Community Science

SHORT RESEARCH ARTICLE
10.1029/2024CSJ000088

A. A. Aranda and J. S. Kelty contributed equally to this work.

Key Points:

- Agricultural community residents led a low-budget environmental health survey to develop evidence-based public health interventions
- Communities can use a carcinogen exposure survey to prioritize and develop actions that reduce cancer burdens in their neighborhood
- When residents' priorities drive research directions, community solutions can be promptly launched within limited resource communities

Supporting Information:

Supporting Information may be found in the online version of this article.

Correspondence to:

J. S. Kelty,
jkelty@ucdavis.edu

Citation:

Aranda, A. A., Kelty, J. S., Manukian, S., Pardo, E., Jabbari, K., Schmidt, R. J., et al. (2024). Environmental health assessment by local environmental justice experts for evidence-based decision-making in an agricultural community of Northern California. *Community Science*, *3*, e2024CSJ000088. https://doi.org/10.1029/2024CSJ000088

Received 20 MAY 2024
Accepted 15 AUG 2024

Environmental Health Assessment by Local Environmental Justice Experts for Evidence-Based Decision-Making in an Agricultural Community of Northern California

A. A. Aranda[1,2,3,4], J. S. Kelty[1,5,6], S. Manukian[1], E. Pardo[1], K. Jabbari[1], R. J. Schmidt[7], H. A. Dabritz[8], J. K. London[2], L. S. Van Winkle[5,6], N. Deeb-Sossa[1,3], and Knights Landing Promotoras[1]

[1]UC Davis Knights Landing One Health Center, Davis, CA, USA, [2]UC Davis Human Ecology Department, Davis, CA, USA, [3]UC Davis Chicana/o Studies Department, Davis, CA, USA, [4]Department of Environmental Studies, Sacramento State University, Sacramento, CA, USA, [5]UC Davis Department of Anatomy, Physiology and Cell Biology, Shool of Veterinary Medicine, Davis, CA, USA, [6]UC Davis Center for Health and the Environment, Davis, CA, USA, [7]UC Davis Department of Public Health Sciences, Davis, CA, USA, [8]Yolo County Health and Human Services Agency, West Sacramento, CA, USA

Abstract Environmental justice research driven by academics and policymakers often overlooks the valuable insights and leadership of the communities most impacted by environmental hazards. When institution-led research approaches are employed, inadequate community ownership and limited institutional accountability hinder the effectiveness of environmental public health interventions. In contrast, a community-owned and -managed approach to environmental justice research can guide community members in developing evidence-based interventions. This paper outlines a community-led environmental health assessment survey (sample = 100) and resulting community actions over 6 years (2017–2023) in a Northern California farmworker community with a perceived high prevalence of cancer and exposure to environmental hazards in households, neighborhoods, and job sites. Local resident experts in Knights Landing, CA, documented community risk factors and exposures in collaboration with interdisciplinary undergraduate and graduate student-researchers. The survey instrument focused on environmental hazards identified by local resident experts including vehicular and agricultural pollution, occupational pesticide contact, and sun exposure. Survey findings highlighted the need for targeted interventions to reduce environmental health risks, such as academic outreach programs, county investments in public services, and community-led mutual aid initiatives. Despite academic reservations about our non-random sampling method and data collection by local resident experts, our project sparked substantial actions and investments with minimal personnel and financial resources. Local leaders working with student-researchers developed more effective environmental public health interventions through a community-owned and -managed approach that went beyond the efforts of local regulatory and research institutions.

Plain Language Summary Agricultural communities in California experience environmental injustice related to toxic exposures in environmental, household, and occupational settings. Environmental justice movements seek to ensure a clean and healthy environment for all communities by mitigating these toxic exposures and amplifying community voices to remove social, economic, and political barriers to healthy environments. This research project started in 2016 when Knights Landing residents revealed their suspicions that environmental carcinogens were potentially causing a high prevalence of cancer in their neighborhood. The community leaders and university researchers partnered to conduct a community survey. The survey results were used by community leaders to establish the following action priorities: household pesticide exposure, addictive substance misuse, access to cancer screening, occupational safety, housing quality, and neighborhood isolation from health services. Feasible and prompt actions were implemented from 2017 to 2023 within the limited resources of this unincorporated community. Communities can initiate a swift, customized, representative environmental health assessment to serve as a starting point when seeking institutional support, funding, or larger research initiatives. Our approach may serve as a model for environmental justice researchers striving to promptly reduce environmental health risks in marginalized communities.

10.1029/2024CSJ000088

1. Introduction

Environmental justice is a social movement of scholarship, policy, and activism that seeks to ensure a clean and healthy environment for all communities (Bullard, 2021; Holifield et al., 2018). Environmental health disparities are amplified by limited access to resources and decision-making processes among poor people, immigrants, and people of color (Perkins & Pulido, 2022). California's CalEnviroScreen and the national EJSCREEN are useful tools for revealing communities most burdened by environmental pollution and vulnerability to associated health effects (Faust et al., 2017; U.S. Environmental Protection Agency, 2019). To ensure reproducibility and replicability, both tools rely on public databases such as health registries, census data, emitting facility and toxic release violation reports, cleanup site tracking, and environmental monitoring (Faust et al., 2017; U.S. Environmental Protection Agency, 2019). However, these tools tend to lose statistical relevance when considering low-density rural areas. The value of regulatory assessment tools for agricultural communities is diluted by inadequate environmental monitoring infrastructure and extensive environmental transport of industrial agrochemicals. Californian agricultural communities need targeted public health and cumulative exposure assessments to develop effective environmental justice interventions. Our project co-developed solutions that address the specific community needs (Schuller et al., 2019) and countered attempts to just provide local decision-makers with extrapolations from regulatory data sets.

Our community-university partnership in Knights Landing (KL) followed community-based participatory action research (CBPAR) approaches to supplement local knowledge about environmental health. This project operated in close collaboration with the university student-run One Health Center and the Chicana/o Studies Department (Sweeney et al., 2018). CBPAR is a research approach that engages community members as equal partners in the research process to address community-identified problems and develop solutions that are relevant to the community (Deeb-Sossa et al., 2022; Manzo et al., 2020). Local resident experts can use targeted health assessments and interventions to improve public health through measures such as educating community members about environmental risk, developing mutual aid systems, and advocating for policy changes by local businesses and regulatory authorities (Edgren et al., 2005; Heaney et al., 2011; Mutiga-Waititu, 2021; Quandt et al., 2013; Ramírez et al., 2015; Sansom et al., 2016; Svendsen et al., 2010; Thompson et al., 2003). Local resident experts recruited student-researchers to study environmental health factors that could elevate cancer risks. Local resident experts included cancer survivors, fire fighters, parents, grandparents, local service providers, immigrants, community organizers, and experienced farm workers. Local resident experts volunteered to serve as *promotora-researchers* for this project with temporary university affiliation and hourly compensation for research design and data collection. A *promotora-researcher* is a community member who is trained to conduct research. They are often bilingual and have a deep understanding of the community's culture and values. *Promotora-researchers* can play a key role in CBPAR research by building trust with community members, recruiting participants, and collecting data (Bustillos & Sharkey, 2015; Deeb-Sossa et al., 2022; Quandt et al., 2013). In our study, *promotora-researchers* included four Latinas and two white women. Through patchwork funding, the KL Environmental Health Project (2016–2023) built community partnerships while conducting qualitative and quantitative research (Deeb-Sossa et al., 2022).

KL is an agricultural community in Yolo County located in northern California with a predominantly Latina/o/x population of approximately 1,000 residents (US Census Bureau, 2017). The growing season is year-round in the region which allowed most residents to remain in KL year-round without entering migrant farmwork. Despite the wealth produced by the local agricultural industry (Yolo County Department of Agriculture & Cooperative Extension, 2022), nearly a quarter of the population lived below the poverty line (US Census Bureau, 2017). The lack of environmental monitoring data and small population size made environmental justice research in KL particularly challenging. Further, state-mandated community health assessments often overlooked the specific needs of vulnerable communities like KL (Becker, 2015; Diaz et al., 2019; Ramírez et al., 2015; Schuller et al., 2019). For example, the eight surveys collected from KL residents for Yolo County's 2014 Community Health Assessment were marginal compared to the 85% of 812 total respondents who reported a urban or suburban city of residence (Yolo County Community Health Branch, 2014).

County public health reports aligned with KL community perceptions about a high cancer risk in their neighborhood but lacked ground-truthed data and tangible pathways to prevent toxic exposures. Yolo County vital records, for example, showed the highest unadjusted frequency of cancer fatalities in the northeastern census tract including KL (Figure 1) (Yolo County Community Health Branch, 2015, 2018). Cancer was the leading cause of

10.1029/2024CSJ000088

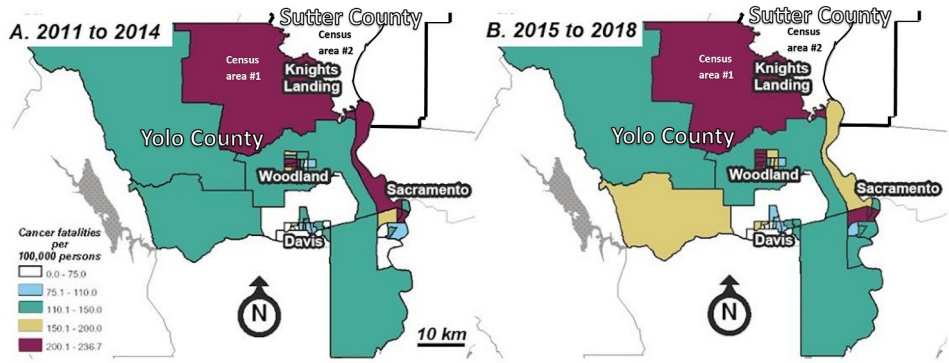

Figure 1. Map of Cancer Fatalities per 100,000 Residents in Yolo County. Cancer fatality rates per 100,000 persons are separated into census tracts for (a) 2011–2014 and (b) 2015–2018. The highest cancer burden was in the northeastern census tract including Knights Landing. Fatality data were retrieved from California Department of Public Health Vital Records Business and Information System. This map was reproduced using ArcGIS Online with permission from Yolo County Community Health Branch (Yolo County Community Health Branch, 2015, 2018).

premature death in Yolo County with lung, colorectal, breast, and pancreatic cancers making up most deaths (Yolo County Community Health Branch, 2015, 2018). Unlike the county disparities in mortality, the 5-year estimates of age-adjusted cancer incidence rates per 100,000 population in the California Health Map zones that represent KL were similar to the county and state rates for 2015–2019 (Table 1) (University of California San Francisco, n.d.). Health indicators in CalEnviroscreen and the national EJSCREEN tool indicated higher environmentally-influenced disease burden in KL (Table 2).

After preliminary discussions between KL residents, the research team decided to identify which potential environmental risk factors for cancer should be prioritized for community-led interventions to reduce exposures to carcinogens. Additionally, the team considered some barriers to early diagnostics and healthy lifestyle options that are protective against cancer and are known to improve prognosis for those diagnosed with cancer. CBPAR was used to evaluate KL residents' contact with potential carcinogens, which informed community-led efforts to reduce toxic exposures and increase access to cancer screenings for early detection and prevention. Community-owned and -managed research approaches enabled the development of culturally- and structurally-relevant assessment tools and weight of evidence strategies to assess environmental contributions to cancer risk for rural agricultural residents (Deeb-Sossa et al., 2022). This manuscript describes the community survey process, key results as interpreted by the *promotora-researchers*, and the actions in the community that were facilitated using this data.

2. Materials and Methods

Our first response to the perceived high prevalence of cancer among KL residents was developing a cross-sectional survey documenting household, occupational, and behavioral exposures to potential carcinogens. Following a community-owned and -managed approach (Heaney et al., 2007), six *promotora-researchers* assumed leadership of the research process, focusing on identifying and implementing solutions to community

Table 1
Age-Adjusted Cancer Incidence Rates of Knights Landing

	Age-adjusted cancer incidence rates (2015–2019)	
California health map zone	5-Year estimates per 100,000 population	95% CI
Knights Landing zone “Yolo 1 (A0766)”	399	(378, 420)
Knights Landing zone “Sutter (B0403)”	402	(385, 419)
Yolo County	398	(385, 410)
California	399	(378, 420)

Note. 5-Year estimates of age-adjusted cancer incidence rates (2015–2019) for the two California Health Map zones that represent Knights Landing, Yolo County, and the state of California (University of California San Francisco, n.d.). Incidence rates include all invasive cancers cases. The California Health Map calculates incidence rates using case counts from the California Cancer Registry or the National Cancer Institute's Surveillance, Epidemiology, and End Results Program.

10.1029/2024CSJ000088

Table 2
Environmental Exposure and Susceptibility Rankings of Knights Landing

Category	Metric	Knights Landing percentile ranks in CalEnviroScreen or EJScreen	
		Census area 1	Census area 2
Environmentally Influenced Disease	Asthma prevalence	75	85
	Low birth weight prevalence	18	25
	Cardiovascular disease prevalence	48	74
Air Quality	NATA Toxic Air Pollution Cancer Index	56	71
	NATA Toxic Air Respiratory Health Index	51	90
	Ozone	61	61
	Diesel particulate matter	8	14
	Particulate Matter (PM 2.5)	12	20
Water Quality	Drinking water threats	60	80
	Groundwater threats	91	93
	Impaired surface water	96	98
Potentially Toxic Pesticide Use	Pesticides	84	84

Note. CalEnviroScreen (Faust et al., 2017) and EJScreen (U.S. Environmental Protection Agency, 2019) tools rank the two census areas representing Knights Landing for the following metrics according to available data in 2018 with higher percentages representing more risk of health damages due to pollution. EJScreen was used for National-Scale Air Toxics Assessment (NATA) (units: percentile ranks of 217,740 United States Census Block Groups) since this indicator was not available in CalEnviroScreen (units: percentile ranks of 8,057 California census tracts).

concerns. Undergraduate and graduate student-researchers volunteered, completed graduation requirements, and secured grants and fellowships to support project aims. *Promotora-researchers* took on the day-to-day management of the research. Weekly team meetings enabled identification of community priorities before developing research instruments. *Promotora-researchers* also engaged with new and existing stakeholders to ensure representative recruitment and analysis. For example, they periodically updated and integrated feedback from residents, community development organizations, faith-based organizations, and community health centers. As our project unfolded, the composition of *promotora-researchers* fluctuated slightly. Following data collection, for example, one Latina *promotora-researcher* left the project for personal reasons while two additional residents joined (Latina and white, respectively). The research was determined by the university Institutional Review Board to be exempt from full review due to minimal risk to participants.

2.1. Environmental Health Survey Development

Surveys were derived by graduate student-researchers from the English and Spanish versions of the following standardized questionnaires: American Community Survey (US Census Bureau, 2017), California Health Interview Survey (UCLA Center for Health Policy Research, n.d.b), Behavioral Risk Factor Surveillance System (BRFSS) (Centers for Disease Control and Prevention, n.d.), and World Health Organization Tobacco Survey (US World Health Organization and Centers for Disease Control, 2011). We also incorporated a smaller-scale Agricultural Safety and Acculturation survey (Stoecklin-Marois et al., 2011) and a Mexican-origin community-validated nutrition survey (Banna et al., 2010). The process of selecting survey questions involved multiple steps. First, graduate student-researchers drafted questionnaires under mentorship from university and county experts in Public Health. *Promotora-researchers* then thoroughly reviewed each question for content, scope, comprehensibility, and appropriateness during a series of team meetings spanning over 3 months. Subsequently, *Promotora-researchers* conducted internal testing and sought input from eight additional community members to assess the survey duration, question readability, and administration techniques. Finally, the *promotora-researchers* and student-researchers reconvened to review and confirm the appropriateness of the survey content and length. The final survey consisted of 62 questions available in both English and Spanish (Texts S1 and S2 in Supporting Information S1). The scope included demographics, health indicators, health behaviors, lifestyle and behavioral factors, and environmental factors such as sunlight exposure, pesticide exposure, and housing conditions.

10.1029/2024CSJ000088

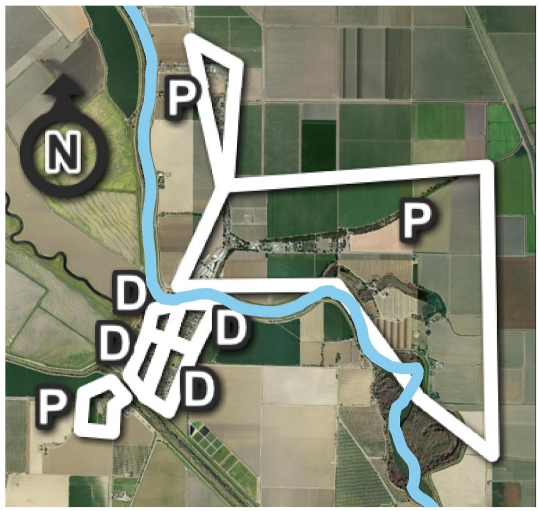

Figure 2. Map of Knights Landing (KL) Environmental Health Survey recruitment zones. Promotora-researchers designated geographic zones to represent the sub-populations of KL. The downtown residential area (D) which covers the KL Census Designated Place (US Census Bureau, 2017) was split along major roads to include quadrants of approximately equal numbers of residents. The periphery zones (P) include a migrant farm-worker labor camp, trailer homes, and farmhouses considered to be underrepresented subpopulations. Representative map was rendered using ArcGIS Online.

2.2. Sampling and Data Collection Methodology

A goal sample size of 89 was calculated by setting parameters for achieving point estimates with 95% confidence intervals (CI) and a maximum tolerated margin of error of ±10% for an estimated total KL population of 1,208 (US Census Bureau, 2017). Several sampling options were considered including randomized door-to-door sampling, convenience sampling at community centers, and targeted convenience sampling in geographic zones. Ultimately, *promotora-researchers* implemented snowball recruitment in downtown and periphery zones which included potentially vulnerable subpopulations in migrant farm-worker labor camps, farmhouses, and trailer parks (Figure 2). Individuals without housing reported their primary sleeping location as their geographic zone. Many residences housed multiple families, so *promotora-researchers* restricted sampling to two surveys per household to minimize clustering. Recruitment primarily occurred outside of agricultural business hours at community events and door-to-door. Safety measures were taken during survey recruitment sessions including *promotora-researchers* checking in with on-duty student researchers upon initiating and finishing deployment (Texts S3 and S4 in Supporting Information S1). *Promotora-researchers'* field logs documented homes attempted, homes surveyed, and the zone of each participant. Weekly meetings enabled coordination of targeted convenience sampling and prevention of multiple responses from any individual.

Promotora-researchers administered 100 surveys to adult KL residents from 30 July to 2 September 2017, when migrant and seasonal farm-worker populations were present (season spans May to October). Verbal informed consent was administered by *promotora-researchers* before survey administration. Screening questions confirmed that participants were adult residents of KL. Research excluded identifying information although a separate log was required by the university to document receipt of participant gift cards ($10 for about 30 min). Interview-style administration by *promotora-researchers* was typically the most effective, especially for participants with limited literacy. We conducted the initial 50 surveys in 6 days. The alcohol consumption question was clarified for subsequent surveys after preliminary assessment revealed inaccurate question administration (Text S5 in Supporting Information S1). The second half was completed in another 6 days.

Paper surveys and field logs were collected by student researchers. Appointments with residents and social groups (like the farm-worker labor camp) arranged by promotora-researchers before deployment enabled our 100% recorded response rate. This was achieved by assigning each promotora-researcher a specific geographic zone and a target number of surveys based on our calculated sample size of 89. While we exceeded this target, no participant declined to participate once contacted, contributing to the perfect response rate. The efficiency and effectiveness of promotora-researcher sampling is demonstrated by the brief 2-week deployment to recruit 100 participants. Survey administration by promotora-researchers was thorough with few non-responses ("Missing," "I don't know," or "Prefer not to state"). The highest non-response rates were 8%–11% of participants for cannabis consumption, frequency of electronic cigarette consumption, produce consumption, years in agriculture, and years working with pesticides; 18% for hours working outside; and 22% for the modified alcohol use question.

2.3. Data Analysis

Student researchers entered survey responses into Microsoft Excel from the paper survey copies and a separate student researcher double-checked entries. Microsoft Access was used for data management and cleaning to ensure uniform coding. For the alcohol consumption question, only the 50 responses after modification were analyzed. For all other questions, the full data set was included in cleaning and analysis. Non-responses were excluded from numeric variable averages, categorical frequencies, and proportions. Statistical Analysis System 9.4 was used to generate descriptive results of the survey. Data were reported as prevalence estimates or mean values with 95% binomial CI. KL sample results were compared to the publicly-available state or federal health monitoring and census data that corresponded to each question in our survey at the finest geographic scale

10.1029/2024CSJ000088

available (KL Census Designated Place (US Census Bureau, 2017), Yolo County (UCLA Center for Health Policy Research, n.d.a), or Sacramento-Roseville-Arden-Arcade Metropolitan Statistical Area (Centers for Disease Control and Prevention, n.d.)). Chi-square tests or Fisher's exact tests were performed for comparisons of categorical variables and two-sample *t*-tests were performed for continuous variables ($\alpha = 0.05$). When our question modifications or differences in sampling invalidated direct comparisons, governmental health monitoring and census data was presented for reference with limitations noted and without statistical interpretations.

3. Survey Results

3.1. Survey Respondent Demographics

Overall, the demographic distributions of our targeted sample were similar to the demographic distribution of the American Community Survey (Table 3). The only significant demographic difference was a higher proportion of individuals with low annual household incomes in our sample relative to the American Community Survey estimates (Table 3). Seventy-four surveys were collected from downtown KL, while 26 were collected from periphery zones (Figure 2). Respondents primarily live in KL year-round (91%) with 44% owning their home and 56% renting. Although our proportions of Latina/o/x participants were consistent with the American Community Survey, the different proportions of foreign-born individuals in our sample could be explained by our exclusion of children who are more likely to be born in the United States compared to adults. Our snowball sampling included more individuals without any college education, more low-income individuals, more unemployed individuals, and less individuals that are not in the labor force than were represented in the American Community Survey. The American Community Survey was not necessarily limited to peak agricultural season when migrant individuals were present while our recruitment was exclusively within this window, which may have contributed to a difference in the number of included agricultural workers.

3.2. Household Exposures to Potential Carcinogens

The respondents' contact with hazardous household exposures was addressed for indoor pollutants and adjacent neighborhood environmental pollution sources. At the neighborhood level, over 63% of respondents reported living within one block (100 m) of a highway or a farm and these proportions reached over 90% living within a 500-m radius (Table 4). Indoor residential pesticide application was reported by 55% of respondents and 41% used pesticides on their home's exterior (Table 4). About a third of respondents used combustible energy sources to cook which may contribute to indoor air pollution, especially since 90% of respondents reported cooking most of their meals at home (Table 4). Bottled water was the main drinking source for 66% of respondents, while 18% drank water primarily from the public system, and 12% used private wells (Table 4). Point-of-use water treatment was used by 33% of respondents that primarily drink from the public system or private wells (Table 4). As an indicator of poor housing quality, chipped paint was reported by 18% of respondents with housing (Table 4). Opportunities for residential carcinogen exposures were common for respondents although the magnitude or frequency were not cataloged.

3.3. Occupational Exposures to Potential Carcinogens

Census data and input from *promotora-researchers* established agricultural labor as our primary focus. Sun exposure was concerning for agricultural and non-agricultural workers since 77% of respondents worked outside over an hour a day and 39% exceeded 9 hr (Table 5). Sun protection was used more than half of the time by only 53% of respondents that worked over an hour a day outdoors (Table 5). For the 70% of respondents that worked in agriculture during their lifetime, the mean employment duration was 12 years (Table 5). For the 24% of respondents that occupationally contacted pesticides, the mean number of years handling pesticides was 8 years (Table 5). Among individuals who worked with pesticides, 35% used protective clothing less than half of the time when handling pesticides and 19% did not change clothes or shoes before entering their home on days they handled pesticides (Table 5). Safe-handling training was completed in the previous year by 78% of respondents who worked with pesticides primarily in their native language (89% of trained respondents) from an organization unrelated to their employer (89% of trained respondents) (Table 5). Of respondents that worked with pesticides, 9% reported going to the doctor for pesticide exposure during their career (Table 5). Most KL residents worked in agriculture, and some lacked occupational safety training or best practices.

10.1029/2024CSJ000088

Table 3
Demographic Summary

	Environmental Health Survey			American Community Survey		
	Sample (n) = adults in Knights Landing recruitment zones			Sample = randomly contacted households in Knights Landing census designated place		
Demographics	%	95% CI	n	%	95% CI	n
Age[a]						
Sample = age ≥18 for Environmental Health Survey or all ages American Community Survey						
18–19	3%	(0, 7)	3	–	–	–
20–24	5%	(1, 10)	5	11%	(2, 20)	110
25–44	43%	(32, 52)	42	18%	(8, 28)	187
45–64	36%	(25, 45)	35	25%	(12, 38)	259
65 and older	12%	(5, 19)	12	18%	(5, 31)	187
Gender						
Sample = age ≥18 for Environmental Health Survey and American Community Survey						
Male	44%	(34, 54)	44	41%	(31, 51)	311
Female	56%	(46, 66)	56	59%	(49, 69)	441
Race/Ethnicity[a]						
Sample = age ≥18 for Environmental Health Survey and all ages American Community Survey						
White/Caucasian	26%	(17, 35)	25	25%	(8, 42)	252
Latino/a or Hispanic	68%	(59, 77)	67	70%	(50, 90)	715
Asian	3%	(0, 7)	3	6%	(0, 15)	61
African-American, Black	1%	(0, 3)	1	0%	(0, 2)	0
Native American, American Indian, or Alaska Native	1%	(0, 3)	1	0%	(0, 2)	0
Education Attainment[a]						
Sample = age ≥25 for Environmental Health Survey and American Community Survey						
No Formal Education	2%	(0, 5)	2	–	–	–
Grade or Middle School (Grades 1–8)	32%	(23, 41)	31	27%	(9, 45)	169
High School or Equivalent	35%	(26, 45)	34	22%	(15, 29)	141
Some College or Associate's Degree	18%	(10, 25)	17	24%	(10, 38)	153
4-Year College or University Graduate	3%	(0, 7)	3	10%	(0, 20)	62
Graduate or Professional School	1%	(0, 3)	1	4%	(0, 9)	26
Vocational, Business, or Trade School	1%	(0, 3)	1	–	–	–
Annual Household Income*						
Less than $15,000	32%	(22, 42)	30	17%	(2, 32)	59
$15,000–$24,999	22%	(14, 30)	20	15%	(0, 30)	51
$25,000–$49,999	29%	(20, 38)	27	39%	(22, 56)	132
$50,000–$99,999	10%	(4, 16)	9	20%	(2, 38)	69
$100,000 or more	7%	(2, 12)	6	8%	(0, 16)	28

10.1029/2024CSJ000088

Table 3
Continued

Demographics	Environmental Health Survey: Sample (n) = adults in Knights Landing recruitment zones — %	95% CI	n	American Community Survey: Sample = randomly contacted households in Knights Landing census designated place — %	95% CI	n
Country of Birth[a]						
Sample = age ≥18 for Environmental Health Survey or all ages American Community Survey						
Native-born (US)	46%	(36, 56)	46	64%	(50, 78)	663
Foreign-born	54%	(43, 65)	53	36%	(22, 50)	365
Latin America	94%[b]	(88, 100)	50	93%	(82, 100)	338
% of foreign-born						
Asia	6%	(0, 12)	3	7%	(0, 18)	27
% of foreign-born						
Occupations[a]						
Sample = age ≥18 for Environmental Health Survey or age ≥16 for American Community Survey						
Unemployed	22%	(14, 30)	21	10%	(3, 17)	81
Not in Labor Force	12%	(5, 19)	11	40%	(26, 54)	319
Includes retirees and those with disabilities						
Employed	66%	(56, 76)	63	50%	(36, 64)	386
Agricultural Labor	41%	(31, 51)	34	9%	(6, 12)	36
% of employed within these sectors		*Agriculture*			*Agriculture, fishing, forestry, hunting, and mining*	
Non-Agricultural Labor	18%	(10, 26)	14	27%	(8, 46)	104
% of employed within these sectors		*Custodial and construction*			*Construction, manufacturing, transportation, warehousing, and utilities*	
Other	41%	(31, 51)	25	64%	(59, 69)	246
% of employed						

Note. The 2017 Environmental Health Survey used community-based participatory action research strategies and snowball sampling of 100 adults in Knights Landing, California. American Community Survey results are 2017 5-year estimates for Knights Landing Census Designated Place (US Census Bureau, 2017). Categorical data are presented as the proportion of respondents with 95% binomial confidence intervals (CI). Significant differences between the Knights Landing and American Community Survey samples are noted as: *$p = 0.05$. [a]Direct comparisons could not be made for variables with different age thresholds for the Environmental Health Survey responses and the American Community Survey. [b]The only Latin America country of origin was Mexico for the Knights Landing foreign-born respondents.

3.4. Cancer-Associated Behaviors

Assessment of behavioral cancer risks included smoking history, alcohol consumption, dietary choices, and cancer screenings. Relative to Yolo County, the prevalence of current smokers (21%) in KL was significantly higher and former smokers (10%) was significantly lower (Table 6). The burden of smoking was also evident with 25% of respondents reporting current smoking by other household members (Table 6). The summed proportion of current and former cannabis smokers in KL was significantly lower by half compared to the 50% of Yolo County residents that ever-used cannabis (Table 6). Chewing tobacco or electronic cigarette usage was reported by less than 6% of respondents (Table 6). The prevalence of monthly binge drinking reported by KL adults (45%) was not significantly different from county levels (Table 6). For the protective behavior of eating fruits and vegetables, only 19% of respondents consumed at least the recommended five servings per day and the mean daily consumption for all respondents was three servings (Table 6). In the most recent 2005 data (UCLA Center for Health Policy Research, n.d.b), Yolo County respondents met daily produce consumption recommendations at double the level we found in KL (Table 6). Challenges to achieving a healthy lifestyle were apparent in KL.

10.1029/2024CSJ000088

Table 4
Cancer-Associated Environmental Exposures

	Environmental Health Survey	
	Sample (n) = adults in Knights Landing recruitment zones	
Cancer-associated environmental exposures	%	95% CI
Type of Housing Unit (n = 100)		
House	62%	(52, 72)
Apartment	26%	(18, 36)
Mobile home or Trailer	6%	(2, 13)
Farm-worker Labor Camp	4%	(1, 10)
Houseless/Automobile	2%	(0, 7)
Proximity to nearest highway or major road (n = 100)		
Less than one block (100 m or one soccer field)	68%	(58, 77)
Between 1 and 5 blocks	29%	(20, 39)
More than 5 blocks	3%	(1, 9)
Proximity to nearest farm (n = 98)		
Less than one block (100 m or one soccer field)	63%	(53, 73)
Between 1 and 5 blocks	27%	(18, 36)
More than 5 blocks	10%	(5, 18)
Do you or anyone in your housing unit use insect control sprays inside your home? (n = 96)		
Yes (excludes respondents without housing)	55%	(45, 65)
Do you or anyone in your housing unit use insect control sprays outside your home? (n = 97)		
Yes (excludes respondents without housing)	41%	(31, 52)
Where meals are typically cooked (n = 95)		
Home	90%	(85, 96)
Restaurant	3%	(0, 7)
Cafeteria	3%	(0, 7)
Fast-food restaurant or food truck	3%	(0, 7)
Fuel used to cook (check all that apply) (n = 70)		
Electricity	63%	(51, 74)
Gas	16%	(8, 26)
Microwave	7%	(2, 16)
Kerosene stove	3%	(0, 10)
Propane stove	21%	(12, 32)
Fuel used to heat the home (check all that apply) (n = 96)		
Electricity	72%	(62, 81)
Gas	4%	(1, 10)
Wood or charcoal-burning stove	5%	(2, 12)
Kerosene stove	6%	(2, 13)
Propane stove	10%	(5, 18)
Main drinking water source (n = 100)		

10.1029/2024CSJ000088

Table 4
Continued

Cancer-associated environmental exposures	Environmental Health Survey Sample (n) = adults in Knights Landing recruitment zones %	95% CI
Public system/Service District	18%	(11, 27)
Well water/Private well	12%	(6, 20)
Bottled water	66%	(56, 75)
If the public system or well water is the main source, do you filter your drinking water? (n = 30)		
Yes	33%	(17, 53)
Have you noticed chipped paint where you are living? (n = 97)		
Yes (excludes respondents without housing)	18%	(10, 26)

Note. The 2017 Environmental Health Survey used community-based participatory action research strategies and snowball sampling of 100 adults in Knights Landing, California. Categorical data are presented as the proportion of respondents with 95% binomial confidence intervals (CI). These survey questions were developed primarily from an agricultural health survey adapted to this community by *promotora-researchers*, so they are not comparable to data regularly collected by public health agencies.

In KL, the prevalence of some diseases potentially exacerbated by environmental pollution were close to county levels: diabetes (14%) and asthma (22%) (Table 7). Obesity was significantly more prevalent in the KL sample (38%) compared to the county (23%) (Table 7). Consistent with asthma rates, breathing issues in the past year were noted by 25% of respondents (Table 7). Half of the respondents reported a family history of cancer (Table 7). While this result is uncertain due to statistical limitations of small sample sizes, cancer diagnosis was reported by less KL respondents (2%) relative to Yolo County (9%) (Table 7). The abundance of cancer survivors that responded to the KL survey could be impacted by individuals moving away for more convenient or affordable treatment as well as potentially poor survival rates in the KL community for those diagnosed with cancer. For individuals within recommended ages for cancer screenings, the proportions of respondents that ever accessed a mammogram (71%) or pap smear (68%) were similar to county residents that accessed these services according to the recommended schedule (Table 7). Conversely, the proportion of KL respondents within recommended age ranges that ever-accessed colonoscopy (38%) was lower than the county residents that received colonoscopy according to the recommended schedule (64%) (Table 7). Most respondents completed a regular medical checkup within the past 2 years (93%) which is significantly higher than the Yolo County rate (83%) (Table 7). Respondents' health insurance coverage (84%) was similar to county levels (Table 7). Health care access challenges were less substantial compared to behavioral risks in KL.

4. Community-Led Interventions

Promotora-researchers distributed survey results through word-of-mouth with an infographic handout (Text S6 in Supporting Information S1), collected residents' feedback, and invited community members to directly advise academic-researchers at our annual One Health Festival (September 2017). Residents overwhelmingly confirmed the consistency of survey results with their own lived experiences. Further documentation of environmental health and cancer risk perceptions was completed in 2018 through five focus groups and accompanying photovoice projects led by *promotora-researchers*. During weekly meetings, *promotora-researchers* prioritized concerns for further community-led action and research. They decided against using our limited resources to address regional issues like traffic or agricultural sources of pollution on account of the high likelihood of conflict within the community regarding action plans; high barriers to reaching and mobilizing regulators and industry; and the perceived threat to the local economy if structural solutions were proposed. As a result, the action priorities became household environmental carcinogen exposure, addictive substance misuse, access to cancer screening, occupational safety, and housing quality including neighborhood isolation from health services (Table 8). The research team built open communication and trust with community members to sustain a partnership that was responsive to existing and emerging needs (Deeb-Sossa et al., 2022). The project was also carefully designed to minimize and mitigate any negative impacts caused by the research.

10.1029/2024CSJ000088

Table 5
Cancer-Associated Occupational Exposures

Cancer-associated occupational exposures	Environmental Health Survey Sample (n) = adults in Knights Landing recruitment zones % Or mean	95% CI
On an average working day, how many hours do you spend outside? (n = 82)[a]		
Up to 1 hr	23%	(14, 32)
2–5 hr	20%	(11, 29)
5–9 hr	18%	(10, 26)
10–15 hr	39%	(28, 50)
If over an hour is spent outside at work, how often do you use sun protection? (n = 80)		
More than half of the time	53%	(42, 64)
Half or less of the time	19%	(10, 28)
Rarely or never	29%	(19, 39)
Ever worked in an agricultural setting? (n = 100)		
Yes	70%	(60, 79)
Mean number of years worked in agricultural setting (n = 59)	12	(9, 15)
Ever handled pesticides at work? (n = 97)		
Yes	24%	(16, 33)
Mean number of years handling pesticides (n = 18)	8	(4, 12)
If ever handled pesticides at work, how often protective clothing was used? (n = 23)		
More than half the time	65%	(43, 84)
Half or less than half the time	17%	(5, 39)
Rarely or never	17%	(5, 39)
If ever handled pesticides at work, on days you handled, did you change your clothes or shoes before entering your home? (n = 21)		
Yes	81%	(58, 95)
If ever handled pesticides at work, did you receive pesticide safety training in past year? (n = 23)		
Yes	78%	(56, 93)
If received training (n = 18), was the training in native language? Yes	89%	(65, 99)
If received training (n = 18), was training offered by an entity unrelated to the employer? Yes	89%	(65, 99)
If ever handled pesticides at work, ever been to the doctor for pesticide exposure? (n = 23)		
Yes	9%	(1, 28)

Note. The 2017 Environmental Health Survey used community-based participatory action research strategies and snowball sampling of 100 adults in Knights Landing, California. Categorical data are presented as the proportion of respondents with 95% binomial confidence intervals (CI) and numerical data are presented as mean with CI. These survey questions were developed primarily from an agricultural health survey adapted to this community by *promotora-researchers*, so they are not comparable to data regularly collected by public health agencies. [a]During survey administration of questions about sun exposure, *promotora-researchers* expanded the concept of "working day" beyond employment leading to 82 respondents which is greater than the 63 respondents who reported employment (Table 3). *Promotora-researcher's* choice allowed inclusion of participants who volunteer, home-makers, or retired people who conduct substantial work on their own rural properties.

10.1029/2024CSJ000088

Table 6
Cancer-Associated Behaviors

	Environmental Health Survey		CHIS	
	Sample (n) = adults in Knights Landing recruitment zones		Sample = randomly called adults in Yolo County	
Cancer-associated behaviors	% Or mean	95% CI	%	95% CI
Tobacco Use	n = 97		n = 242, 2016–2017	
Current Tobacco Smokers*	21%	(13, 30)	6%[a]	(2, 9)
Mean Years Smoked (n = 19)	15	(10, 19)	–	–
Mean Cigarettes per Day (n = 19)	16	(7, 24)	–	–
Former Tobacco Smokers*	10%	(5, 18)	17%	(10, 25)
Mean Years Smoked (n = 9)	13	(4, 23)	–	–
Other Smokers in Home or Housing Unit	n = 96		–	
Yes	25%	(17, 35)	–	–
Cannabis Use	n = 93		n = 381, 2015–2016	
Current Cannabis Smokers	19%	(12, 29)	–	–
Mean Years Smoked (n = 17)	19	(12, 27)	–	–
Mean Days of Use in Past 30 Days (n = 16)	23	(17, 29)	–	–
Former Cannabis Smokers	5%	(2, 12)	–	–
Mean Years Smoked (n = 3)	7	(0, 19)	–	–
Mean Days of Use in 30 Days (n = 3)	11	(0, 52)	–	–
Ever Smoked Cannabis*	25%	(17, 34)	50%	(33, 67)
Electronic Cigarette or Vapourizer Use	n = 97		n = 242, 2016–2017	
Current Electronic Cigarette User	5%	(2, 12)	3%[a]	(0, 6)
Mean Years of Use (n = 5)	1	(1, 2)	–	–
Former Electronic Cigarette User	4%	(1, 10)	–	–
Mean Years of Use (n = 4)	1	(0, 2)	–	–
Chewing Tobacco Frequency	n = 97		–	
Every day	1%	(0, 6)	–	–
Some days	2%	(0, 7)	–	–
Not at all	97%	(91, 99)	–	–
Alcohol Use	n = 42		n = 252, 2017–2018	
Binge-drink at least once in an average month	45%	(30, 61)	48%	(32, 65)
Mean number of days binge-drink in average month	5	(3, 7)	–	–
Daily Fruit and Vegetable Consumption	n = 91		–	
Consume 5 or more servings of vegetables a day	19%	(11, 28)	–	–
Mean servings of fruits and vegetables per day	3	(3, 4)	–	–

Note. The 2017 Environmental Health Survey used community-based participatory action research strategies and snowball sampling of 100 adults in Knights Landing, California. Yolo County results were from random samples collected through the California Health Interview Survey (CHIS) (UCLA Center for Health Policy Research, n.d.b). Categorical data are presented as the proportion of respondents with 95% binomial confidence intervals (CI) and numerical data are presented as mean with CI. Significant differences between the Knights Landing and county samples are noted as *$p < 0.05$. [a]Publicly available 2016 AskCHIS Neighborhood Edition (UCLA Center for Health Policy Research, n.d.a) estimates are included here for reference for the two census tracts that represent Knights Landing and are not recommended for statistical comparisons: current smoker 9% (7, 11) and current electronic cigarette user 3% (2, 4). Conversely, publicly available 2020 California Health Maps data (University of California San Francisco, n.d.) reveals a discrepancy in health agency monitoring estimates of adults who are current smokers: 7% for region Yolo 1 (A0766) and 16% for region Sutter (B0403).

10.1029/2024CSJ000088

Table 7
Environmentally Influenced Disease Burden and Health Care Utilization

	Environmental Health Survey		CHIS or BRFSS	
	Sample (n) = adults in KL recruitment zones		Sample = randomly called adults	
Environmentally influenced disease burden and health care utilization	%	95% CI	%	95% CI
Obesity*	$n = 96$		$n = 242$	
Body Mass Index (kg/m^2) of 30 (obese) or more	38%	(28, 48)	23%[a]	(18, 28)
Diabetes diagnosed by medical professional	$n = 99$		$n = 242$ †	
Yes	14%	(7, 21)	14%[a]	(10, 18)
Asthma diagnosed by medical professional	$n = 99$		$n = 242$	
Yes	22%	(14, 30)	21%[a]	(16, 26)
Breathing issues in the past year	$n = 91$		–	
Not at all	75%	(66, 84)	–	–
Less than every month	5%	(1, 10)	–	–
Every month	10%	(4, 16)	–	–
Every week	7%	(1, 12)	–	–
Every day	3%	(0, 7)	–	–
Cancer diagnosed by medical professional*	$n = 100$		$n = 242$	
Yes	2%	(0, 5)	9%	(5, 12)
Family History of Cancer	$n = 96$		–	
Yes	49%	(39, 59)	–	–
Ever accessed colonoscopy[b]	$n = 26$		$n = 297$ ‡	
Yes—Among respondents aged 50–75 years old	38%	(20, 57)	64%[a]	(58, 71)
Ever accessed mammogram[b]	$n = 38$		$n = 271$ ‡	
Yes—Among women 40 years old and over	71%	(57, 85)	74%[a]	(68, 81)
Ever accessed pap smear[b]	$n = 50$		$n = 238$ ‡	
Yes—Among women 21–65 years old	68%	(55, 81)	78%[a]	(72, 84)
Last regular medical checkup*	$n = 99$		$n = 813$ ‡	
One year ago or less	83%	(75, 90)	66%	(61, 70)
More than 1 up to 2 years ago	10%	(4, 16)	17%	(13, 20)
More than 2 years up to 5 years ago	3%	(0, 6)	9%	(7, 12)
More than 5 years ago	1%	(0, 3)	8%	(6, 10)
Never	3%	(0, 6)	0%	
Health insurance coverage	$n = 98$		$n = 822$ ‡	
Yes—Insurance, Medicare, or Medicaid coverage	84%	(76, 91)	93%	(91, 95)

Note. The 2017 Environmental Health Survey used community-based participatory action research strategies and snowball sampling of 100 adults in Knights Landing, California. Yolo County results were from random samples covered by the 2016–2017 California Health Interview Survey (CHIS, †) (UCLA Center for Health Policy Research, n.d.b) or 2016 Behavioral Risk Factor Surveillance System (BRFSS, ‡) data representing the Sacramento–Roseville–Arden-Arcade Metropolitan Statistical Area (Centers for Disease Control and Prevention, n.d.). Categorical data are presented as the proportion of respondents with 95% binomial confidence intervals (CI). Significant differences between the Knights Landing and county samples are noted as *$p < 0.5$. [a]Publicly available 2016 AskCHIS Neighborhood Edition (UCLA Center for Health Policy Research, n.d.a) estimates are included here for reference for the two census tracts that represent Knights Landing and are not recommended for statistical comparisons: obese 35% (29, 41), diabetes 12% (8, 15), and asthma 19% (13, 26). The publicly available 2020 California Health Maps data (University of California San Francisco, n.d.) that follows demonstrates the consistency of health agency monitoring data: (1) Adult obesity = 28% for both region Yolo 1 (A0766) and region Sutter (B0403). (2) Percent of adults aged 50–75 years who have received a fecal occult blood test (FOBT) within the past year, a sigmoidoscopy within the past 5 years and a FOBT within the past 3 years, or a colonoscopy within the past 10 years = 64% for region Yolo 1 (A0766) and 62 % for region Sutter (B0403). (3) Percent of women aged 50–74 years who have received a mammogram in the past 2 years = 77% for region Yolo 1 (A0766) and 74% for region Sutter (B0403). (4) Percent of women aged 21–65 years who have not received a hysterectomy and have received a cervical screening test = 83% for region Yolo 1 (A0766) and 81% for region Sutter (B0403). [b]Environmental Health Survey data cannot be compared to county data since the BRFSS data was narrowed respectively to colonoscopy in the past 10 years, mammogram in the past 2 years, and pap test in the past 3 years.

10.1029/2024CSJ000088

Promotora-researchers prioritized pesticides for further investigation based on occupational exposure risks (Cockburn et al., 2011; Deziel et al., 2015; Thompson et al., 2003) and potential for drift into residential areas (Deziel et al., 2015; Harrison, 2011). California Rural Legal Assistance Foundation and Western Center for Agricultural Health and Safety provided strategies to interrupt the occupational pesticide take-home pathway (Cockburn et al., 2011; Deziel et al., 2015; Thompson et al., 2003). Residential use of consumer pesticides in our sample was similar to other urban and farmworker households in California (Quirás-Alcal et al., 2011). *Promotora-researchers* shared strategies to reduce pest and pesticide entry with residents, acknowledging that housing quality and maintenance may be more important than knowledge of pesticide exposure prevention. Student-researchers mapped state-monitored potentially carcinogenic pesticide applications by industrial farms in KL and a neighboring organic region. Seasonal application and active ingredient patterns in these two growing regions were validated by quantifying potentially carcinogenic pesticides in household dust and tap water. Moving forward, we aim to evaluate the feasibility of collaboratively developing agricultural pesticide fate and transport models with farm-operators, applicators, and irrigators. In combination with regulatory monitoring, farm-operator tools and protective residential practices could reduce carcinogenic pesticide exposures.

KL drinking water contamination concerns were amplified after two of three public wells failed during a recent drought (2014–2017). In shallow, unregulated private wells further water quality concerns include septic system leakage and agrochemical percolation. KL also has a history of natural toxic metal leaching (Ayotte et al., 2016). A neighboring town where many KL children attend elementary school received a state grant for bottled drinking water deliveries due to arsenic contamination of their community well. A follow-up sampling study, launched in collaboration with a neighboring organic agricultural community, investigated potential carcinogen contamination in private drinking water and irrigation wells. *Promotora-researchers* provided precautionary advice about effective drinking water treatment strategies and a public water bottle refill station is now being considered (Ayotte et al., 2016). Many residents of KL rely on bottled water due to uncertainty about water quality. Additionally, the research team stayed involved in KL Community Service District strategies to improve water infrastructure and security.

Promotora-researchers intend to address concerns about cumulative exposures to potentially carcinogenic combustion byproducts in KL (California Air Resources Board, 2021; Noth et al., 2020; Stampfer et al., 2020). The COVID-19 pandemic delayed plans to partner with farm-operators and local organizations to reduce diesel exhaust, promote household appliance electrification and ventilation, and partner with the Air Quality Management District to address recreational wood and agricultural burning (California Mobile Source Control Division, n.d.; Chen et al., 2007; Ross, 2015). In response to smoking disparities (American Lung Association in California, 2018; Liu et al., 2016; Stillman et al., 2018), *promotora-researchers* initiated research interviews with smokers and nonsmokers, which revealed a lack of sustainable mental/emotional health services and smoking cessation treatments. The student-run KL One Health Center was tasked to provide services for residents interested in reducing addictive substance dependence or recreational consumption. *Promotora-researchers* founded peer support groups for residents interested in reducing consumption of addictive substances and seeded youth-focused programs to provide healthy recreational alternatives. They also responded to the community's food desert status and shortage of safe exercise spaces by constructing a community garden and piloting a micro-transit program to urgently increase access to neighboring city resources (Deeb-Sossa et al., 2022).

5. Discussion

Environmental justice is a social movement that seeks to address the disproportionate exposure of marginalized communities to environmental health hazards. Academic research plays a critical role in the movement by raising awareness of environmental risks, providing evidence to support claims of environmental injustice, and helping to develop effective interventions (Heaney et al., 2007). However, criticisms of institution-led research often spotlight a lack of shared power and a focus on scientific priorities rather than community needs. A community-owned and -managed approach for conducting environmental justice research in marginalized communities is ideal because leadership of community members is emphasized throughout the research process, from the development of research questions to the dissemination of findings (Heaney et al., 2007). As such, community control over the research process ensures that the research focuses on finding successful solutions that benefit the community.

10.1029/2024CSJ000088

Table 8
Actions Toward Knights Landing Environmental Health Project Priorities From 2017 to 2023

Household exposures to environmental carcinogens
➔ *2018* Research study to model pesticide exposure and sample households to fill regulatory monitoring data gaps. Samples were also collected after the Camp Fire in the neighboring organic region
➔ *2021* One Health Center implemented pulmonary health monitoring program
➔ *2021* County cleaned up environmental hazards found along river road that provided shelters to residents experiencing houselessness
➔ *2021* Youth participatory action research documented the intersection of the COVID-19 pandemic and environmental justice in Knights Landing and Firebaugh agricultural communities
➔ *2022* Community leaders partnered with UC Davis wildfire research group to inform studies of wildfire smoke exposures for pregnant people and to deploy do-it-yourself air filters into agricultural communities
Consumption of addictive substances
➔ *2019* One Health Center launched smoking cessation services and cost-effective mental/emotional health resources
➔ *2019* Research interviews with local smokers and non-smokers compared their experiences and goals for a healthier town
➔ *2021* Support groups were strengthened for those experiencing addiction and their loved ones
➔ *2021* One Health Center initiated a Mental Health Program
➔ *2022* Research interviews focused on mental/emotional health for elderly people and their needs to connect with services and community
Cancer detection access
➔ *2018* One Health Center developed an annual mammogram program
➔ *2018* Research team conducted follow up community health assessment survey
➔ *2019* Research team volunteered to encourage more engagement with rural communities for the UC Davis Cancer Center needs assessment
➔ *2023* Research team conducted follow up community health assessment survey and formally committed to a 5-year cycle
Occupational safety
➔ *2017 Promotora-researcher* word-of-mouth campaign encouraged farmworkers to keep their potentially contaminated work clothes away from their cars and homes
➔ *2018* and *2021* Western Center for Agricultural Health and Safety partnership brought occupational health resources to residents including pandemic essential worker resources
➔ *2018, 2020, 2021* One Health Center promptly distributed personal protective equipment to essential workers during hazardous wildfire smoke periods and the COVID-19 pandemic
➔ *2021* One Health Center and UC Davis Medical School launched monthly farmworker lung health monitoring with special consideration for working conditions, smoke, heat, and COVID-19 exposure
Housing quality including neighborhood isolation from health resources and services
➔ *2017* Community- and student-volunteers conducted a food access health assessment, completed a community-led design process, and built a community garden
➔ *2018* One Health Center created a health education program including healthy cooking classes
➔ *2019 Promotora-researchers* partnered with local organizations to successfully lobby for a park revitalization and increased access to public transportation
➔ *2020–2023* One Health Center and local nonprofits increased resource tables for residents (for example: food pantry, pet food, toiletries, and personal protective equipment)

Note. Dates of successful implementation indicate when enough resources were secured to initiate a service/program and do not include the community organizing time that predated this project.

In this study, a cross-section of local experts assumed the role of *promotora-researchers* to conduct environmental justice research alongside interdisciplinary student-researchers in an agricultural community with a perceived high prevalence of environmental hazards and cancer. Background research revealed that national-, state-, and county-level reporting corroborated residential perceptions but was not actionable with limited community resources. A cross-sectional survey and community review process was agreed upon to document environmental health risks while refining environmental justice priorities within the resources of residents and local levels of government to affect. Despite the absence of local environmental public health data, our community-owned and -managed approach to environmental justice research sparked concentrated follow-up research that aligned with community needs and community-led interventions that were prompt and feasible (Abara et al., 2014; Brody et al., 2009; Deeb-Sossa et al., 2022; Sansom et al., 2016).

The research presented in this paper has several limitations. First, sampling was not randomized although *promotora-researchers* minimized clustering, so results may not be generalizable to other communities. Second, the data was collected by local experts and relied on participant self-reporting, which may have introduced response and recall bias into our results. Third, the research was conducted over a short period of time, which makes long-term trends difficult to identify such as the health impacts of chronic exposure to air pollution. Fourth, while our study was powered to document community-level patterns, the small sample size limited our ability to run statistical analyses. As a result, qualitative research was designed to subsequently document and address disparities within the KL population. Lastly, the research did not assess the cost effectiveness of the community-led environmental health assessment survey. Overall, this study provides valuable insights into the potential benefits of a community-owned and -managed approach to environmental justice research. However, our community-specific data, with modified questions, may limit both the ability to replicate our survey findings and the comparability of our community action results to other environmental health monitoring and environmental justice interventions.

Our study demonstrates the value of community-owned and -managed research to develop effective environmental public health interventions that reflect community needs. This approach can help identify and address environmental hazards that are disproportionately impacting California's rural agricultural communities. Findings from this study are analytically generalizable (Yin, 2018) to other rural communities with similar population sizes, levels of environmental health information availability, and patterns of environmental risk (Cannon, 2021). Details of the history of this community-university partnership and the resources that were available to this research team are detailed in Deeb-Sossa et al., 2022. Likewise, our approach may serve as a model for environmental justice researchers striving to promptly reduce environmental health risks in marginalized communities.

6. Conclusions

Community ownership and management, in combination with CBPAR, increased the rigor, reach, relevance, and representativeness of our environmental justice study in a small, agricultural community (Balazs & Morello-Frosch, 2013; Heaney et al., 2007; Sansom et al., 2016). Local experts helped to overcome community-specific research challenges (Abara et al., 2014; Edgren et al., 2005; Quandt et al., 2013) and they provided critical context as community priorities advanced in response to interventions and current events (Banna et al., 2010; Quandt et al., 2013; Sansom et al., 2016). Likewise, student-researchers provided university resources to sustain research activity in the form of technical assistance and fundraising (Brody et al., 2009; Sansom et al., 2016). Student-researchers embraced CBPAR despite pressures to follow established extractive research routes and many academic sacrifices were made to prevent delays in community action (Deeb-Sossa et al., 2022). The survey process and results steered by local experts led to expanded research directions and implementation of feasible community actions over 6 years despite shortcomings in our sustained efforts to achieve structural change (Davis & Ramírez-Andreotta, 2021).

CBPAR is a powerful tool for advancing environmental justice and improving environmental public health in the absence of local, representative data. Our team cautions that communities without existing institutional partnerships may struggle to replicate the scale and pace of action demonstrated here (survey was completed in 4 months with under $5,000 in pilot funding) (Abara et al., 2014; Balazs & Morello-Frosch, 2013; Sansom et al., 2016). Such approaches are necessary to address multifactorial environmental justice concerns like cancer within a specific neighborhood or community context, even if statistical and other research limitations limit the academic utility of the data generated. Communities can initiate a swift, customized, representative environmental health assessment to serve as a starting point when seeking institutional support, funding, or larger research initiatives.

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Data Availability Statement

Data supporting this research is owned by community leaders and is not accessible to the public. Based on community-university research partnership agreements, data access and usage are restricted to projects that are

approved by the community leaders (*promotora-researchers*). Access to data and the community leader approval process can be initiated by contacting the authors.

Acknowledgments

Accomplishments described here were only possible due to the actions of promotora-researchers, survey participants, and community organizers. Promotora-researchers are Knights Landing residents and they preferred collective acknowledgment to respect their privacy. California Rural Legal Assistance Foundation, Yolo County Community Services Environmental Health Division, Yolo County Health and Human Services Agency Community Health Branch, KL Community Service District, and Environmental Justice Coalition for Water contributed to our understanding of community and existing environmental health monitoring. *Funding*: University fellowships; National Institutes of Health: *T32HL007013*, Environmental Health Science Center Exposure Core Seed Funds and Idea Pitch *P30ES023513*; National Cancer Institute: Geographic Management of Cancer Health Disparities Program Region 4 Research Stimulus Award *P30CA015704*; Western Center for Agricultural Health and Safety Fellowship and Rapid Response Grant *2U54OH007550*; and Achievement Rewards for College Scientists.

References

Abara, W., Wilson, S., Vena, J., Sanders, L., Bevington, T., Culley, J. M., et al. (2014). Engaging a chemical disaster community: Lessons from graniteville. *International Journal of Environmental Research and Public Health*, *11*(6), 5684–5697. https://doi.org/10.3390/ijerph110605684

American Lung Association in California. (2018). State of tobacco control 2018 California Local Grades. Retrieved from https://www.lung.org/local-content/california/documents/state-of-tobacco-control/2018/2018-sotc-california-full.pdf

Ayotte, J. D., Nolan, B. T., & Gronberg, J. A. M. (2016). Predicting arsenic in drinking water wells of the Central Valley, California. *Environmental Science & Technology*, *50*(14), 7555–7563. https://doi.org/10.1021/acs.est.6b01914

Balazs, C. L., & Morello-Frosch, R. (2013). The Three R's: How community based participatory research strengthens the rigor, relevance and reach of science. *Environmental Justice*, *6*(1), 9–16. https://doi.org/10.1089/env.2012.0017

Banna, J. C., Vera Becerra, L. E., Kaiser, L. L., & Townsend, M. S. (2010). Using qualitative methods to improve questionnaires for Spanish speakers: Assessing face validity of a food behavior checklist. *Journal of the American Dietetic Association*, *110*(1), 80–90. https://doi.org/10.1016/j.jada.2009.10.002

Becker, K. L. (2015). Conducting community health needs assessments in rural communities: Lessons learned. *Health Promotion Practice*, *16*(1), 15–19. https://doi.org/10.1177/1524839914555887

Brody, J. G., Morello-Frosch, R., Zota, A., Brown, P., Pérez, C., & Rudel, R. A. (2009). Linking exposure assessment science with policy objectives for environmental justice and breast cancer advocacy: The Northern California household exposure study. *American Journal of Public Health*, *99*(Suppl 3), S600–S609. https://doi.org/10.2105/AJPH.2008.149088

Bullard, R. D. (2021). Confronting environmental injustice and racism: Continuing challenges and new directions. *Environment and Planning*, *53*, 1862–1879.

Bustillos, B. D., & Sharkey, J. R. (2015). Development and implementation of a culturally and linguistically centered nutrition education program for Promotoras de Salud (Community Health Workers) to Foster Community Health Education and Outreach in Texas Border Colonias. *Journal of Hunger & Environmental Nutrition*, *10*(3), 299–312. https://doi.org/10.1080/19320248.2015.1007260

California Air Resources Board. (2021). Camp fire air quality data analysis.

California Mobile Source Control Division. (n.d.). In-use off-road mobile agricultural equipment. Retrieved from https://ww2.arb.ca.gov/our-work/programs/mobile-agricultural-equipment

Cannon, C. (2021). The case of booker T. Washington High School: How post-disaster urban growth produces environmental risks and racism. *City*, *25*(3–4), 218–234. https://doi.org/10.1080/13604813.2021.1935510

Centers for Disease Control and Prevention. (n.d.). Behavioral risk factor surveillance system survey questionnaire and data 2010–2017. Retrieved from https://www.cdc.gov/brfss/

Chen, L. W. A., Watson, J. G., Chow, J. C., & Magliano, K. L. (2007). Quantifying $PM_{2.5}$ source contributions for the San Joaquin Valley with multivariate receptor models. *Environmental Science & Technology*, *41*(8), 2818–2826. https://doi.org/10.1021/es0525105

Cockburn, M., Mills, P., Zhang, X., Zadnick, J., Goldberg, D., & Ritz, B. (2011). Prostate cancer and ambient pesticide exposure in agriculturally intensive areas in California. *American Journal of Epidemiology*, *173*(11), 1280–1288. https://doi.org/10.1093/aje/kwr003

Davis, L. F., & Ramírez-Andreotta, M. D. (2021). Participatory research for environmental justice: A critical interpretive synthesis. *Environmental Health Perspectives*, *129*(2), 26001. https://doi.org/10.1289/EHP6274

Deeb-Sossa, N., Manzo, R. D., Kelty, J. S., & Aranda, A. A. (2022). Community-responsive scholar-activist research: Conceptualizing capacity building and sustainability in a Northern California Community-University Partnership. *Journal of Community Practice*, *30*(1), 71–83. https://doi.org/10.1080/10705422.2022.2033375

Deziel, N. C., Friesen, M. C., Hoppin, J. A., Hines, C. J., Thomas, K., & Freeman, L. E. B. (2015). A review of nonoccupational pathways for pesticide exposure in women living in agricultural areas. *Environmental Health Perspectives*, *123*(6), 515–524. https://doi.org/10.1289/ehp.1408273

Diaz, H. J. M., Ainsworth, D., & Schmidtlein, M. C. (2019). Funding priorities: Data-driven approach for prioritizing community health needs in vulnerable communities. *Health Promotion Practice*, *20*(4), 616–623. https://doi.org/10.1177/1524839918771977

Edgren, K. K., Parker, E. A., Israel, B. A., Lewis, T. C., Salinas, M. A., Robins, T. G., & Hill, Y. R. (2005). Community involvement in the conduct of a health education intervention and research project: Community action against asthma. *Health Promotion Practice*, *6*(3), 263–269. https://doi.org/10.1177/1524839903260696

Faust, J., August, L., Bangia, K., Galaviz, V., Leichty, J., Prasad, S., et al. (2017). In A. Hirsch & D. Siegel (Eds.), *CalEnviroScreen 3.0*. California Office of Environmental Health Hazard Assessment. Retrieved from https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30

Harrison, J. (2011). *Pesticide drift and the pursuit of environmental justice*. MIT Press.

Heaney, C. D., Wilson, S. M., Wilson, O. R., Cooper, J., Bumpass, N., & Snipes, M. (2011). Use of community-owned and -managed research to assess the vulnerability of water and sewer services in marginalized and underserved environmental justice communities. *Journal of Environmental Health*, *74*(1), 8–17.

Heaney, C. D., Wilson, S. M., & Wilson, O. R. (2007). The West End Revitalization Association's community-owned and -managed research model: Development, implementation, and action. *Progress in Community Health Partnerships: Research, Education, and Action*, *1*(4), 339–349. https://doi.org/10.1353/cpr.2007.0037

Holifield, R., Chakraborty, J., & Walker, G. (2018). *The Routledge handbook of environmental justice*. Routledge, Taylor & Francis Group.

Liu, L., Edland, S., Myers, M. G., Richard Hofstetter, C., & Al-Delaimy, W. K. (2016). Smoking prevalence in urban and rural populations: Findings from California between 2001 and 2012. *American Journal of Drug and Alcohol Abuse*, *42*(2), 152–161. https://doi.org/10.3109/00952990.2015.1125494

Manzo, R., Brazil-Cruz, L., Florez, Y., & Rivera-Lopez, H. (2020). *Cultura y Corazon: A decolonial methodology for community engaged research*. University of Arizona Press.

Mutiga-Waititu, M. (2021). *Osseo health and wellness project: A community-driven model to address inequities in students' nutrition, health and wellness in a culturally diverse school district*. University of Minnesota ProQuest Dissertations Publishing.

Noth, E. M., Lurmann, F., Perrino, C., Vaughn, D., Minor, H. A., & Katharine Hammond, S. (2020). Decrease in ambient polycyclic aromatic hydrocarbon concentrations in California's San Joaquin Valley 2000–2019. *Atmospheric Environment (Oxford, England: 1994)*, *242*, 117818. https://doi.org/10.1016/j.atmosenv.2020.117818

Perkins, T. J., & Pulido, L. (2022). Environmental justice at 40: A look back and a look ahead. *Environmental Science & Policy*, *126*, 106937.

Quandt, S. A., Grzywacz, J. G., Talton, J. W., Trejo, G., Tapia, J., D'Agostino, R. B., Jr., et al. (2013). Evaluating the effectiveness of a lay health promoter-led, community-based participatory pesticide safety intervention with farmworker families. *Health Promotion Practice*, *14*(3), 425–432. https://doi.org/10.1177/1524839912459652

Quirás-Alcal, L., Bradman, A., Nishioka, M., Harnly, M. E., Hubbard, A., McKone, T. E., et al. (2011). Pesticides in house dust from urban and farmworker households in California: An observational measurement study. *Environmental Health*, *10*(1), 19. https://doi.org/10.1186/1476-069X-10-19

Ramírez, D. M., Ramírez-Andreotta, M. D., Vea, L., Estrella-Sánchez, R., Wolf, A. M. A., Kilungo, A., et al. (2015). Pollution prevention through peer education: A community health worker and small and home-based business initiative on the Arizona-Sonora Border. *International Journal of Environmental Research and Public Health*, *12*(9), 11209–11226. https://doi.org/10.3390/ijerph120911209

Ross, C. (2015). Freight impacts on small urban and rural areas

Sansom, G., Berke, P., McDonald, T., Shipp, E., & Horney, J. (2016). Confirming the environmental concerns of community members utilizing participatory-based research in the Houston neighborhood of Manchester. *International Journal of Environmental Research and Public Health*, *13*(9), 839. https://doi.org/10.3390/ijerph13090839

Schuller, K. A., Cronin, C. E., Nicks, S. E., Jing, X., Kingori, C., & Morrone, M. (2019). Development and application of a rubric to compare strategies for improving access to health care in rural communities in the United States. *Evaluation and Program Planning*, *74*, 61–68. https://doi.org/10.1016/j.evalprogplan.2019.02.013

Stampfer, O., Austin, E., Ganuelas, T., Fiander, T., Seto, E., & Karr, C. (2020). Use of low-cost PM monitors and a multi-wavelength aethalometer to characterize $PM_{2.5}$ in the Yakama Nation Reservation. *Atmospheric Environment (Oxford, England: 1994)*, *224*, 117292. https://doi.org/10.1016/j.atmosenv.2020.117292

Stillman, F. A., Tanenbaum, E., Wewers, M. E., Devi, C., Mumford, E. A., Groesbeck, K., et al. (2018). Variations in support for secondhand smoke restrictions across diverse rural regions of the United States. *Preventive Medicine*, *116*, 157–165. https://doi.org/10.1016/j.ypmed.2018.09.014

Stoecklin-Marois, M. T., Hennessy-Burt, T. E., & Schenker, M. B. (2011). Engaging a hard-to-reach population in research: Sampling and recruitment of hired farm workers in the MICASA study. *Journal of Agricultural Safety and Health*, *7*(4), 291–302. https://doi.org/10.13031/2013.39803

Svendsen, E. R., Whittle, N. C., Sanders, L., McKeown, R. E., Sprayberry, K., Heim, M., et al. (2010). GRACE: Public health recovery methods following an environmental disaster. *Archives of Environmental & Occupational Health*, *65*(2), 77–85. https://doi.org/10.1080/19338240903390222

Sweeney, J. M., Zielinska Crook, P., Deeb-Sossa, N., Tu, B., Dear, J. D., & Mazet, J. A. K. (2018). Clinical one health: A novel healthcare solution for underserved communities. *One Health (Amsterdam, Netherlands)*, *6*, 34–36. https://doi.org/10.1016/j.onehlt.2018.10.003

Thompson, B., Coronado, G. D., Grossman, J. E., Puschel, K., Solomon, C. C., Islas, I., et al. (2003). Pesticide take-home pathway among children of agricultural workers: Study design, methods, and baseline findings. *Journal of Occupational and Environmental Medicine*, *45*(1), 42–53. https://doi.org/10.1097/00043764-200301000-00012

UCLA Center for Health Policy Research. (n.d.a). AskCHIS neighborhood edition. Retrieved from https://askchisne.ucla.edu/ask/SitePages/Login.aspx?ReturnUrl=%2Fask%2F_layouts%2FAuthenticate.aspx%3FSource%3D%252Fask%252F%255Flayouts%252Fne%252Fdashboard%252Easpx&Source=%2Fask%2F_layouts%2Fne%2Fdashboard.aspx#/

UCLA Center for Health Policy Research. (n.d.b). California Health Interview Survey and data 2005–2017. Retrieved from https://healthpolicy.ucla.edu/our-work/california-health-interview-survey-chis

University of California San Francisco. (n.d.). California Health Maps Website. Retrieved from https://www.californiahealthmaps.org

US Census Bureau. (2017). American community survey 5-year estimates 2013–2017. Retrieved from https://www.census.gov/acs/www/data/data-tables-and-tools/data-profiles/2017/

US. Environmental Protection Agency. (2019). Environmental justice mapping and screening tool EJSCREEN technical documentation.

US World Health Organization and Centers for Disease Control. (2011). *Tobacco questions for surveys: A subset of key questions from the Global Adult Tobacco Survey (GATS): Global tobacco surveillance system*. World Health Organization. Retrieved from https://apps.who.int/iris/handle/10665/87331

Yin, R. K. (2018). *Case study research and applications design and methods*. Sage.

Yolo County Community Health Branch. (2014). Community health assessment regional report. Healthy Yolo: Our community, our future. Retrieved from https://www.yolocounty.gov/home/showpublisheddocument/27029/636228310029930000

Yolo County Community Health Branch. (2015). Mortality in Yolo County, 2010–2014. Healthy Yolo: Our community, our future. Retrieved fom https://www.yolocounty.org/Home/ShowDocument?id=34448

Yolo County Community Health Branch. (2018). Mortality in Yolo County 2015–16. Retrieved from https://www.yolocounty.org/Home/ShowDocument?id=50642

Yolo County Department of Agriculture & Cooperative Extension. (2022). Crop statistics. Retrieved from https://www.yolocounty.org/government/general-government-departments/agriculture-cooperative-extension/agriculture-and-weights-measures/crop-statistics