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Analyzing the Military's Role in Producing Air Toxics Disparities in the United States: A Critical Environmental Justice Approach

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ABSTRACT

The negative environmental, health, and social effects arising from U.S. military action in communities both domestically and abroad suggest that the military represents an understudied institutional source of environmental injustice. Moreover, scholars and activists have long argued that the state is an active or a tacit contributor to environmental inequality, thus providing an opportunity to link U.S. military activity with approaches to the state developed under critical environmental justice. We build on these literatures to ask: Does the presence of domestic military facilities significantly increase carcinogenic risks from air toxics? And do communities of color face additional military-associated carcinogenic risks? Multilevel analyses reveal that locales in closer proximity to a military facility and those exposed to greater military technological intensity, independent of each other, experience significantly higher carcinogenic risk from air toxics. We find that proximity to military facilities tends to intensify racial and ethnic environmental inequalities in exposure to airborne toxics, but in different ways for Latinx and Black populations. These results highlight the role of the state in perpetuating racial and environmental expendability as reflected in critical environmental justice and represent an important expansion of nationwide environmental justice studies on contributors to environmental inequality.

KEYWORDS: U.S. military; environmental justice; racial and ethnic inequalities; environmental sociology; multilevel modeling.

By signing Executive Order 12898 in 1994, President Clinton directed sixteen federal agencies to develop strategic plans to address disproportionate environmental inequalities affecting poor and nonwhite communities. As of today, the Department of Defense (DoD) has not updated its environmental justice (EJ) strategic plan since 1994—an aberration when compared to the other federal agencies (Government Accountability Office 2019). The absence of a current EJ plan from the DoD is especially disconcerting given that the agency 1) may be the single greatest institutional contributor of greenhouse gas emissions worldwide (Crawford 2019); 2) had an enormous $649 billion budget in 2018 (Tian et al. 2019); and 3) is one of the largest employers in the country with 2.7 million active duty personnel, reservists, and civilian support staff (Defense Manpower Data Center 2020). Previous research demonstrates negative environmental, health, and social effects arising from

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military action, including actions near Indigenous communities and lands in the United States (Hooks and Smith 2004; Kuletz 1998; LaDuke 1999; LaDuke and Cruz 2013), as well as in locales abroad, including some that are both near and distant from combat (Bonds 2016; Frey 2013; Smith, Hooks, and Lengefeld 2014). Others have claimed that "the presence of a military facility is the most reliable single predictor of environmental trauma" (Seager 1993:33). This suggests that the military represents an important and possibly overlooked institutional source of environmental injustice.

EJ scholars have long argued that the state is an active or a tacit contributor to environmental inequality (Bullard 1990; Bullard and Wright 2012; Pellow and Brulle 2005; Pulido 2017), thus providing an opportunity to link military activity with approaches to the state developed under critical environmental justice (CEJ) (Pellow 2017; Pulido 2016). The U.S. military has a history of environmental degradation and injustice that results from defense operations and land appropriation, including on the basis of race and colonial history (Alvarez, Theis, and Shtob 2021; Dillon 2015; Hooks and Smith 2004, 2005; Kuletz 1998; LaDuke 1999; Seager 1993). These environmental injustices may be compounded by the overrepresentation of racial and ethnic minority military personnel in the lower ranks (Armor and Gilroy 2010; Mariscal 2005; Martinez and Huerta 2020; Williams 1998) that may place people of color in closer proximity to risk. By situating the military as an institutional example of the state's role in promoting or opposing EJ, we use CEJ to reconceptualize the environmental consequences of the U.S. military and the potential impacts of military development on service members and civilians who live and work near facilities (Bonds 2016).

Merging literatures on the environmental impacts of the military, the sociology of race and racism, and CEJ, we stress the importance of assessing environmental injustice surrounding domestic military facilities across the United States. Military and environmental sociologists highlight the influential role the military plays in community economic development, how this draws military facilities into locales, and the environmental harms associated with this phenomenon (Alvarez 2021; Downey 2015; Hooks and Smith 2004; Lutz 2001). Others have drawn attention to the military's racial history, from historical segregation to contemporary racial disparities across the hierarchy of rank (Alvarez et al. 2021; Aragon 2015; Council on Foreign Relations 2020). Recent innovations in CEJ studies provide an opportunity to draw these research fields together with an enhanced focus on state production of environmental inequalities, especially for poor neighborhoods and communities of color (Pellow 2017; Pulido 2016). Together, these literatures suggest the following research questions: Does the presence of domestic military facilities significantly increase carcinogenic environmental health risks from air pollution? And are there significant racial and ethnic disparities in military-associated carcinogenic health risks?

To help answer these questions, we use multilevel analysis to demonstrate that proximity to the nearest U.S. military installation, as well as technological intensity of the military site, are each significantly associated with greater carcinogenic airborne pollution across census tracts in the United States. We find further evidence that proximity to military facilities exacerbates racial and ethnic environmental inequalities in air pollution, especially for tracts with greater proportions of Latinx and Black residents. These results highlight the role of the state in perpetuating racial and environmental expendability as reflected in CEJ studies (Pellow 2017) and represent an important expansion of nationwide EJ studies on contributors to environmental inequality (Mohai and Saha 2007).

BACKGROUND

The Environmental Harms of the U.S. Military

Military and environmental sociologists have demonstrated the military's environmental impacts domestically and abroad (Bonds 2016; Frey 2013; Hooks and Smith 2004; Kuletz 1998; LaDuke 1999; LaDuke and Cruz 2013; Smith, Hooks, and Lengefeld 2013). Military activity can result in environmental contamination and health risks due to the use of industrial chemicals as well as through the production of nuclear, biological, and chemical weapons (Alvarez 2021; Cable, Mix, and Shriver

2008; Downey 2015). In the United States, a number of decommissioned military facilities are designated Superfund Sites—an Environmental Protection Agency (EPA) designation for toxic sites—including Oak Ridge Nuclear Laboratory, Camp Lejeune, and McClellan Air Force Base (Dillon 2015). Research also shows that environmental harm from the military is not limited to closed sites but includes those functioning today (Alvarez 2021).

In part, the environmental harm of the military derives from constant preparation for armed conflict that requires intensive energy and resource use (Alvarez 2016; Bradford and Stoner 2017; Clark, Jorgenson, and Kentor 2010; Jorgenson, Clark, and Kentor 2010; Lengefeld and Smith 2013).[1] Maintaining its many facilities and service people domestically and abroad, the military consumes energy and fossil fuels—in 2017 it was estimated that the U.S. military emitted more greenhouse gases than some industrialized nations, such as Sweden and Denmark (Crawford 2019). The military's emissions profile is partially due to its exemption from environmental regulations (Schmidt 2004; Seager 1993; Truban 2004). After September 11, 2001, the U.S. military had a proactive legislative agenda, convincing lawmakers to exempt them from several environmental regulations via the Defense Appropriations Act of 2004 and 2005 (Babcock 2007). Moreover, the enactment of the Stump National Defense Authorization Act of 2002 explicitly prioritized military training over environmental protection, effectively rendering court rulings against the DoD moot (Truban 2004). Therefore, if both "war and the preparation of war are among the most environmentally destructive of human activities" (Downey 2015:226), we should examine how the military contributes to environmental injustice.

EJ research reveals communities of color and poor neighborhoods face greater environmental health risk from air pollution due to neighboring toxic-generating facilities (Ard 2015; Downey and Hawkins 2008). Additionally, researchers have distinguished industrial sites based on their attributes, such as number of employees (Grant et al. 2010), type of activity (Liévanos, Greenberg, and Wishart 2018), or duration of environmentally harmful use (Elliott and Frickel 2015). However, fewer quantitative EJ studies consider military facilities as centers of pollution notwithstanding that evidence suggests the environmental harms of the military (including increases in pollutants) may parallel approaches to industrial facilities in EJ research (Alvarez 2021). Evidence suggests heightened water pollution near military sites due to use of hazardous chemicals such as perfluorooctane sulfonate and trichloroethylene (Hamilton 2016; U.S. Govermental Accountability Office 2018). Moreover, military gear and equipment—including heavy armored vehicles—have negative environmental effects due to their industrial-grade characteristics (Lawrence et al. 2015). Contamination from military facilities and equipment is therefore linked to health risks for military personnel and civilians alike (Schettler 1995). Because of the increasingly technological, geographically diffuse, and resource intensive nature of the U.S. military (Shaw 1988, 2002), many scholars have chosen to analyze the military and its environmental consequences through production- and consumption-related emissions, especially in the case of sophisticated, capital- and resource-intensive militaries (Givens 2014; Hooks and Smith 2005; Jorgenson and Clark 2011; Sbicca 2012; Shaw 2002; Smith and Lengefeld 2020).

Missing from the literature, however, is a specific focus on the relationships between environmental impacts of the military, environmental injustice, and race/ethnicity. Given the role of the military as a significant state institution and polluter, it is important to contextualize the U.S. military's environmental impacts within the history of race and racism in the armed forces, because those most impacted may be military personnel themselves.

1 As Hooks and Smith (2004, 2005) outline in the treadmill of destruction, the dynamics of the environmental consequences of the military are unique as compared to the treadmill of production. They demonstrated that the siting of dangerous military activities and coercive relocation exposes Indigenous populations to greater environmental fallout.

The U.S. Military: A Racial History

The U.S. military is an integral arm of the racial state: this implies that it may play a central role in the unequal distribution of environmental injustice (Alvarez et al. 2021). Race and racism influence the environmental and health effects caused by the U.S. military domestically and abroad. Black activists for nuclear disarmament recognized the racial prejudices of the U.S. government towards Japanese people during World War II, especially in the use of the nuclear bombings in Hiroshima and Nagasaki (Intondi 2015). The Cold War arms race fueled nuclear weapons testing and waste production destroying ecosystems and the well-being of Indigenous communities (Kuletz 1998; LaDuke 1999; LaDuke and Cruz 2013). Abroad, the military's use of the toxic herbicide, Agent Orange, caused adverse ecological and health problems to Vietnamese people and U.S. soldiers (Frey 2013). Recent studies have focused on the adverse environmental and health effects from the open-air burning of solid waste on bases in the Middle East (Liu et al. 2016). Situating the U.S. military within the study of race and racism reveals a likelihood of unequal risk distribution when national security becomes a priority.

The military is among the nation's largest employers. Due to proximity to military operations, personnel and their families may face significant health risks due to environmental contamination. Moreover, the history of race and racism within the armed forces suggests that certain communities may face greater exposure to environmental harms. The U.S. armed services were racially segregated from the Revolutionary War until 1948, with full integration achieved during the 1950s (Aragon 2015; Bielakowski 2013). During World War II, the military enforced segregated facilities and enlisted most Black soldiers as laborers (Aragon 2015). Meanwhile, Mexican-Americans, who were classified as white, participated more in combat units and received commendations for their service (Aragon 2015). Research focused on Indigenous and Asian military personnel is comparatively scarce; however, it is noted that nearly a third of Indigenous men served in World War II (Bernstein 1991). Black military personnel faced racism from their service: "the often-violent resistance of both [B]lack civilians and servicemen to brutality, emphasized and institutionally reinforced [B]lackness as threatening and subversive in the eyes of military officials and federal law enforcement," contributing to their continued mistreatment and the lynching of Black veterans (Aragon 2015:513; see also Equal Justice Initiative 2017).

In recent years, the military has likely seen a change in racial and ethnic demographics on military bases and in surrounding communities (Lutz 2008). In part due to economic disenfranchisement, people of color are more likely to pursue careers in the armed forces, and racial/ethnic minority representation in the military has increased over the past two decades (Armor and Gilroy 2010; Barroso 2019; Lutz 2008; Mariscal 2005). Moreover, the U.S. military targeted Latinx youth for military service in the late 1990s and early 2000s (Mariscal 2005; Williams 1998). Currently, there is an overrepresentation of personnel of color in the armed forces (Council on Foreign Relations 2020), yet this overrepresentation is situated in the lower ranks and is not present among officers. The lack of racial and ethnic minority representation among officers likely has repercussions in terms of decision-making, potentially increasing the likelihood that military personnel of color on the front lines will experience trauma, including environmental exposure (Alvarez et al. 2021).

Connecting the history of personnel of color with the military's environmental impact record suggests the possibility of a systematic patterning of environmental harm from nearby military facilities on communities of color. Indeed, coupled with targeted recruitment and changing national demographics, this likely contributes to an increasing number of people of color in neighborhoods on or near military bases (Farley and Frey 1994; Iceland and Sharp 2013). Due to these histories, and bearing in mind that discrimination need not be overt to have real consequences (Pulido 2000, 2016, 2017), we investigate whether domestic military facilities contribute to greater environmental harm, especially for communities of color.

The U.S. Military within a Critical Environmental Justice Approach

First coined by Pellow and Brulle (2005), critical environmental justice reconceptualizes environmental injustices as state-sanctioned violence manifesting through multiple social hierarchies and contributing to racial and ecological expendability (Pellow 2016, 2017, 2019). The CEJ framework is anchored by four pillars: 1) recognition of overlapping systems of power and hierarchy; 2) the use of multiscalar approaches; 3) reconsideration of the role of state power as either a source of environmental justice, or, importantly, a driver of environmental injustice; and 4) consideration of the role of racial and socio-environmental indispensability (Pellow 2018). The environmental profile of the U.S. military, coupled with its history of racism and its present racial and demographic characteristics, suggests the value of using CEJ to examine pollution disparities near military sites across the United States.

Using a CEJ perspective recognizes that state violence, including that from the U.S. military, happens through overlapping systems of power (e.g., capitalism and racism). Similarly, EJ work identifies environmental injustices as racialized processes adapting to capitalist relations, producing racial disparities through the institutional power of the state (Pulido 2016, 2017). For example, the carceral system—a system tied to state action and the prison-industrial complex—locates prisoners in places where they may face elevated pollution levels (Pellow 2018). In addition to its racialized character and pollution potential, the military parallels the carceral system spatially (Alvarez et al. 2021) inasmuch as personnel and support employees may be required to live on or near facilities (Lutz 2001). CEJ illuminates the perspective that state-sanctioned environmental violence, such as harm caused by the U.S. military, may be produced through a system of capitalism that is inseparable from racism, thereby creating social differences through overlapping social hierarchies (Pellow 2019).

Applying the multiscalar approach forwarded by CEJ to the U.S. military reveals how EJ concerns interconnect across domestic and global scales. Alvarez et al. (2021) use risk-transfer militarism, developed outside of CEJ, to conceptualize the transfers of risks from combat zones to marginalized communities abroad and domestically. Risk-transfer militarism observes that many of the risks of military activity have shifted from combat zones to civilian sites well behind the front lines; this may result from preparation for distant warfare such as bases and training facilities (Bonds 2016) or from activities such as military spraying of herbicides in the war on drugs (Smith et al. 2014). To our knowledge, however, no study has taken this approach with respect to the changing racial and ethnic characteristics of the military itself or its adjacent communities. These examples imply the significance of a multiscalar approach as recommended by CEJ to inform EJ analysis among different communities.

Through a CEJ framework, we can analyze the state as a structural apparatus that may generate environmental inequalities rather than eliminating them, including on the basis of race and ethnicity (Bullard and Wright 2012; Kuletz 1998; Pellow 2017; Pulido 2016, 2017; Taylor 2015). Of particular importance is the idea that the state acts *in relation* to other structural factors, such as racism and capitalism, and is central to racial formation through the differentiation and devaluation of human bodies (Kurtz 2009; Omi and Winant 1994; Pulido 2017). Yet state-based militarization—a likely contributor to both environmental harm and racial and ethnic demographics in communities near military bases—constitutes an under-explored aspect of environmental inequality formation (Lengefeld and Smith 2013; Pellow 2000). Due to CEJ's primary emphasis on state-sanctioned environmental violence, it provides a useful framework to understand and explain potential environmental injustice related to the U.S. military.

CEJ centers communities of color as indispensable to environmental and social justice. Despite Black, Indigenous, and other persons of color enlisting in the military for purposes of recognition, national honor, or economic opportunity, military treatment of racial and ethnic minorities historically parallels that of the racism endemic to broader U.S. society, including segregation, economic deprivation, discrimination, and physical violence. Moreover, the environmental effects of U.S. militarism on communities of color suggests the U.S. military have taken part in producing racialized environmental inequalities. Ultimately, the purpose of CEJ is to move towards racial and environmental equity.

Building on these literatures, we use CEJ to understand the expendability of racial and ethnic minorities from environmental harms caused by state military power. The environmental impacts caused from military activity implies that local environmental injustice analyses that use proximity to locally unwanted land uses, such as landfill placements (Bullard 1990; Chavis 1987; Mohai and Saha 2007) and industrial sites (Downey 1998; Liévanos 2017) as their measures, should be extended to military sites nationwide. Moreover, EJ measures can be adapted to capture the distinct intensity of militarism (Clark et al. 2010). Because the military has characteristics distinct from commercial and industrial facilities—such as exemption from environmental regulations, a high rate of resource consumption, the recruitment of people of color for military service and its role as an integral arm of the state—the location and intensity of military activity may have important, distinctive EJ consequences. Based on these theoretical foundations, our research questions are: 1) Is there a national trend of domestic military facilities contributing to air toxics exposure? And 2) do communities of color face additional environmental inequality burdens from these facilities?

HYPOTHESES

The use of air pollution to evaluate our research questions confers key advantages as compared to the use of unexploded ordinance and other forms of pollution (Downey 2015; Seager 1993). Air pollution disproportionately impacts communities closer to its source and disperses quickly when compared to soil or groundwater contamination. Therefore, it allows us to test whether disproportional environmental health risks are being transferred to local communities at a particular point in time.[2] For these reasons and the availability of data, we use a cross-sectional analysis, following previous cross-sectional EJ work assessing air toxics and environmental inequality in other contexts (Collins et al. 2011; Liévanos 2015).

Hypothesis 1 establishes the baseline for this research by evaluating the environmental inequalities from industrial and other forms of air pollution in the United States generally (i.e., without a specific focus on military involvement) found in poor neighborhoods and communities of color (Brulle and Pellow 2006; Taylor 2000).

Building upon this baseline, Hypothesis 2 addresses our first research question by assessing whether domestic military facilities presence and technological intensity contribute to greater air pollution exposure on nearby communities. It makes sense to extend residential proximity in EJ theory and methods from industrial to military pollution, including through analysis of residential proximity to potential pollution sources and the intensity of activity at those sources. Reflecting previous military and environmental sociology scholarship that argues the significance of technological expansion and intensification of militaries in understanding how they produce environmental harms (Clark et al. 2010; Kentor and Kick 2008), we use a constructed variable known as plant replacement value (PRV) density that divides the replacement value of each facility according to the DoD by its area to approximate technological intensity. This measure of technological intensity lends nuance into the variation across military facilities. The use of measures of proximity and intensity of polluting activity also reflects a common and continuing theme in EJ research (Downey 1998; Downey and Hawkins 2008; Elliott and Frickel 2015; Grant et al. 2010; Liévanos 2017; Liévanos et al. 2018; Pastor, Sadd, and Morello-Frosch 2004). Based on CEJ, we expect the presence and technological intensity of military facilities to be associated with greater environmental injustice for communities of color.

Hypothesis 3 addresses our second research question: is there an *additional* environmental health risk on communities of color from domestic military facilities? Here we use statistical interaction terms—between military facility proximity, the facility's technological intensity, and percent of race and ethnic minority residents—to test whether these significantly relate to air pollution disparities. If

2 As opposed to, for example, a Superfund site that may arise from a long, mostly hidden history of terrestrial pollution.

the state is fundamental to the production of racial disparities, as suggested by CEJ, and the presence of military facilities influences the racial/ethnic composition of nearby communities, it is reasonable to expect that greater local military presence will influence racial environmental harm. This is especially so because populations of people of color near military bases may have increased in recent years, if for no other reason than the greater representation of personnel on base and the greater integration of nearby neighborhoods (Farley and Frey 1994; Park and Iceland 2011). These questions result in our three hypotheses:

Hypothesis 1 (Environmental Inequality Hypothesis):
Tracts with more poor residents and residents of color, independent of each other, will report greater carcinogenic risk from air toxics.

Hypothesis 2 (Military and Environmental Inequality Hypothesis):
Tracts that are exposed to greater military presence—measured by proximity to a military facility and that facility's cost intensity, independent of each other—will report greater carcinogenic risk from air toxics.

Hypothesis 3 (Critical Environment Injustice Hypothesis):
Tract proximity to greater military presence intensifies the relationship between communities of color and environmental health risk, meaning that communities of color in areas with greater military presence (either by military facility proximity or that facility's cost intensity) will be subject to additional airborne carcinogenic risk.

METHOD AND DATA

Sample

We chose census tracts as the primary unit of analysis because they are the finest scale common to our primary variables and often employed in previous research (Downey and Hawkins 2008; Liévanos 2015; Zwickl, Ash, and Boyce 2014). Tracts represent settlements of 1,500 to 8,000 people in a stable, spatially delimited setting. Because tracts vary by size, we include each tract's area as a control variable. Our sample includes 71,317 tracts within the 50 U.S. states and Washington, DC. Given the regulatory power that administrative organizations have on environmental protection (Ard 2015; Liévanos 2019a; Zwickl et al. 2014), we use multilevel models to control for county- and state-level clustering by nesting census tracts within counties and counties within states. Table 1 reports the descriptive statistics.

Dependent Variable: Estimated Cancer Risk from Air Toxics

The EPA produces the National Air Toxics Assessment (NATA) to evaluate concentrations of 180 air toxics, as listed under the Clean Air and Clean Water Acts, and their corresponding environmental health risks (Office of Air Quality Planning and Standards 2018). NATA is produced through a rigorous multi-stage process beginning with compiling the National Emissions Inventory, which is then used to estimate ambient concentrations of air toxics through computer modeling of meteorological and photochemical processes. Environmental health risk is estimated by combining air toxics emissions concentrations with models of daily human outdoor activity.[3] Previous research (Collins et al. 2011; Liévanos 2015) uses NATA-estimated cancer risk from air toxics to assess environmental inequality because it captures actual risk to human health instead of toxicity concentrations and presents a standardized unit (i.e., per million persons) for analysis. A noteworthy limitation is that the toxic emissions included in NATA includes both military and non-military polluters (later, we

3 The EPA estimates population risk by dividing the population into "cohorts based on residential location, life stage (age), and daily activity pattern" (Office of Air Quality Planning and Standards 2018:13).

Table 1. Descriptive Statistics

Variable	*Level*	*Mean*	*SD*	*Min*	*Median*	*Max*
Estimated cancer risk from air toxics per million persons	tract	31.66	12.97	6.17	30.98	1505.12
Military proximity (km)	tract	41.03	43.50	0.00	27.43	1072.71
PRV density (ln)	tract	4.78	1.98	−4.61	5.03	11.06
Race/ethnicity by tract						
People of color (%)	tract	36.78	30.23	0.00	27.21	100.00
Black (%)	tract	13.38	21.99	0.00	3.70	100.00
Latinx (%)	tract	15.71	21.24	0.00	6.61	100.00
Median household income (in $10,000s)	tract	5.70	2.81	0.25	5.09	25.00
Metro (binary)	county	0.83	0.37	0.00	1.00	1.00
GDP per capita (thousands of dollars per person)	county	54.94	34.61	4.90	49.38	715.81
Gini index	county	0.46	0.03	0.33	0.46	0.65
Active-duty personnel (%)	state	0.34	0.38	0.01	0.31	3.58
Area of tract (km^2)	tract	132.30	1517.74	0.01	5.16	234473.80
Defense spending per capita	state	1237.49	1055.42	290.00	1112.00	9924.00
Impervious surface (%) (n=70,876)	tract	27.83	23.98	0.02	24.13	96.37
Primary roads proximity (km)	tract	19.44	108.15	0.00	4.66	3787.00
Renters (%)	tract	36.35	22.72	0.00	31.19	100.00
Some college and up (%) (n=71,316)	tract	57.05	17.80	4.74	56.17	100.00
Unemployment (%)	tract	9.80	6.01	0.00	8.47	100.00

Notes: n=71,317 unless otherwise stated

discuss how we differentiate military sources). Our dependent variable is the estimated cancer risk from air toxics in a lifetime of 70 years per million persons for the year 2014.

Primary Independent Variables: Military Facility Proximity and PRV Density

The DoD broadly defines military sites as installations, ranges, training areas, bases, forts, camps, armories, centers, and so on. Because these facilities' purposes range from civilian support to combat training, they tend to feature different environmental impact profiles (i.e., patterns of production and consumption). Yet these different entities function interdependently; it would be difficult to manage military bases without armories, training camps, or other support facilities. Thus, we use the DoD's definition of military sites as units of the military facility because they represent sites of preparation for the military's broader mission of national security, including its geopolitical mandate and related behaviors (Mann 1984).

The Defense Installations Spatial Data Infrastructure Program produces geospatial information for the DoD, including the Map of U.S. Military Installations, Ranges, and Training Areas (DoD 2019). This map "provides a comprehensive listing of all sites owned and managed by the DoD," as well as GIS-compatible vector representations of most facilities (a few are excluded for national security reasons) and the site operational status—for example, either active or inactive (DoD 2015a:2). The Base Structure Report that is linked to this map also includes the plant replacement value, or the "calculated cost to replace the current physical plant (facilities and supporting infrastructure)," and is the only financial information published by the DoD for each installation (DoD 2015a:5). To

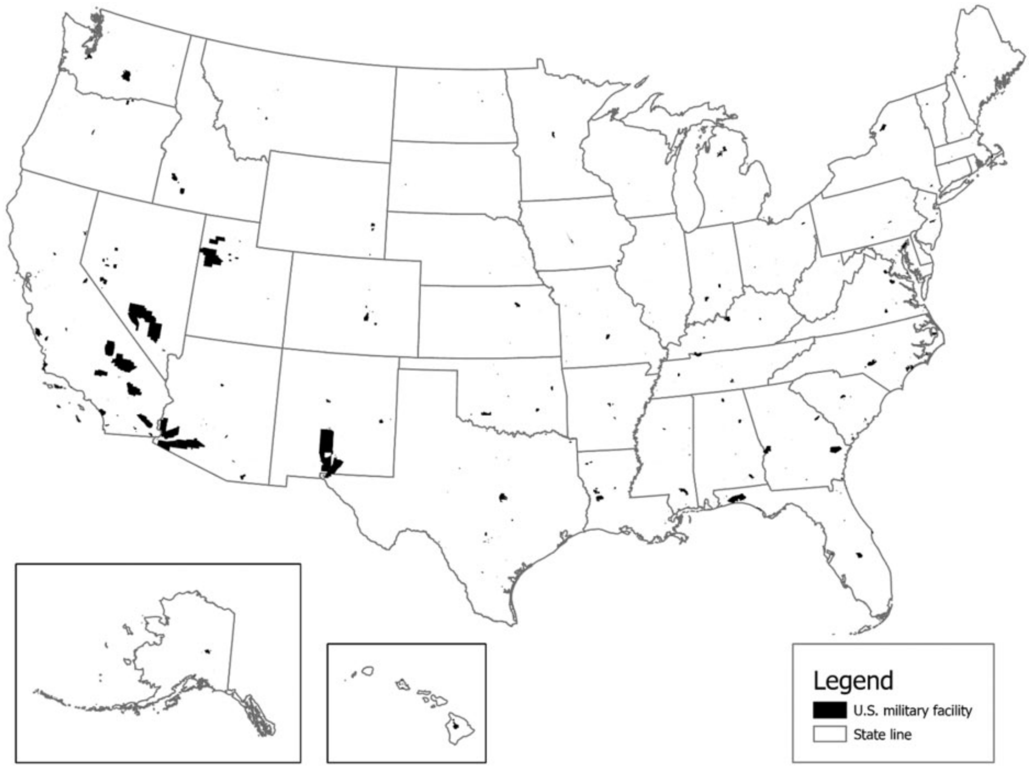

Figure 1. U.S. Military Facilities across the United States.

maintain consistency among sites, we use geospatial data for 2014, totaling 689 military installations that reported both active status and PRV (see Figure 1).

A robust measure of local military presence would, first, account for military sites across geographic boundaries (e.g., tracts, counties, and states). Second, the measure should record variability in the technological intensity across facilities (Clark et al. 2010). With these criteria in mind, we evaluated various geographic measurements of local military presence.[4] We chose proximity and PRV density of each military facility, because they best reflect the presence and intensity of military facilities.

We extend EJ research's logical use of proximity to evaluate exposure to environmental hazards such as waste disposal facilities and industrial sites (Alvarez 2021; Bullard 1983; Chavis 1987; Downey 1998; Liévanos 2017). To calculate military facility proximity for each tract, we calculated the distance in kilometers between tract and the nearest military facility centroids using ESRI ArcGIS. Figure 2 demonstrates the proximity calculation for tract number 62.04 within Clark County, Nevada, estimated at 4.206 kilometers away from the closest facility. Using a continuous measure such as proximity has the advantage of maintaining data precision compared to other proximity measures, such as buffer zones. Moreover, proximity to the nearest military facility is preferable to areal measures, since it better reflects air emissions dispersion to nearby communities.

As noted, previous military and environmental sociology literature evaluated the intensity of militaries as an indicator of environmental degradation because the U.S. military often receives special

4 We evaluated proximity to the nearest facility, percent of military area within a census tract, the area of the nearest military facility, and the PRV of the nearest military facility. The percentage of each tract that is a military facility features an overwhelming number of zero values, does not account for tracts adjacent or near military facilities, and may misrepresent local military intensity for tracts that include a portion of an expansive facility.

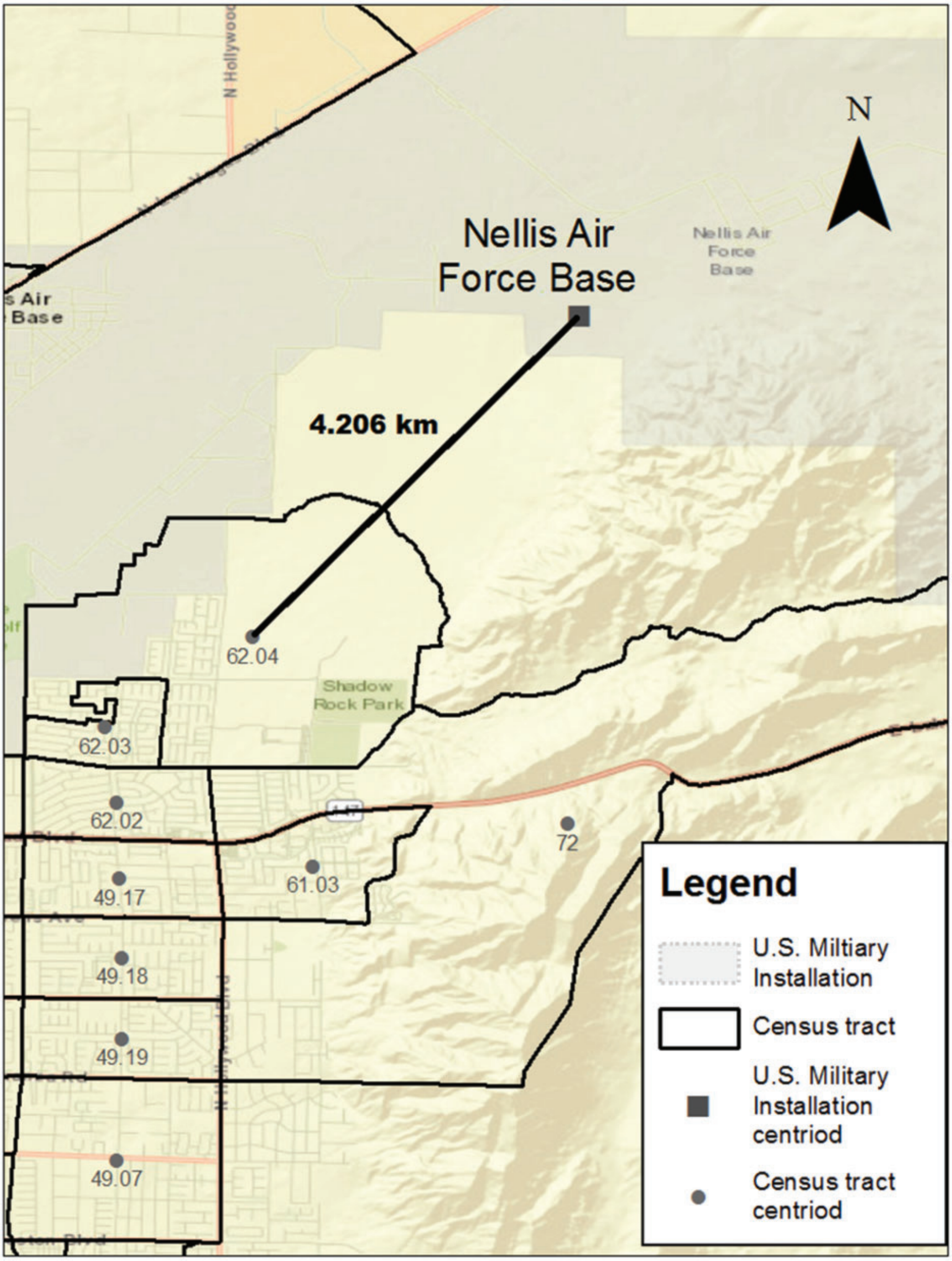

Figure 2. Close-up example of U.S. Military facility, overlaid U.S. census tracts in Las Vegas, Nevada.

treatment from the state as compared to commercial entities in environmental regulations and resources (Clark and Jorgenson 2012; Clark et al. 2010; Jorgenson and Clark 2011; Kentor and Kick 2008). Conceptually, the argument is that if the state diverts more resources in either capital or labor to the military, then it is more likely to consume natural resources and produce hazardous externalities. Previous cross-national research used expenditures per soldier to gauge "the high-tech nature, or capital intensiveness, of national militaries" (Clark et al. 2010:32). Similarly, to assess the technological intensity of each military facility, we constructed the *PRV density* of each military facility by dividing its PRV by its area. As mentioned earlier, PRV is the financial estimate to replace the facility's construction in materials and labor, serving as a proxy for its capital and technological intensity. A noteworthy limitation of PRV is that it does not capture the use or labor-intensity of the facility, such as the number of personnel. However, PRV does reflect the resource-intensity of facility and equipment, including operations, research, production, and storage, and if onsite equipment is industrial-grade (Lawrence et al. 2015). Akin to cross-national studies, the rationale is that if more resources are directed to certain military sites, they may be more likely to produce environmental hazards.

Here, we use PRV density as a proxy for technological intensity of each facility, as well as to distinguish nuance between sites. For example, Fort Shafter in Hawaii, one the oldest military facilities in the country, has a PRV density of 366.30 (PRV is \$890.1 million and area is 2.43 km^2), while the National Guard Oglethorpe Armory in Georgia has an PRV density of 140.77 (PRV is \$18.3 million and area is .13 km^2). Because proximity does not control for the differences between military facilities, PRV provides an infrastructural proxy for the technological intensity of the site: a replacement cost value per km^2. This measure allows for comparison across military sites. The PRV density was highly skewed, so we used a natural log transformation.

Additional Independent Variables

Demographic data came from the U.S. Census American Community Survey (ACS) wave 2010–2014 and were downloaded from the National Historical Geographical Information System (Manson et al. 2018). Similar to previous EJ research (Downey 1998; Huang and London 2012; Pastor et al. 2004), we use percent people of color, percent Black, percent Latinx and median household income to evaluate environmental inequality. Data limitations involving sample size and potential introduction of error did not allow us to disaggregate Indigenous and Asian American populations. Research in environmental sociology demonstrates the importance of economic development in the formation of environmental degradation (Smith and Lengefeld 2020; York, Rosa, and Dietz 2003), and thus we include a measure of economic development, county-level gross domestic product (GDP) per capita and its quadratic from the Bureau of Economic Analysis for the year 2014. Previous research demonstrates that metro areas report greater air pollution, and we employ the county-level metropolitan area status derived from the USDA ERS Rural-Urban Continuum Codes (Greiner, Shtob, and Besek 2020; Jorgenson et al. 2010; Liévanos 2019b). Recent research stresses the importance of income inequality, so we use the county-level Gini Index, a widely used measure of inequality that is scaled from 0 to 1 and came from the ACS (Hill et al. 2019).

Control Variables

To control for other factors known to be associated with air pollution, we included additional spatial and demographic variables in a saturated model. First, we controlled for spatial characteristics that are known to be associated with greater air pollution: proximity to primary roads (all states) and percent impervious surface as a measure of overall land development (all states except Alaska and Hawaii) (Alvarez 2021; Liévanos 2015, 2017). Second, economic deprivation variables used in previous literature included: percent renters, unemployment rates, and educational attainment (Pastor, Sadd, and Morello-Frosch 2004; Huang and London 2012). Third, we controlled for two military variables analogously used in cross-national studies (Alvarez 2016; Clark et al. 2010; Kentor and Kick 2008) at the state-level: percent of the state population that is active duty military personnel and defense spending (Defense Manpower Data Center 2020; DoD 2015b). Finally, we control for EPA regions with region six as the reference category, because it reported the highest average estimated cancer risk (Ard 2015; Liévanos 2015). The variance inflation factor (VIF) of each variable was less than ten, meaning that multicollinearity is within acceptable social science standards (Neter, Wasserman, and Kutner 1989).

Analytical Approach

Multilevel analyses are an efficient, sophisticated way to evaluate relationships and to control for clustering within administrative geographic boundaries (Hox 2010). We used a three-level random intercept model of tracts (level 1) nested within counties (level 2) nested within states (level 3):

$$y_{ijk} = \beta\delta + v_{0k} + \mu_{0jk} + e_{0ijk}$$

$$v_{0k} \sim N\left(0,\ \sigma_v^2\right)$$

$$\mu_{0jk} \sim N\left(0,\ \sigma_\mu^2\right)$$

$$e_{0ijk} \sim N\left(0,\ \sigma_e^2\right)$$

Where y_{ijk} is the outcome value of tract i within county j, in state k. δ is the vector of intercept and fixed effects with β as the parameter coefficient such as percent people of color or GDP per capita. The random effects at the state level are represented by σ_v^2, the county by σ_μ^2, and the tract level by σ_e^2. All random effects are assumed to be normally distributed.

We use the variation partition coefficient (VPC) and proportional change in variation (PCV) to assess the amount of explained variation. The VPC calculates the amount of variation of the dependent variable that is explained by higher levels (in this case, county and state levels) by taking the random effects of the higher levels and dividing them by the total number of random effects:

$$VPC = \frac{\sigma_v^2 + \sigma_\mu^2}{\sigma_v^2 + \sigma_\mu^2 + \sigma_e^2} * 100$$

Every time a fixed effect is added to the model, the VPC decreases because the added fixed effect explains away some of the variation of the dependent variable. The PCV evaluates the amount of between-county and -state variation of the dependent variable that is explained by additions to each successive model (Axelsson Fisk et al. 2018; Evans et al. 2018). The PCV takes the difference of the sum of random effects at the higher levels of two models and divides them by total sum of the random effects of the previous model:

$$PCV = \frac{\left(\sigma_{v\ model\ 1}^2 + \sigma_{\mu\ model\ 1}^2\right) - \left(\sigma_{v\ model\ 2}^2 + \sigma_{\mu\ model\ 2}^2\right)}{\left(\sigma_{v\ model\ 1}^2 + \sigma_{\mu\ model\ 1}^2\right)} * 100$$

The logic of multilevel models is to begin with the null model and examine the increased explanatory power gained through additional fixed effects (i.e., independent variables) until a saturated model is reached. Therefore, our models begin with the null model and progressively add variables from our suite to evaluate our three hypotheses. One set of models focuses on percent of people of color overall, while the second set of models follows a similar progression from null to saturated model but decomposes race and ethnicity into percent Black and percent Latinx.

RESULTS

Table 2 reports the random intercept results for percent people of color. Model 1A (the null model) reports the intercept or the precision-weighted grand mean of the sample as approximately 25 estimated deaths from cancer risk from air toxics per million persons. Almost seventy percent (VPC = 69.60 percent of Model 1A) of the variation of estimated cancer risk from air toxics is explained by the county- and state-levels with most of the variation coming from the county level ($\sigma_{\mu}^2 = 88.27$ and $\sigma_{v}^2 = 64.99$).

Model 1B shows support for the environmental inequality hypothesis: census tracts with higher percentages of people of color, lower median household income, greater GDP per capita, and located in metro areas independently having significantly[5] higher environmental health risk. The VPC of Model 1B decreases slightly to 68.45 percent because these variables explain some of the variation left unexplained by the null model. The PCV of these models can be used to assess the amount of variance attributable to the added fixed effects. The PCV Model 1B from Model 1A is 6.18 percent, meaning just over six percent of the between-county and -state variation of estimated cancer risk is explained by the fixed effects of Model 1B.

Model 1C evaluates whether proximity and intensity of the nearest military facility contributes to disparities in air toxic exposure. The military facility proximity coefficient is significant and negative indicating, as expected, that tracts in closer proximity to military facilities are associated with greater cancer risk from air toxics. PRV density of the nearest military facility is significant and positively associated with air toxics cancer risk. This means that, also as expected, tracts located near military facilities with greater PRV density independently report greater airborne cancer risk. In Model 1C, all previously mentioned predictor coefficients retain their direction and statistical significance except the Gini index. The results from Model 1C support Hypothesis 2.

To further assess the amount of between-county and -state variation in environmental health risk that is explained by military presence, we use the PCV between Model 1C and 1B to compare the proportional difference of their random effects. Since Model 1C only added fixed effect measures of the U.S. military, we can attribute the proportional change in between-county and -state variation to those fixed effects. The PCV of Model 1C reports that roughly 6 percent (reported as 6.25 percent) of the between-county and -state variation in estimated cancer risk from air toxics is explained by military facility proximity and PRV density, indicating the importance of military presence.

To assess whether the U.S. military presence modifies the relationship between environmental health disparities and percent people of color, we use interaction terms between percent people of color and military variables in Model 1D. Military facility proximity modifies the relationship between percent people of color and risk such that, as tracts are closer to facilities, the tracts with more people of color face additional environmental health risk. This supports Hypothesis 3. The interaction between percent people of color and PRV density of nearest facility is positive and nears statistical significance ($p = 0.122$), thus indicating that in tracts located near military facilities with higher PRV density, the relationship between percent people of color and environmental health risk may be intensified. However, the effect is not as strong as the proximity interaction and only marginally supports Hypothesis 3. All coefficients from Model 1C maintain their direction and statistical significance except the Gini index, which loses its statistical significance.

Model 1E is the fully saturated model with all the control variables including the interactions. The military presence variable and the interaction terms between military presence and percent people of color maintain their direction and statistical significance. Figure 3 demonstrates the effect of the interaction term and illustrates that the tracts in closer proximity to military facilities tend to have greater racial environmental inequality. Variables relating to all three hypotheses maintain direction and significance with the inclusion of control variables in Model 1E, except median household income and the Gini index.

5 We define *significant* as $p < .05$.

Table 2. Results from Multilevel Linear Regression Models with Percent People of Color.

	Model 1A			*Model 1B*			*Model 1C*		
FIXED EFFECTS	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*
Intercept	25.247	1.166	0.000	21.973	2.852	0.000	24.873	2.837	0.000
People of color (%)				0.024	0.002	0.000	0.022	0.002	0.000
Median household income (10,000s)				−0.170	0.016	0.000	−0.174	0.016	0.000
Metro				4.007	0.390	0.000	2.279	0.401	0.000
GDP per capita				0.046	0.009	0.000	0.045	0.009	0.000
(GDP per capita)-squared				−8.430E-05	0.000	0.001	−6.310E-05	0.000	0.013
Gini index				−0.133	5.993	0.982	0.321	6.020	0.000
Military proximity (km)							−0.042	0.002	0.000
PRV density (ln)							0.254	0.031	0.000
INTERACTIONS									
POC x military proximity									
POC x PRV density (ln)									
CONTROL VARIABLES									
Active-duty personnel (%)									
Area of tract (km^2)									
Defense spending per capita									
Impervious surface (%)									
Primary roads proximity (km)									
Renters (% of housing units)									
Some college and up (%)									
Unemployment (%)									

(*continued*)

Table 2. Results from Multilevel Linear Regression Models with Percent People of Color.(continued)

FIXED EFFECTS	*Model 1A* Est.	SE	p	*Model 1B* Est.	SE	p	*Model 1C* Est.	SE	p
RANDOM EFFECTS									
Tract	66.953	0.362		66.287	0.358		65.846	0.356	
County	88.272	2.455		83.204	2.328		84.366	2.380	
State	64.989	13.571		60.590	12.705		50.435	10.721	
VPC	69.60%			68.45%			67.18%		
PCV				6.18%	†		6.25%	‡	
N	71,317			71,317			71,317		

FIXED EFFECTS	*Model 1D* Est.	SE	p	*Model 1E* Est.	SE	p
Intercept	24.443	2.844	0.000	35.613	3.359	0.000
People of color (%)	0.021	0.005	0.000	0.012	0.005	0.013
Median household income (10,000s)	−0.170	0.016	0.000	0.095	0.024	0.000
Metro	2.365	0.402	0.000	0.953	0.406	0.019
GDP per capita	0.044	0.009	0.000	0.035	0.009	0.000
(GDP per capita)-squared	−5.500E-05	0.000	0.030	−6.290E-05	0.073	0.073
Gini index	1.178	6.022	0.845	−1.307	6.010	0.828
Military proximity (km)	−0.037	0.003	0.000	−0.021	0.003	0.000
PRV density (ln)	0.207	0.042	0.000	0.084	0.042	0.048
INTERACTIONS						
POC x military proximity	−1.496E-04	3.910E-05	0.000	−2.466E-04	4.220E-05	0.000
POC x PRV density (ln)	0.001	0.001	0.122	0.001	0.001	0.159
CONTROL VARIABLES						
Active-duty personnel (%)				−4.124	2.909	0.156
Area of tract (km^2)				−9.050E-05	0.000	0.212
Defense spending per capita				0.001	0.001	0.132

(*continued*)

Table 2. Results from Multilevel Linear Regression Models with Percent People of Color.(continued)

	Model 1D			Model 1E		
FIXED EFFECTS	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*
Impervious surface (%)				0.069	0.002	0.000
Primary roads proximity (km)				−0.043	0.004	0.000
Renters (% of housing units)				0.011	0.002	0.000
Some college and up (%)				−0.012	0.003	0.000
Unemployment (%)				−0.001	0.007	0.855
EPA regions						
1				−17.524	2.912	0.000
2				−12.881	3.488	0.000
3				−10.744	2.914	0.000
4				0.586	2.274	0.797
5				−13.657	2.536	0.000
6 (ref.)						
7				−11.398	2.665	0.000
8				−15.633	2.478	0.000
9				−7.679	3.076	0.013
10				−10.206	2.970	0.001
RANDOM EFFECTS						
Tract	65.826	0.356		64.874	0.351	
County	84.327	2.378		83.069	2.338	
State	50.934	10.816		14.367	3.318	
VPC	67.26%			60.03%		
PCV				27.72%	¥	
N	71317			70875		

Notes: † PCV relative to Model 1A. ‡ PCV relative to Model 1B. ¥ PCV relative to Model 1C.

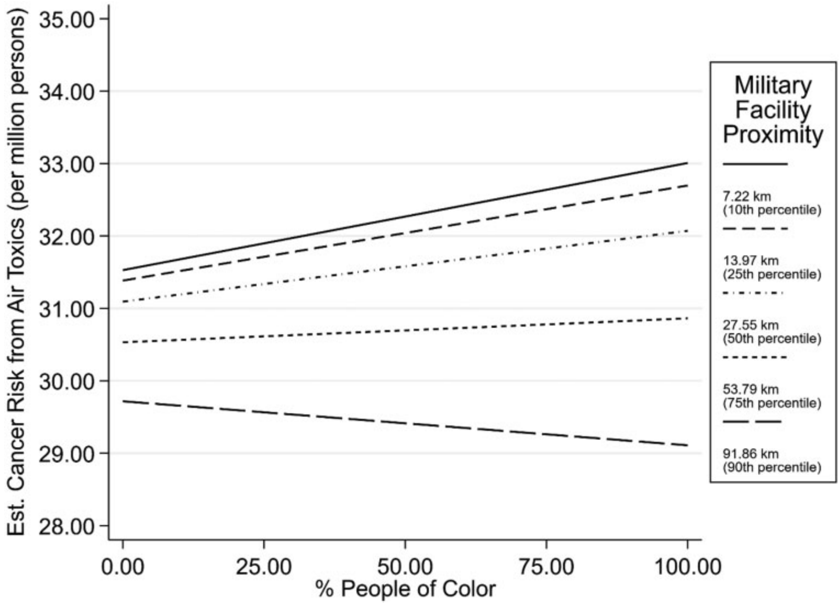

Figure 3. Predicted Values of Estimated Cancer Risk from Air Toxics Across Percent People of Color for Various Military Facility Proximities (Model 1E).

Table 3 reports the random intercept results with percent Black and Latinx residents. Model 2A reports that census tracts with a higher percent of Black and Latinx residents have higher environmental health risk. Moreover, the results of the coefficients for median household income, metro area status, GDP per capita, Gini index, military proximity, and PRV density retain their previous directions and statistical significance from Model 1D.

In Model 2B, the interaction terms for military proximity with each of percent Black and Latinx are significant and negative. Bearing in mind the results reported earlier concerning the relationships between communities of color overall and military proximity, this suggests that military facility proximity intensifies the relationship between percent Black and Latinx and airborne cancer risk and illustrates some of the variation among racial and ethnic categories. The interaction for military facility PRV density and percent Black is negative and approaches significance ($p=.087$). This means that as percent Black increases, the effect of PRV on air toxic exposure decreases. On the other hand, the interaction between military facility PRV density and percent Latinx is positive and is nearly significant ($p=.050$) meaning that nearby facility PRV may exacerbate the relationship between percent Latinx and air toxic exposure.

Model 2C is the saturated model and both interactions for military facility proximity maintain their direction (negative) and significance. Both interactions between PRV density and percent Black ($p=.49$) and Latinx ($p=.11$) lose their significance. Figures 4 and 5 plot the effects of the interaction terms between proximity and percent Black/Latinx and although the interactions report the same direction (negative), the differences in their magnitudes are illustrated by the figures. The association with carcinogenic risk increases at a greater rate (i.e., greater slope) as percent Latinx increases for census tracts in closer proximity to military facilities. All in all, the figures demonstrate significant environmental inequality for Black and Latinx communities residing in closer proximity and underscore the potential for variation among racial and ethnic groups. Model 2C reports similar statistical significance and direction to Model 1E except for percent of educational attainment and unemployed. Furthermore, the results are robust to sensitivity analyses that involve dropping outliers greater than three standard deviations from the mean for both military proximity and PRV density.

Table 3. Results from Multilevel Linear Regression Models with Percent Black and Latinx.

	Model 2A			Model 2B			Model 2C		
FIXED EFFECTS	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*
Intercept	24.234	2.847	0.000	23.927	2.845	0.000	35.083	3.382	0.000
Black (%)	0.007	0.002	0.000	0.022	0.006	0.000	0.013	0.006	0.038
Latinx (%)	0.039	0.002	0.000	0.041	0.007	0.000	0.034	0.007	0.000
Median household income (10,000s)	-0.167	0.016	0.000	-0.162	0.016	0.000	0.072	0.024	0.002
Metro	2.299	0.402	0.000	2.382	0.401	0.000	0.902	0.406	0.026
GDP per capita	0.045	0.009	0.000	0.046	0.009	0.000	0.035	0.009	0.000
(GDP per capita)-squared	−6.080E-05	0.000	0.016	−6.740E-05	0.000	0.008	-6.460E-05	0.000	0.065
Gini index	1.961	6.034	0.745	1.804	6.019	0.764	-2.108	6.015	0.726
Military proximity (km)	−0.042	0.002	0.000	−0.035	0.002	0.000	−0.019	0.003	0.000
PRV density (ln)	0.256	0.031	0.000	0.224	0.039	0.000	0.094	0.040	0.019
INTERACTIONS									
Black x military proximity				-1.799E-04	0.000	0.007	-2.734E-04	0.000	0.000
Latinx x military proximity				-4.048E-04	0.000	0.087	-4.516E-04	0.000	0.000
Black x PRV density(ln)				−0.002	0.001	0.000	−0.001	0.001	0.478
Latinx x PRV density(ln)				0.002	0.001	0.050	0.002	0.001	0.104
CONTROL VARIABLES									
Active-duty personnel (%)							-4.120	2.960	0.164
Area of tract (km^2)							-8.330E-05	0.000	0.251
Defense spending per capita							0.001	0.001	0.136
Impervious surface (%)							0.067	0.002	0.000
Primary roads proximity (km)							−0.044	0.004	0.000
Unemployment (%)							0.019	0.008	0.010
Renters (% of housing units)							0.010	0.002	0.000
Some college and up (%)							0.001	0.004	0.678

(*continued*)

Table 3. Results from Multilevel Linear Regression Models with Percent Black and Latinx.(continued)

	Model 2A			*Model 2B*			*Model 2C*		
FIXED EFFECTS	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*	*Est.*	*SE*	*p*
EPA regions									
1							-17.587	2.958	0.000
2							-12.938	3.549	0.000
3							-10.602	2.963	0.000
4							0.685	2.316	0.767
5							-13.725	2.583	0.000
6 (reference)									
7							-11.442	2.714	0.000
8							-15.977	2.522	0.000
9							-8.174	3.127	0.009
10							-10.465	3.022	0.001
RANDOM EFFECTS									
Tract	65.736	0.355		65.694	0.355		64.763	0.351	
County	84.849	2.392		84.213	2.371		83.171	2.341	
State	51.395	10.892		52.125	11.035		14.944	3.439	
VPC	67.45%			67.48%			60.24%		

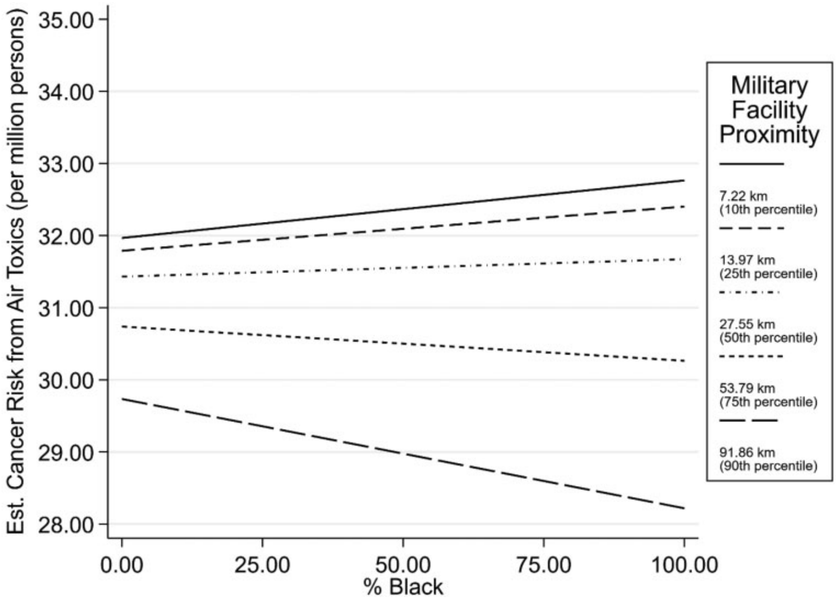

Figure 4. Predicted Values of Estimated Cancer Risk from Air Toxics Across Percent Black Residents for Various Military Facility Proximities (Model 2C).

DISCUSSION AND CONCLUSIONS

We find that U.S. military presence contributes to racial and environmental expendability at the intersection of multiple social hierarchies and scales. As reflected in the first pillar of CEJ, we found that environmental inequality associated with military facilities is at the nexus of race, class, and economic factors. We find that, on average, census tracts closer in proximity to U.S. military facilities and with greater technological intensity, independent of each other, have higher estimated cancer risk from air toxics, all else equal. These results, coupled with previous work on the second pillar of CEJ show that environmental harms from the U.S. military happen at multiple scales, local to global. The location of domestic U.S. military facilities, including bases and stations, may seem unremarkable or harmless compared to U.S. military activities near combat zones. However, first impressions may be deceiving and divert attention from how environmental harms affect nearby civilian populations and military personnel, thus demonstrating the transfer of risks from military activity to marginalized communities (Alvarez et al. 2021; Bonds 2016).

Building on the third and fourth pillar of the CEJ perspective, we highlight the role of the state, specifically the U.S. military, in the production of racial-environmental expendability. *We find that proximity to military facilities tends to make this form of environmental injustice worse.* Importantly, we found these relationships have greater intensity in communities with more Latinx residents, as compared to more Black residents. For military facility intensity as represented by PRV density, our findings were mixed, as the interaction effects were non-significant in the saturated model. The organizational aims of the U.S. military may focus expressly on arms races, national security, and geopolitical goals, but they may also contribute to domestic environmental injustice in pursuit of these goals. This helps us to view the U.S. military as a state institution, the activities of which may intersect with existing hierarchies to produce environmental health risks through race- or class-based stratification, regardless of intent. Future research should focus on these interactions to disentangle why different racial and ethnic groups experience these environmental burdens differently.

This study provides quantitative support for recent theoretical innovations in CEJ studies and the study of state-sanctioned environmental violence, while at the same time centering military activity in these conversations. It links these patterns across spatial scales, provides evidence of military sacrifice

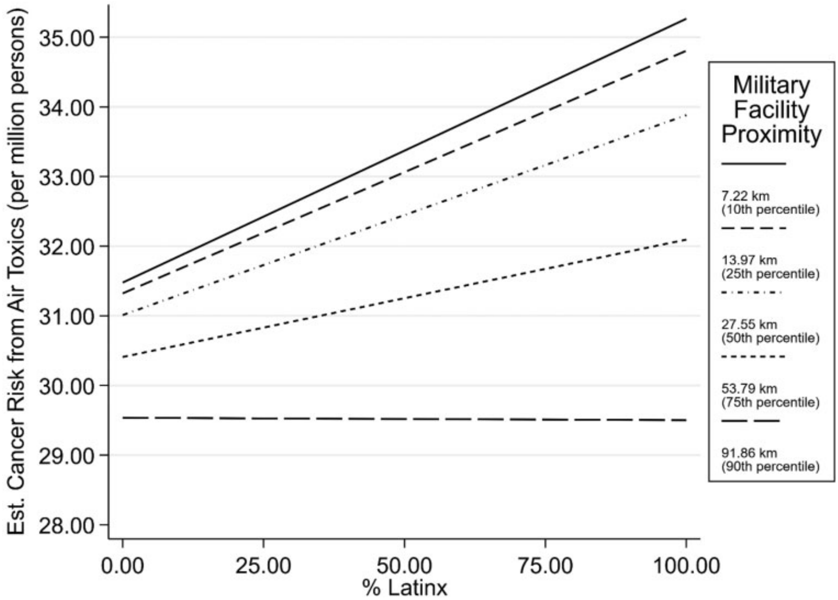

Figure 5. Predicted Values of Estimated Cancer Risk from Air Toxics Across Percent Latinx Residents for Various Military Facility Proximities (Model 2C).

zones in which environmental harms are concentrated near EJ communities (Hooks and Smith 2004; Kuletz 1998; Lerner 2010), and emphasizes the possibility that communities of color near military facilities are treated as expendable in cumulative ways based on race and location, and in ways that are specific to racial and ethnic groups (Pellow 2017).

There are many reasons that this may be the case. First, the U.S. military consumes vast amounts of resources supporting drills and active missions domestically and abroad due to its organizational structure and modern technological transformations (Clark et al. 2010; Crawford 2019; Hooks and Smith 2004, 2005; Shaw 2002). Moreover, the proliferation of domestic surveillance and digital technologies such as drones has transformed spatial relationships between combat participants, militarized frontlines, and polluting activity that may be distant from overseas combat and training sites (Alvarez et al. 2021; Hooks and Smith 2012; Smith et al. 2014; Smith and Lengefeld 2020). Furthermore, facilities, economic support systems, and their environmental impacts exist in a society featuring racialized and classed hierarchies, potentially putting communities of color more at risk (Taylor 2015). We emphasize the potential importance of overrepresentation of people of color within the lower ranks of military personnel. This is due, in part, to limited economic opportunities in communities of color arising from structural racial discrimination and resulting in targeted recruitment of Black and Latinx youth. In turn, this contributes to increased enlistment and suggests another formative mechanism for this type of environmental inequality (Armor and Gilroy 2010; Barroso 2019; Lutz 2008; Mariscal 2005; Williams 1998).

There are a few limitations of this study that also provide avenues for future research. First, while we control for overall economic activity, we cannot distinguish between military, military support industries, and non-military emissions sources. The existence of interrelated support economies and racially targeted recruitment blurs this distinction as it links economic forces and political coercion in context (Smith and Lengefeld 2020). Second, although we used tracts for their fine scale, we cannot distinguish between effects on military personnel, support staff or families located on or near bases, and unaffiliated members of surrounding communities. Third, our cross-sectional analysis is not a direct causal model. While our use of frameworks and contextual guides provide insight into likely causal factors, future research should employ longitudinal models to further establish causation. Finally, while our quantitative approach does not (and perhaps cannot) fully capture intention, we feel that the use of proximity and base PRV is similar to the common use of industrial siting and facility attributes in EJ research (Taylor 2015). In this way it provides a foundation for scholars who are interested in the mechanics of critical environmental justice, including quantitative intensification of the number of military facilities and qualitative intensification of individual facility attributes.

We couple recent scholarship on critical environmental justice calling for enhanced attention to the role of the state when evaluating environmental injustice with insights about the military to demonstrate that military facility presence contributes to environmental health risk disparities arising from air toxics, exacerbating environmental inequalities in communities of color. Indeed, U.S. military expansion has domestic environmental injustice impacts, likely due to its cost intensification, level of resource consumption, and state of perpetual readiness. Regardless of intention, it appears that military activities treat some groups as expendable and less worthy of environmental protection. Environmental sociology, military sociology, and the sociology of race and racism provide details about the manner and mechanisms through which military-specific examples of these processes may unfold, including through exemption from environmental regulations and the recruitment of people of color for military service. One possible policy recommendation is that the DoD should update and implement a strategic EJ plan. We invite further exploration of military-environment interactions through organizational, critical, and intersectional lenses in different regions of the United States as well as around the globe.

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