

University of California, Merced



Scope of Work Statement

Health impacts of air pollution in Fresno, CA

Sponsor: City of Fresno, California

Prepared by: Sandie Ha

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1. Problem statement

Air pollutants including fine particles and ozone have been consistently linked to many health outcomes ranging from minor respiratory irritation to cardiorespiratory complications and even premature death.¹⁻⁶ Biologic mechanisms linking air pollution to adverse health outcomes include oxidative stress, systemic inflammation, and endocrine disruption.^{7,8} Despite a significant body of work, very few studies have comprehensively evaluated health impacts of air pollution in central California, an area with significant air pollution levels, marked health disparities, and severely limited access to care.^{9,10}

2. Objectives

The objectives of this health impact assessment are three-fold. First, we seek to **assess the extent to which air pollution impacts the risk of common health outcomes across the lifespan**. These health outcomes include infant mortality, preterm delivery, childhood asthma, and cardiovascular events in the city of Fresno, CA from 2008-2019. Second, to inform policy and planning efforts, we also **calculate the excess number of cases that are attributed to air pollution in the region**. Stated differently, these estimates refer to the number of cases that could be prevented if air pollution levels are minimized. Additionally, we will also explore whether the health impacts of air pollution differ in neighborhoods with high and low socioeconomic indicators. Third, we seek to **conduct a community-based health survey to explore residents' concerns, behaviors, health outcomes, and health needs that are relevant to air pollution in the region**. This assessment is designed to be consistent with the World Health Organization's general principles of health risk assessment of air pollution¹¹, while incorporating important information that is relevant to the city of Fresno.

3. Administration

The study will be led by Dr. Sandie Ha from the University of California, Merced. The assessment is expected to be completed in 18 months. During the study period, the PI will be available for public meeting to provide updates and/or discuss any potential issues or questions.

Administrative activities including IRB approval, data request, and survey design will be started prior to the study period (but after contract approval) to ensure timely completion.

4. Brief research methods

To provide a comprehensive assessment the community's health related to air pollution, the study will consist of two components including 1) **a population-based health risk assessment** and 2) **a community health survey**. The population-based health risk assessment will provide population-based estimates that are useful for health impact estimation, policy decisions and community planning. Meanwhile, the community health needs survey will provide more details about residents' concerns, behaviors, health status, and needs that will further support policy decisions and intervention efforts.

4.1 Population-based health risk assessment

4.1.1 Overview.

In the population-based health risk assessment, we will be spatiotemporally linking large population-based health databases to air pollution estimation surfaces as well as other social environment indicators (more details on data sources are described in *section 4.1.3*). The resulting dataset will provide estimation of air pollution exposures by individuals at any space-time and allows the opportunity to evaluate whether air pollution exposures are associated with the risk of specific health outcomes of interest across the lifespan.

4.1.2 Health outcomes of interest

To capture the wide range of potential health impacts of air pollution, we will be assessing multiple health effects across the lifespan in different age groups. These specific health outcomes include infant mortality and preterm birth among pregnant women and infants <1 year, asthma among children <18 years, and cardiovascular events (i.e., stroke, heart attack, etc) among adults ≥18 years in Fresno, CA. To address environmental injustice, we will also evaluate whether certain neighborhoods, indicated by area-level socioeconomic indicators, are more susceptible to the health effects of air pollution.

4.1.3 Data sources

The research team will be linking large population-based databases from a several well-known sources to ensure generalizability (Table 1). Data for air pollution, traffic/highway, truck routes, meteorological conditions, environmental injustice indicators, adverse pregnancy outcomes (i.e., infant mortality, preterm birth), and healthcare encounters (i.e. ED visits, hospitalization) for asthma and cardiovascular disease will be geocoded and spatiotemporally linked based on residential zip-code. Zip-code is the smallest geographical indicator available due to data privacy. The resulting linked file allows a comprehensive estimation of daily air pollution exposures, neighborhood characteristics, distance from major roads, and health information for each individual (e.g., all births and all emergency room visits and hospitalizations) in the databases.

For adverse pregnancy outcomes, addresses are available for more detailed spatial analyses. (See *Section 4.1.4* below)

Table 1. Data sources			
Types of data	Data source	Year	Data description
Air pollution	San Joaquin Valley Air District	2007-2020	Daily concentration of air pollution estimated for all zip-codes in Fresno
Major roadways, truck routes	Caltrans	2008-2019	Major roadways, truck routes, traffic density in Fresno
Meteorological data	EPA Air Monitoring Network	2007-2020	Daily meteorological data at local monitors located in Fresno
Adverse pregnancy outcomes (e.g., infant mortality, preterm birth)	California Vital Statistics Birth Cohort Data	2008-2018 (2018 is the latest year available)	Linked birth and death certificates for all births registered in Fresno
Asthma and cardiovascular	California's Office of Statewide Health Planning and Development (OSPHD)	2008-2019 (2019 is the latest year available)	Patient-level administrative data abstracted from individual patient records and facility-level utilization data on healthcare services from hospitals and healthcare facilities in Fresno
Environmental Justice indicators	CalEnviroScreen 4.0 from the The Office of Environmental Health Hazard Assessment (OEHHA) *Note: a new version is available but the older 2018 version is closer to the study period.	2021	Environmental scores for all census tracts in Fresno based on potential exposures to pollutants, adverse environmental conditions, socioeconomic factors and prevalence of certain health conditions.
Neighborhood and contextual characteristics	American Community Survey and US Census	2010	Provides neighborhood socioeconomic indicators (e.g., income, education, etc) for all zip-codes in Fresno

4.1.4. Study design and analytic approach

We will be using the time-stratified case-crossover design and analyses to fully control for potential time-invariant confounding. This innovative approach is commonly and increasingly used to evaluate the effects of air pollution on acute outcomes in the literature.¹²⁻¹⁶ To assess potential delayed effects of air pollution, we will evaluate risks within one week of exposure. Conditional logistic regression models will be used to calculate excess risk of health outcomes associated with air pollution exposures.

For pregnancy outcomes, we will be able to obtain residential address of the mother at delivery. Thus, in addition to the analyses mentioned above, we will also perform a more detailed spatial analysis which assesses whether proximity to major roadways, truck routes, or the distribution center are associated with elevated risk of adverse pregnancy outcomes. Such analysis will compare births

<500m away from a source to those who live further away. Potential confounders of interest will be evaluated using directed acyclic graphs.

We will also explore differences in health impacts of air pollution based on neighborhood characteristics. For example, at the same level of air pollution exposure, we will identify whether certain communities have more health impacts compared to others (i.e. more susceptible to impact of air pollution).

4.2 Community-based health survey

4.2.1 Overview

In order to supplement the population-based health risk assessment, we will also conduct a community-based health survey to obtain more details regarding residents' health status, concerns, awareness, and needs. We will be working with our established community partner to conduct a survey of ~1000-2,000 randomly selected Fresno residents living at varying distance from distribution center. The survey will be administered by trained interviewers, and will assess residents' concerns, health status, behavior, and health needs that are relevant to air pollution exposures.

4.2.2 Health outcomes of interest

The survey will be capturing several important health domains that are relevant with respect to pollution exposures. These include address (for geocoding); demographics; health conditions; surrounding environmental conditions; employment; general health behaviors; knowledge, perception and practice related to air pollution; sources of air pollution and health information; neighborhood concerns; and healthcare utilization and access.

4.2.3 Study design and analytical approach

This survey will employ a cross-sectional design. We will be providing descriptive statistics of the health outcomes described in *section 4.2.2*. We will also compare needs, concerns and other health indicators across demographic groups using t-tests or chi-square tests as appropriate. Comparisons will also be made between those who live closer to the distribution center and those who live further away.

5. Deliverables

Through the contract period, the researchers and sponsor will be engaged in ongoing discussion to ensure timely and high-quality deliverables. Deliverables and their tentative due dates are presented in Table 2 below.

[illegible]

7. Estimated Budget

Please see attached Excel sheet

Principal Investigator: Sandie Ha								Budget Start Date: 1/1/22								
Sponsor: City of Fresno								Budget End Date: 6/30/23								
Project Title: Health impacts of air pollution in Fresno, CA																
Salaries		Monthly Rate	Year 1	Year 2: Six months	Year 3	Year 4	Year 5	Total	Personnel		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	
PI: Sandie Ha		\$ 11,322.22	33,967	11,662	-	-	-	45,629	PI: Sandie Ha		1	1				
Co-PI 1		-	-	-	-	-	-	-	Co-PI 1							
Co-PI 2		-	-	-	-	-	-	-	Co-PI 2							
Co-PI 3		-	-	-	-	-	-	-	Co-PI 3							
Co-PI 4		-	-	-	-	-	-	-	Co-PI 4							
PI Salary: Course Buyout		-	-	-	-	-	-	-	PI Salary: Course Buyout							
Postdoc Level		-	-	-	-	-	-	-	Postdoc Level							
Staff (Exempt)		-	-	-	-	-	-	-	Staff (Exempt)							
Staff (Non-Exempt)		-	-	-	-	-	-	-	Staff (Non-Exempt)							
Undergraduate Academic Year		\$15.00 2,600	7,020	-	-	-	-	7,020	Undergraduate Academic Year	1						
Undergraduate: summer, holidays		\$15.00 2,600	5,850	-	-	-	-	5,850	Undergraduate: summer, holidays	1						
GSR-AY (Fall): Step V		\$ 4,902.83	11,009	-	-	-	-	11,009	GSR-AY (Fall): Step V	1	1					
GSR-AY (Spring): Step V		\$ 4,902.83	11,009	11,340	-	-	-	22,349	GSR-AY (Spring): Step V	1	1					
GSR- Sumr: Step V		\$ 4,902.83	14,679	2,520	-	-	-	17,199	GSR- Sumr: Step V	2	1					
Professional Research Scientist (Exempt)		-	-	-	-	-	-	-	Professional Research Scientist (Exempt)							
Professional Research Scientist (Non-Exempt)		-	-	-	-	-	-	-	Professional Research Scientist (Non-Exempt)							
Project Scientist (Exempt)		-	-	-	-	-	-	-	Project Scientist (Exempt)							
Project Scientist (Non-Exempt)		-	-	-	-	-	-	-	Project Scientist (Non-Exempt)							
Project Coordinator (Exempt)		-	-	-	-	-	-	-	Project Coordinator (Exempt)							
Project Coordinator (Non-Exempt)		-	-	-	-	-	-	-	Project Coordinator (Non-Exempt)							
Total Salaries			83,534	25,521	-	-	-	109,056	# of Months Per Yr (integer value)							
Fringe: Composite Benefit Rates effective 7/1/21		%							Personnel		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	
PI: Sandie Ha		3.0%	1,019	350	-	-	-	1,369	PI: Sandie Ha		3	1				
Co-PI 1		3.0%	-	-	-	-	-	-	Co-PI 1							
Co-PI 2		3.0%	-	-	-	-	-	-	Co-PI 2							
Co-PI 3		3.0%	-	-	-	-	-	-	Co-PI 3							
Co-PI 4		3.0%	-	-	-	-	-	-	Co-PI 4							
PI Salary: Course Buyout		37.0%	-	-	-	-	-	-	PI Salary: Course Buyout							
Postdoc Level		14.0%	-	-	-	-	-	-	Postdoc Level							
Staff (Exempt)		45.7%	-	-	-	-	-	-	Staff (Exempt)							
Staff (Non-Exempt)		53.5%	-	-	-	-	-	-	Staff (Non-Exempt)							
Undergraduate Academic Year		3.0%	211	-	-	-	-	211	Undergraduate Academic Year	9						
Undergraduate: summer, holidays		3.0%	176	-	-	-	-	176	Undergraduate: summer, holidays	3						
GSR-AY (Fall): Step V		3.0%	330	-	-	-	-	330	GSR-AY (Fall): Step V	4.5						
GSR-AY (Spring): Step V		3.0%	330	340	-	-	-	670	GSR-AY (Spring): Step V	4.5	4.5					
GSR- Sumr: Step V		3.0%	440	76	-	-	-	516	GSR- Sumr: Step V	3	1					
Professional Research Scientist (Exempt)		45.7%	-	-	-	-	-	-	Professional Research Scientist (Exempt)							
Professional Research Scientist (Non-Exempt)		53.5%	-	-	-	-	-	-	Professional Research Scientist (Non-Exempt)							
Project Scientist (Exempt)		45.7%	-	-	-	-	-	-	Project Scientist (Exempt)							
Project Scientist (Non-Exempt)		53.5%	-	-	-	-	-	-	Project Scientist (Non-Exempt)							
Project Coordinator (Exempt)		45.7%	-	-	-	-	-	-	Project Coordinator (Exempt)							
Project Coordinator (Non-Exempt)		53.5%	-	-	-	-	-	-	Project Coordinator (Non-Exempt)							
Total Fringe			2,586	766	-	-	-	3,372	Percentage of Effort Per Month Per Yr							
Total F & S			86,040	26,287	-	-	-	112,327	Personnel		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	
Equipment									PI: Sandie Ha		100.0%	100.0%				
Equipment									Co-PI 1							
Equipment									Co-PI 2							
Equipment									Co-PI 3							
Equipment									Co-PI 4							
Total Equipment			-	-	-	-	-	-	PI Salary: Course Buyout							
Travel									Postdoc Level							
Travel-domestic			4,000	6,000				10,000	Staff (Exempt)							
Travel-international			2,000					2,000	Staff (Non-Exempt)							
Total Travel			6,000	6,000	-	-	-	12,000	Undergraduate Academic Year	30.0%						
Participant Support									Undergraduate: summer, holidays	75.0%						
Stipends									GSR-AY (Fall): Step V	49.9%						
Travel									GSR-AY (Spring): Step V	49.9%	49.9%					
Subsistence									GSR- Sumr: Step V	49.9%	49.9%					
Other:									Professional Research Scientist (Exempt)							
Total Participant Support			-	-	-	-	-	-	Professional Research Scientist (Non-Exempt)							
Subawards									Project Scientist (Exempt)							
Subaward 1: TBD Fresno CBO									Project Scientist (Non-Exempt)							
Subaward 2									Project Coordinator (Exempt)							
Subaward 3									Project Coordinator (Non-Exempt)							
UC Subaward 4									Inflation auto-completes DO NOT EDIT							
UC Subaward 5									1.03							
UC Subaward 6									Person Months Per Year (auto-completes)							
Total Subawards			-	-	-	-	-	-	Personnel		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Other Direct Costs									PI: Sandie Ha		3	1	0	0	0	4
Materials/Supplies: four computers, software license, data costs, da			18,550					18,550	Co-PI 1	0	0	0	0	0	0	0
Participant Incentives			20,000					20,000	Co-PI 2	0	0	0	0	0	0	0
Consultant Services: environmental justice + other TBD			37,000					37,000	Co-PI 3	0	0	0	0	0	0	0
SPARC lab			3,000					3,000	Co-PI 4	0	0	0	0	0	0	0
Other: Biostatistics recharge			5,000					5,000	PI Salary: Course Buyout	0	0	0	0	0	0	0
Other: Includes GSR Tuition & Fees		Fall Spring							Postdoc Level	0	0	0	0	0	0	0
Tuition **		5,721 5,721	11,442	12,586	-	-	-	24,028	Staff (Exempt)	0	0	0	0	0	0	0
Non-resident Supplemental Tuition **		7,551 7,551	-	-	-	-	-	-	Undergraduate Academic Year	2.7	0	0	0	0	0	2.7
Student Services Fee **		564 564	1,128	1,241	-	-	-	2,369	Undergraduate: summer, holidays	2.25	0	0	0	0	0	2.25
Health Insurance **		1,356 1,899	3,255	3,580	-	-	-	6,835	GSR-AY (Fall): Step V	2,2455	0	0	0	0	0	2,2455
Sub-Total Tuition & Fees			15,925	17,407	-	-	-	33,332	GSR-AY (Spring): Step V	2,2455	2,2455	0	0	0	0	4,491
Total Other Direct Costs			99,375	17,407	-	-	-	116,782	GSR- Sumr: Step V	2,994	0.499	0	0	0	0	3,493
Total Direct Costs			191,415	49,694	-	-	-	241,110	Professional Research Scientist (Exempt)	0	0	0	0	0	0	0
Portion of Sub-award to be charged IDC			-	-	-	-	-	-	Professional Research Scientist (Non-Exempt)	0	0	0	0	0	0	0
MTOC (less equipment, Stdnt fees, & 9K's > 25,000)			175,590	32,287	-	-	-	207,877	Project Scientist (Exempt)	0	0	0	0	0	0	0
Total Indirect Costs			52,677	9,686	-	-	-	62,363	Project Scientist (Non-Exempt)	0	0	0	0	0	0	0
Total Request			244,092	59,381	-	-	-	303,473	Project Coordinator (Exempt)	0	0	0	0	0	0	0
									Project Coordinator (Non-Exempt)	0	0	0	0	0	0	0
									Fall Semester # GSR							
			Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5			
Salary			36,698	13,859	-	-	-	50,557	Tuition **	1	1	0	0	0	0	0
Fringe			1,101	416	-	-	-	1,517	Non-resident Supplemental Tuition **							
Consortium IDC									Student Services Fee **	1	1	0	0	0	0	0
Direct costs less consortium IDC			191,415	49,694	-	-	-	241,110	Health Insurance **	1	1	0	0	0	0	0
									Spring Semester # GSR							
			FY 2022	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5			
Composite Benefit Rates per year			45.7%	45.7%	45.7%	45.7%	45.7%	45.7%	Tuition **	1	1	0	0	0	0	0
Other Academic and Exempt Staff									Non-resident Supplemental Tuition **							
Faculty (Academic Year)			37.0%	37.0%	37.0%	37.0%	37.0%	37.0%	Student Services Fee **	1	1	0	0	0	0	0
Post Doctoral Scholars			14.0%	14.0%	14.0%	14.0%	14.0%	14.0%	Health Insurance **	1	1	0	0	0	0	0
Limited Benefits Eligibility (including Faculty Summer Salaries)			3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	Tuition **	1	1	0	0	0	0	0
Non Exempt Staff			53.5%	53.5%	53.5%	53.5%	53.5%	53.5%	Health Insurance **	1	1	0	0	0	0	0
									Tuition increase (do not edit)							1.1

8. References

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BUDGET JUSTIFICATION:

PI: Sandie Ha

Project Title: Health impacts of air pollution in Fresno, CA

Project Period: 1/01/2022 - 6/30/2023

A. SENIOR PERSONNEL:

- A.1. Dr. Sandie Ha will commit a total of 3 person months. She will work on, and supervise the research assistants working on the project.

B. OTHER PERSONNEL:

- B.1. The Graduate Student Researcher (TBD) will commit 13 person academic months and 4 person summer months. The GSR will help with data management and analyses during the academic year. During summer two Graduate Student Researchers will help with survey data cleaning, management, and analysis.
- B.2. The Undergraduate Student Assistant will assist with recruitment efforts, survey instrument design, data cleaning and management. The student will also be helping with administrative tasks such as IRB application and data acquisition.

Salaries are based on current actual salaries and are projected to include a 3% annual cost-of-living adjustment (and merit, if applicable) effective each year, consistent with institutional policy.

C. FRINGE BENEFITS:

- a. 3% benefit rate is used for PI/Co-PIs.
- b. 45.7% benefit rate is used for Research Scientists.
- c. 14% benefit rate is used for Post-Doctoral Scholars.
- d. 3% benefit rate is used for Graduate Student Researchers.

The University of California, Merced Composite Fringe Benefit Rates (CFBR) have been reviewed and federally approved by the Department of Health and Human Services (DHHS) for use by all fund sources for FY21. Rates beyond June 30, 2021 are estimates and are provided for planning purposes only. Future CFBR rates are subject to review and approval by DHHS on an annual or bi-annual basis. Fringe benefits are assessed as a percentage of the respective employee's salary. *For more information, please see:*

<https://bfs.ucmerced.edu/departments/costing-and-policy/cbr>

D. TUITION AND FEES:

The University of California, Merced provides full remission of tuition, all fees, and graduate student health insurance to all graduate students who are employed on-campus at 25% time or greater during the academic year. The rates are based on current graduate fees and are escalated annually in the budget at a rate of 10% per year. Additional information regarding the fee remission program can be found at:

https://catalog.ucmerced.edu/content.php?catoid=17&navoid=1626#fee_schedule

E. TRAVEL:

- E.1. Domestic: Funding is requested for domestic travel for conferences for professional development and learn relevant methods for the project. Estimated breakdown of costs are as follows:

Item	Year 1	Year 2	Total
Airfare	1,500	1,500	3,000
Lodging	800	800	1,600
Meals	300	300	600
Conference Registration	300	300	600
Transportation	100	100	200
TOTAL:	3,000	3,000	6,000

E.2. Foreign: Funding is requested for foreign travel for conferences for professional development and learn relevant methods for the project. Estimated breakdown of costs are as follows:

Item	Year 1	Year 2	Total
Airfare	3,000	0	3,000
Lodging	1,500	0	1,500
Meals	300	0	300
Conference Registration	600	0	600
Transportation	600	0	600
TOTAL:	6,000	0	6,000

International per diem rates can be found here:
https://aoprals.state.gov/web920/per_diem.asp

F. OTHER DIRECT COSTS:

F.1. Materials and Supplies: Funding is requested for purchasing:

F.1.1. Four (4) high performance computers for the management and linkage of large datasets.

F.1.2. Software: ArcGIS will be used to link spatial data

F.1.3. Vital statistics requests

F.1.4. Data storage: A larger server to accomodate the large amount of data necessary to conduct the proposed studies.

F.2. Consultant Services: Funding is requested for consultant (TBD). Environmental justice expert consultants will advise on issues surrounding incorporating environmental justice measures into the analyses.

F.3. UCM Biostatistics Core: An on-site recharge facility will provide comprehensive statistical and data analysis support.

F.4. Geocoding: UC Merced GIS Lab will be consulted to assist with geocoding birth certificate data.

G. INDIRECT COSTS:

Per the sponsor's policy, indirect costs have been limited to 30% of total direct costs.