenges. In Panel A, the height of the dark blue bars within each category shows the number of participants categorized as having one or more physical health symptoms within the past month, while the height of the light blue bars shows the number of participants within each category who did not experience any symptoms. The percentages within each bar show the proportion of participants in each challenge category that either experienced no symptoms (light blue percentage) or any symptoms (dark blue percentage) in the past month. For example, 67% of participants in the low challenge category did not experience any symptoms and 33% experienced one or more symptoms. Panel B is interpreted in the same way as Panel A but displays information for medical diagnoses rather than physical health symptoms.

Figure 29. Number and percentage of survey participants who reported physical symptoms (Panel A) or medical diagnoses (Panel B), categorized by number of challenges (low, medium, or high)

Community Priorities and Proposals for Change

Key Finding: There was a strong alignment between factors harming health and factors participants want policymakers to prioritize: pollution and chemical exposures, violence and crime, and food insecurity.

When asked to select the top three factors most negatively impacting their health, the most commonly selected factors were pollution (52%), financial resources (29%), and violence/crime (27%). They also believe policymakers should prioritize pollution (46%), violence/crime (30%), and food insecurity (20%).

Table 1. Factors participants believe are most negatively impacting their health and that policymakers should prioritize in their communities

Factor	Number of Participants (%)[1]	
	Most Negatively Impacting Health	**Policymakers Should Prioritize**
Pollution and chemical exposures	74 (52%)	65 (46%)
Limited financial resources	41 (29%)	-
Minimum wage increase	-	31 (22%)
Violence and/or crime	39 (27%)	43 (30%)
Poor neighborhood conditions	38 (27%)	30 (21%)
Food insecurity	23 (16%)	37 (19%)
Limited job opportunities	19 (13%)	26 (18%)
Problems accessing mental health care	19 (13%)	27 (19%)
Housing instability	17 (12%)	30 (21%)
Systemic racism	17 (12%)	18 (12%)
Other	15 (11%)	8 (6%)
Lack of reliable transportation	13 (9%)	-
Lack of public transportation	-	7 (5%)
Problems accessing medical health care	12 (8%)	17 (12%)
Problems with police or the criminal justice system	12 (8%)	25 (18%)
Limited educational opportunities	7 (5%)	11 (8%)
Poor quality housing	8 (6%)	24 (17%)

[1] Totals add to over 100% because participants were each asked to select three factors.
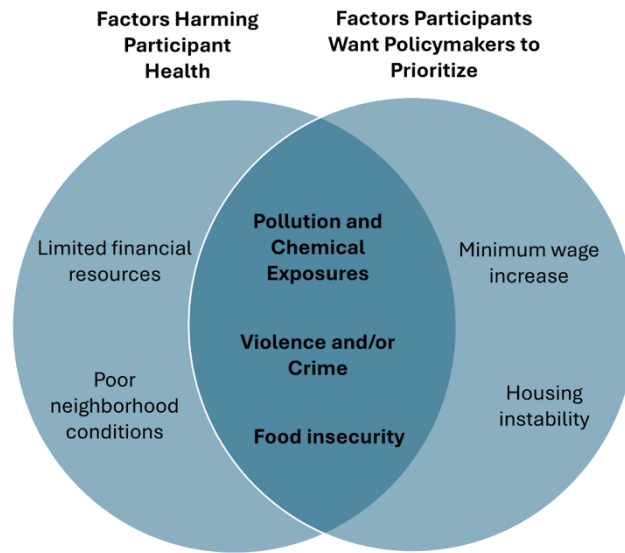
Figure 30. Diagram showing the overlap between the top five factors harming participant health and the top five factors participants want policymakers to prioritize

Focus group participants echoed these concerns:

"It's crazy, all these things [industrial facilities] surrounding us. It's like we live in a Bermuda triangle" – Participant 17

"The pollution is very pressing, but if you get shot, then you don't have a chance. If you or killed or maimed, so that that seems worse than the pollution, although the pollutions insidious. I'm aware of, and all that. It's not good but I guess. The gunshots excuse me, they kill... the possible homicides. It's very high for town, small like Chester, even if the city officials boast that it was only like 13 last year. It's a small city, I mean. I'm very nervous outside of the house. I don't sit in my yard, or things like that, because of that, and that. That's a stressful life course." – Participant 19

"You know, it's just a stressor. You're gonna have that constant anxiety of, you know, what do I do? Do I, you know, pay my electric bill? Or do I feed my kids this week? There's always gonna be that constant choice. – Participant 5

Focus group participants identified numerous potential solutions to their communities' challenges. Proposed solutions included increasing community awareness and advocacy, investing in resources, and implementing new policies and programs.

Focus group participants emphasized the need for more investment in community resources and educational programs to promote health and well-being:

We need, "...a nice recreational center here in the community for the children and adults to be able to go and work out." - Participant 21

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"I know, we need to upgrade our libraries, I mean. I see our libraries still have stuff that when I was like a little girl like we're, we're not upgraded to where we need to be." - Participant 9

"Community support groups almost to, you know, people that are having similar issues, maybe groups of people that can offer financial management tips, that can offer, you know, money management tips in general, you know, a lot of families might not know banking. They might not know budgeting. They might not know that there's resources out there for grants, or they may need assistance applying for benefits." – Participant 5

Many participants called for advocacy and policy action to address existing sources of pollution in their communities and to prevent further industrial development.

"Strict monitoring. See where all the contamination is coming from, and see what they can do to change it." – Participant 7

"We could approach our legislature legislators was representative at the State level to start the passing. You know, some laws limiting what, for example, what the Chester incinerator can take on, what the refineries, how much business they can do down there? You know what the car barn can do to limit the noise. You know, may put up a noise barrier between their operation and our residential neighborhood here. So you know there's couple of things we could do legislatively to handle or address those concerns" - Participant 10

"Stop letting them bring all these types of things into the communities, all these different companies, all these different trucks and things that come through our city through, you know, the railroads and all different kinds of things... it seems like a lot of areas use our area as a dumping ground for bad things. So stop that from coming through the city..." - Participant 9

Participants also highlighted the need for better planning, more transparency, and opportunities for two-way communication to protect their communities against potential environmental risks and resulting harm.

"Think outside the box and try to make do preventative maintenance. You don't have to get ready if you are ready, and so you should be ready for just about anything, and people shouldn't have to lose their life for you to realize something needs to be fixed." - Participant 17

"Yeah, I would say, more transparency. You know, when they are asking questions about, You know, what are the risk for this? What are you know the negatives that we're gonna be suffering and kind of, you know, taking control of that, you know, doing risk management like, what solutions could we provide for these potential risk for our

community and doing that ahead of time so that they can ease our minds." – Participant 5

"Maybe they should have a hotline that you could call and voice your concerns." – Participant 2

Participants called for community coalition-building to help enact these changes and ensure that community voices are represented and acknowledged in decision-making spaces:

"They built a new municipal building. They were supposed to have activity rooms in there for the youth, but instead they got, you know, they got two cells, two more cells for the police department, and all the council people now have their own individual office. So, in other words, there has to be a mindset from the community and the stakeholders to make sure that we have and that we use spaces that will help maintain and encourage healthy activities." - Participant 13

"We gotta do something. Whether it's our community leaders, our churches, you know, our workplaces. We need to be at this moment coming together. And looking at, what do you have for resources in our communities to help everyone in the community to get the things that they need as human beings cause our basic needs aren't even being met at this point." – Participant 8

"I think oftentimes we don't do enough environmental education and advocacy from one of the most formal Institutions in our culture which is the church and or organized religion, there should be more involvement from that community." – Participant 13

Conclusion

The goals of collecting data on community strengths, stressors, and needs and describing the cumulative impacts of chemical and nonchemical stressor exposures in Southern Delaware County Communities were met through a survey and a series of focus groups.

Key Findings

- Odors, air pollution, and noise were common environmental health concerns; participants noted direct impacts on their well-being and quality of life.
- Adverse physical symptoms were common and interfered with daily life. Self-reports of adverse physical health symptoms (i.e., congestion, headaches and cough) were more common than clinician-diagnosed physical health conditions (i.e., allergies, hypertension and asthma).
- Adverse mental health symptoms were common and interfered with daily life. Self-reports of mental health symptoms consistent with depression and anxiety were more common than professional medical diagnoses of these conditions.
- Asthma rates were high among children living in Southern Delaware County. More children experience symptoms consistent with asthma (e.g., wheezing and coughing) than have clinician-diagnosed asthma.
- Participants were proud of their communities and felt a strong connection and support from other community members.
- In addition to pollution and related environmental concerns, Southern Delaware County residents often faced many challenges (e.g., limited financial resources and food insecurity).
- Participants who faced more challenges in their lives tended to report having poorer health. Participants acknowledged the compounding burden of environmental, physical, and mental health challenges in their communities.
- There was a strong alignment between factors harming health and factors participants want policymakers to prioritize: pollution and chemical exposures, violence and crime, and food insecurity.

Strengths and Limitations

The findings reflect what we learned from the study participants; however, the main limitation of this study is the small sample size. The findings may not represent the experiences and perspectives of all area residents. Additionally, self-reported health outcomes may be misremembered, resulting in under- or over-reporting. The general consistency comparing our findings on the prominence of mental health and chronic disease impacts with similar findings of the Delaware County Community Health Assessment helps to address this concern.

A key strength of our study was our community-based participatory research approach. This approach allowed us to develop and tailor all study design and implementation aspects according to community needs, priorities, and preferences. Another strength of our study was the focus on the cumulative impacts of chemical and non-chemical stressors and, more importantly, how community residents experience these factors. Our mixed methods approach, collecting quantitative and qualitative data, allowed us to understand the lived experiences of impacted residents and filled the gaps raised by the exclusive use of quantitative health metrics.

Recommendations

Based on our key findings, we have developed a series of recommendations for policymakers, community organizations and advocates, and academic researchers. Stakeholders should leverage our findings on community strengths to implement recommendations.

For State and Local Regulators and Policymakers:

1. Enact environmental justice legislation to address cumulative burdens in permit approval processes, which must:

    a. Consider existing pollution sources as well community-level environmental and public health data

    b. Require permit applicants to demonstrate how any proposals for new and expanding infrastructure will mitigate and not exacerbate existing environmental and public health stressors

2. Prioritize community engagement, inclusion and transparency in any decision-making processes that affect fenceline residents before facilities and infrastructure are proposed

    a. Broaden consideration of community health and safety to be more inclusive of the full range of community concerns and needs

    b. Leverage community strengths in discussions around community health and safety

3. Implement or expand air, odor, and noise monitoring programs in Southern Delaware County and develop mitigation plans as needed

4. Enforce and strengthen environmental regulations to effectively reduce pollution and health harms

5. Actively support and adopt policies and programs that positively impact health outcomes in Southern Delaware County, with a focus on:

    a. Reducing sources of pollution

    b. Addressing crime and violence

    c. Decreasing food insecurity

    d. Improving access to mental health services

e. Enhancing access to green community spaces

f. Increasing education, care management, and tracking of children's asthma

6. Invest in policies and programs that advance the implementation of cumulative impact assessments to protect fenceline communities

For Community Organizations and Advocates:

1. Organize and educate community members and grassroots community groups on key findings to empower change with policy and permitting procedures to be inclusive of cumulative burdens

2. Educate local officials, community groups, and other residents about existing cumulative impact laws and policies in the United States[1]

3. Engage more faith-based organizations in advocacy efforts around pollution and cumulative burdens

4. Facilitate information sharing, coordination, and transparency among community organizations addressing pollution and cumulative burdens

5. Empower residents to amplify their voices regarding cumulative burdens

For Academic Researchers:

1. Expand consideration of health outcomes to include sub-diagnostic measures of health (e.g., symptoms rather than medical diagnoses alone)

2. Broaden concepts of health to include measures of mental health and well-being

3. Increase use of community-based participatory research (CBPR) approaches to improve the rigor, relevance, and reach of studies

Approach and Methods

Approach: Community-Based Participatory Research

We embraced a community-based participatory research (CBPR) approach in which residents, community advocates, and public health researchers at Johns Hopkins University were equal partners in all aspects of this study, including the design, conduct, interpretation, and communication of results.

This CBPR approach moves away from the traditional model of academics conducting studies in environmental justice communities without meaningfully engaging with community members. Instead, it provides a model in which the impacted residents guide research questions to address community priorities and concerns and participate in the scientific process. CBPR approaches help to ensure that scientific studies address community priorities and/or concerns and that the resulting data from scientific studies are relevant and useful to communities. All aspects of study design and implementation (e.g., funding acquisition, study design, data collection, data analysis, and interpretation) have been completed collaboratively by all co-investigators.

All co-investigators began meetings in 2022 to design the study and draft a funding proposal to the Johns Hopkins University Community Health Addressing Regional Maryland Environmental Determinants of Disease (CHARMED) Center.

Survey Methods

Survey Development

Our Community and Environmental Health survey was designed to investigate the cumulative impacts of chemical and non-chemical stressors experienced by residents in Southern Delaware County. Community and academic co-investigators created the survey together using an iterative process. Our survey was designed to be completed in 20 to 25 minutes and included questions on six broad topics:
1. Participants' demographic information (e.g., race, sex)
2. Pollution and other environmental exposures
3. Current life situation (e.g., lack of health insurance, poor housing conditions)
4. Community strengths, needs, and priorities
5. Health information (e.g., medical diagnoses and symptoms)
6. Child health information (If applicable)

Wherever possible, we included questions from existing survey instruments (e.g., RAND Corporation's 36-Item Short Form Survey Instrument for health status and Brief Patient Health Questionnaire (PHQ-4) for Depression and Anxiety for mental health status) that have been

extensively tested to ensure that they are reliable and accurate. To fully capture community concerns, we also included questions unique to the strengths and challenges in Southern Delaware County. Because all questions were mandatory, we included a "prefer not to say" option for questions regarding potentially sensitive topics (e.g., certain medical diagnoses).

Our survey was hosted online through the Research Electronic Data Capture (REDCap) website, a user-friendly and secure method for data collection and management [24, 25]. We conducted internal and pilot testing with community members to ensure our survey was easy to understand and to complete.

Survey Recruitment

Adults aged 18 years or above who resided in one of 12 Southern Delaware County municipalities (Boothwyn, Chester Township, City of Chester, Eddystone, Linwood, Marcus Hook, Ogden, Parkside, Trainer, Twin Oaks, Upland and Upper Chichester) were eligible to participate in the survey. We recruited participants using various methods, including social media posts, emails to listservs, and in-person outreach at community events (e.g., festivals and church events). Participants received a $10 gift card for completing the survey and were invited to enter a raffle to win an additional $50 gift card.

Survey Analysis

Data analyses were conducted using R version 4.3.1 and Excel. We calculated frequencies for categorical variables and descriptive statistics for numerical variables. We also compared the proportions of variables by race/ethnicity and municipality of residence. Due to small sample sizes, these analyses were restricted to participants identifying as Black or White (race/ethnicity analyses) and those living in Marcus Hook, Trainer, or the City of Chester (municipality analyses). To investigate cumulative impacts, we added the number of challenges reported by each participant from the following list: lack of health insurance, food insecurity, issues with housing quality, lack of transportation, financial insecurity, and racism and discrimination. We then classified each participant as having low (0 or 1 challenge), medium (2 challenges) or high (3 or more challenges) cumulative challenges. We compared the proportions of participants in each cumulative challenge group who reported experiencing any physical health symptoms or any medical diagnoses while living in Southern Delaware County. For open-ended survey responses, we used an inductive coding approach. We first reviewed each response and identified emergent themes, then coded each response using an iterative process to refine and aggregate codes.

Focus Group Methods

Participants who completed the survey were invited to participate in a focus group. These focus groups aimed to probe more deeply into the themes and issues identified in our survey and to document the lived experiences of community participants.

Before convening the focus groups, we developed a focus group discussion guide using questions derived from our research questions and overall study aims. Discussion questions surrounded the participants' thoughts on the impacts of their community environments on their health – ranging from physical to mental health, as well as the cumulative impact of these factors on their quality of life. Some discussion question examples are:

"What are the most pressing issues affecting the environment in your community?"
"What factors influence your mental health?"
"How do these fit together?"

To compensate them for their time in a focus group discussion, participants received a $50 gift card. We convened six focus groups on Zoom between January and February 2024. Before initiating the focus group discussion during the Zoom meeting, oral consent was obtained from each participant. Each focus group discussion lasted 52 to 87 minutes.

Data Entry and Management

The focus groups were recorded using Zoom's automatic transcription function in addition to a co-investigator notetaker. Each automatically generated transcription was cross-checked with the audio recording for accuracy. Data were stored in a password-protected server accessible to the ASSESS research team, and the study team used Participant IDs (PIDs) to anonymize the focus group transcripts. A password-protected document linking the PIDs and participant names were stored.

Data Analysis

We used ATLAS.ti Version 23 (Berlin, Germany) to analyze the focus group data, employing a hybrid inductive/deductive thematic analysis approach. The codebook was developed in Microsoft Excel by defining a few codes *a priori,* such as strengths and influences on environmental, physical, and mental health, along with cumulative impacts and solutions. These a priori topics were defined using the focus group discussion guide. After further familiarizing with the data and refining these predefined codes, the codebook was transferred to ATLAS.ti. Using this data management software, the research team applied line-by-line emergent codes to the cleaned transcripts while simultaneously organizing these coded segments into key themes to establish a final codebook illustrating the main findings of the six focus group discussions.

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List of Additional Resources

The following materials are available online by clicking the links below.

ASSESS Survey Data
ASSESS Survey Questions
ASSESS Focus Group Discussion Guide