

EXAMINING RACIAL AND ETHNIC DIVERSITY AMONG THE UNITED STATES
ENVIRONMENTAL HEALTH WORKFORCE

By

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ABSTRACT

Background:

Environmental health professionals (EHPs) work in various aspects of EH and are largely employed by state and local health departments. The long history of predominantly White males in the EH profession does not adequately represent the racial and ethnic diversity in the communities they serve. A more diverse and representative EH workforce creates opportunities to enhance cultural sensitivity and gain trust of underrepresented communities.

Specific Aims:

The aims of the research dissertation are multifold: 1) develop a profile of the EH workforce in the US, 2) analyze associations between minority EHPs and non-minority EHPs responses to job satisfaction, addressing public health issues, supervisory status, and organizational DEI efforts from the Public Health Workforce Interests and Needs Survey (PH WINS), and 3) provide recommendations to increase racial and ethnic diversity in EH.

Methods:

A mixed-methods approach was employed to triangulate findings using the largest national public health available database (PH WINS, 2021) and in-depth qualitative interviews with minority EHPs (n=19). In the quantitative analysis, data from the PH WINS was analyzed using SPSS (version 29), and qualitative thematic analyses were conducted using NVIVO version 14.

Results:

The racial and ethnic composition of the EH Workforce was 64.4% white, 20.7% BIPOC, and 11.3% Hispanic. In quantitative analysis, the most significant relationships identified included race/ethnicity with pay, supervisory status, addressing the social determinants of health, and organizational DEI efforts. In qualitative analysis, key themes to increase minority representation in EH included mentorship, internship opportunities, and marketing/advertisement.

Discussion:

Progress has been made toward increasing diversity in the workforce through internship programs and research involving undergraduate and graduate students. By including the working EHPs' perspective on diversity, we can validate programs that are already working to increase minority representation in EH as well as implement innovative ideas for future programs.

Examining Racial and Ethnic Diversity Among the
US Environmental Health Workforce

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CHAPTER 1: INTRODUCTION

Environmental health is a subsection of public health aimed at preventing environmental hazards and promoting well-being and health (Frumkin, 2016). In 2017, a bill was introduced to Congress requiring the Department of Health and Human Services (DHHS) to establish guidelines for environmental health workers and create a plan to develop the workforce. Four years later, the Environmental Health Workforce Act was enacted in 2021 (Lawrence, 2021). Through this legislation, Congress recognized the importance of the environmental health workforce and acknowledged the vital role of EHPs in protecting public health and safety.

Environmental health professionals (EHPs) working in local, state, and federal government health organizations are critical to protecting public health. A significant portion of the public health workforce is comprised of environmental health professionals (Dyjack et al., 2021). EHPs are trained to address a variety of factors within the environment, including chemical, social, biological, and psychosocial. However, according to the National Association of County and City Health Officials (NACCHO) and the Association of State and Territorial Health Officials (ASTHO), over 50,600 environmental health workforce jobs have been lost since 2008 (Lawrence, 2021). The significant loss of workforce highlights the profound need for EHPs across the country and justification for recruitment efforts for environmental health protection.

EHPs have the responsibility to advocate for the sustainability of environmental health and play a fundamental role in mediating the health needs of humans and the natural world (Jameton & Frumkin, 2016). Risk assessments and preventative measures taken by EHPs protect the public from environmental threats. Environmental issues impacting communities include vulnerability, disproportionate exposure, and changing demographics (Walker & Spann, 2008).

Environmental health impacts affect low-income and minority communities more severely. Increased communication from diverse individuals could make the community more accepting of the intervention (Roberts, 2009). Therefore, a diverse workforce is needed to bring cultural sensitivity and understanding when addressing environmental issues.

Purpose of the Study

A racially and ethnically diverse environmental health workforce can influence environmental justice and equity. The Environmental Protection Agency (EPA) defines environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (US Environmental Protection Agency, 2023). Epidemiological research suggests that most poor and underserved communities have an increased likelihood of exposure to environmental contaminants (Walker & Spann, 2008). True environmental justice will be achieved when everyone can enjoy equal access to the decision-making process and have the same degree of protection from environmental and health hazards (US Environmental Protection Agency, 2023).

Race and ethnicity are significant factors when investigating environmental health issues. In 1987, the United Church of Christ published a report called “Toxic Wastes and Race in the United States”. The following were key findings:

- Race was the most significant variable tested associated with the location of commercial hazardous waste facilities.
- Over 15 million African Americans and over 8 million Hispanics reside in communities with one or more uncontrolled toxic wastes.

- Over half of all American Indians and Asian/Pacific Islanders resided in communities with uncontrolled hazardous waste sites.
- Communities with the most commercial hazardous waste facilities had the greatest composition of racial and ethnic minorities (United Church of Christ Commission for Racial Justice, 1987).

These findings show the injustices communities of color face in relation to hazardous waste sites. Unfortunately, minority communities today still experience these types of injustices.

The water crisis in Flint, Michigan is one of the most prominent environmental justice cases over the past few years. Census data from July 2022 shows that the city is approximately 56.7% African American, with 35.5% of the residents living in poverty (US Census Bureau, n.d.). Once the prime location for car manufacturing, Flint was on the decline for decades after the downsizing of the General Motors Plant. The city switched its water source to the Flint River in 2011 to save money and non-elected officials were put in place preventing residents from having a voice. Residents complained about the water throughout 2014 and 2015; however, the state Department of Environmental Quality and EPA ignored the complaints.

In 2015, independent research conducted by Virginia Tech and Hurley Medical Center showed high lead levels in the water, and 4% of children had an elevated blood lead level. The city did not return the water supply to its original source until October 2015. Several environmental justice issues existed in Flint: lack of community engagement and power over decisions made, environmental classism and racism, low prioritization of health for minority and low-income communities, and lack of concern by the state and federal government regarding community complaints (Wilson & Aber, 2018). Environmental justice issues, similar to the Flint, Michigan water crisis, occur a in racial and ethnic minority communities, indigenous

communities, and communities with limited access to resources across the United States (CDC, n.d.).

Rationale

The healthcare workforce has consistently focused on the need for increased racial and ethnic diversity since they provide healthcare directly to patients. However, there has been less focus on diversifying the environmental health workforce. Traditionally, the environmental health workforce has consisted primarily of white men. Findings from the 2019 UNCOVER EH (Understanding the Needs, Challenges, Opportunities, Vision and Emerging Roles in Environmental Health) survey suggest the workforce is over 80% white, with the remaining minority groups making up less than 20% (CDC, 2021b; Gerding et al., 2019). The environmental health workforce is often not representative of the populations being served.

Various environmental health organizations have expressed interest in increasing diversity in environmental health. The National Institute of Environmental Health Sciences (NIEHS) aims to increase diversity through targeted programs such as the Superfund Research Program and NIEHS Scholars Connect Program. Collaborative efforts from colleges, universities, government, and professional agencies aim to increase diversity in the environmental health workforce. Eastern Kentucky University (EKU) and CDC developed and led a diversity recruitment and retention model from 2003 to 2006. The joint program aimed to achieve racial and ethnic diversity in the environmental public health workforce (Harper, 2007). EKU and CDC collaborated to form the National Environmental Health Diversity Recruitment Task Force (NEHDRTF). NEHDRTF developed a successful recruitment film, *Environmental Health Science, Challenging, and Diverse*. Over 1,000 students have viewed the film, which has

been vital in diversity recruitment for local and state health authorities in Kentucky (Harper, 2007).

The Association of Environmental Health Academic Programs (AEHAP) efforts have resulted in accredited environmental health programs at minority-serving institutions. Over four years, the program saw a 31.5% increase in minority students enrolled in accredited environmental health programs (Harper, 2007). The National Environmental Health Association (NEHA) Journal of Environmental Health has published several messages from past presidents regarding the need for diversity within the workforce. Former president, Welford Roberts, published a commentary in 2009. He discussed how diversity in the environmental health workforce is important for the success of environmental health services in the community. Diverse EHPs can increase community communication, understanding, and intervention acceptance (Roberts, 2009).

In 2020, former NEHA president Priscilla Oliver published “A Call for Diversity in Environmental Health.” She expressed how diversity has become a significant part of organizational operations and health. Diversity in environmental health will allow a better understanding of all people, cultures, and living conditions to serve communities (Oliver, 2020). Dr. Oliver also mentioned the importance of having role models for others to increase our self-worth. Planning, recruitment, training, and marketing are key to achieving diversity goals (Oliver, 2020). Roberts and Oliver, key environmental health leaders, emphasized the significance of having a diverse workforce.

Government initiatives, like affirmative action, were designed to increase diversity. Affirmative action legislation must be implemented by employers to recruit and advance qualified minorities, women, individuals with disabilities, and covered veterans. Written

affirmative action programs must be implemented and kept on file (US Department of Labor, n.d.). Recently, the US Supreme Court voted to reverse affirmative action in college admissions (Totenberg, 2023a). The magnitude of this decision is currently unknown, but it is anticipated that minorities will have a more challenging experience during the college admissions process. This may impact racial and ethnic diversity within all disciplines, including environmental health professions.

This project focused on racial and ethnic diversity among the environmental health workforce in the United States to adequately promote environmental justice and equity. The overarching purpose of this study was to increase diversity in environmental health. There are EHPs from diverse groups throughout the United States. EHPs of a particular race, ethnicity, and/or gender are more likely to have a better understanding of diverse community culture and linguistics. A diverse environmental health workforce will encourage equal representation and protection of diverse communities by EHPs (Balanay & Richards, 2022). To increase minority representation in environmental health, we must first determine what brought diverse individuals into the field and how their personal experiences contribute to the profession.

Aims and Objectives

This study aimed to 1) develop an environmental health workforce profile using 2021 PH WINS data and compare responses from minorities and non-minorities, 2) explore racial and ethnic diversity within the environmental health workforce by understanding the background and experiences of minority EHPs, and 3) provide recommendations to increase racial and ethnic diversity in environmental health. Despite the lack of diversity in the workforce, there are minority individuals who have chosen an environmental health career path. Understanding factors that led diverse EHPs into the field would help increase representation and facilitate the

next generation of EHPs. These factors include educational background, influences, challenges, ethical principles, and recommendations.

Objective 1

Using data from PH WINS, develop a workforce profile of the US environmental health workforce. The data includes respondents from all areas of public health throughout the US. The responses will help determine the racial and ethnic composition of the environmental health workforce. The profile includes demographic and workforce characteristics (e.g., race, ethnicity, gender, employment status, income, type of employment, etc.). The PH WINS survey includes information on supervisory status, job satisfaction, agency promotion of DEI, health equity, social determinants of equity, social determinants of health, structural racism, and environmental justice.

Objective 2

The second objective was to investigate diverse EHPs backgrounds. Minority EHPs choose environmental health as a profession, but why? Background experiences such as exposure, upbringing, and education may influence whether diverse individuals pursue a career in environmental health. How and when do diverse EHPs become interested in environmental health work? Was there a single event that encouraged them to join the field, or did they come into the field accidentally? In-depth interviews with diverse EHPs were the best approach to answering these questions in more detail. Discussions about their experiences provided meaningful insight on areas to focus diversity efforts.

Objective 3

The third objective was to provide recommendations to increase racial and ethnic diversity in environmental health from minority EHPs. Minority EHPs helped identify programs and

methods to increase diversity from their own experiences. They identified barriers and challenges from their own experiences and suggest ways to encourage other minorities to the field of environmental health.

Research Questions and Hypothesis

This research project followed a mixed methods design, including both qualitative and quantitative research questions. The dissertation was divided into two publishable manuscripts for Chapters 3 and Chapter 4 with separate research questions and hypothesis.

Chapter 3 Research Questions and Hypothesis

For Chapter 3, *Assessing Diversity, Equity, and Inclusion in the U.S. Environmental Health Workforce: Challenges and Opportunities*, there were 8t research questions that could be divided into 3 categories.

Environmental Health Workforce Composition

RQ 1: What are the demographic characteristics of the environmental public health workforce in the U.S.?

Environmental Health Workforce and Workplace Environment

RQ 2: Does job, organization, pay, and job security levels differ between races in the environmental health workforce?

Environmental Health Worker Perceptions of Addressing DEI Public Health Issues

RQ 3: Is there a significant difference between BIPOC and White EH workers and being familiar with the concepts of health equity, social determinants of equity, social determinants of health, structural racism, and environmental justice?

RQ 4: Are there differences in the level of agreement between BIPOC EH workers and White EH workers in how they perceive their organization's priorities on diversity, equity, and inclusion?

RQ 5: Does the perception of organizational effectiveness in addressing public health issues vary by racial background among EH workers?

RQ 6: Do BIPOC and White race EH workers view the importance of their work differently?

RQ 7: Do BIPOC and White EH workers have differences in opinions on workplace efforts to address racism as a public health crisis in their health department?

RQ 8: Are there differences between BIPOC and White EH workers on whether they feel that they have adequate funding to address racism as a public health crisis?

Research question 2 examined and assessed EH workers' perceptions of job satisfaction, whereas, research questions 3 through 8 examined EH workers' perceptions and awareness of DEI. EH workers' level of confidence addressing DEI public health issues were also examined.

Hypothesis Testing

Null Hypothesis (H₀): There is no significant difference in median perception levels addressing concepts of health equity, structural racism, social determinants of equity and health, and environmental justice between BIPOC and White EH workers.

Alternative Hypothesis (H_a): There is a significant difference in median perception levels addressing concepts of health equity, structural racism, social determinants of equity and health, and environmental justice between BIPOC and White EH workers.

Chapter 4 Research Questions

For Chapter 4, *A Mixed-Methods Study on Diversity in Environmental Health: Insights from Environmental Health Professionals from Across the United States*, there were three research questions. First, *what factors influence minority EHPs to pursue a career in environmental health in the US?* The research question aimed to understand the background of diverse EHPs. A series of in-depth interviews will provide insights from racially and ethnically diverse EHPs to better understand their education, upbringing, exposure, and other factors that have led them to their current role in environmental health.

Second, *what recommendations will help increase racial and ethnic diversity in the US environmental health workforce?* This research questions aimed to gain insights on how to increase racial and ethnic diversity from the in-depth interviews. Participants provided three to five recommendations to increase racial and ethnic diversity from their perspective. Lastly, *do perceptions of diversity, equity, inclusion, and other related factors differ between white and BIPOC EHPs?* This research question aimed to provide knowledge on the perceptions of EHPs as it relates workplace diversity, equity, inclusion, fairness, and justice.

Operational Definitions

- **Diversity:** Diversity refers to differences between individuals (Bailey et al., 2021). When discussing diversity, race/ethnicity, age, gender, and national origin come to mind. Income, education, religion, appearance, physical/mental ability, and appearance are other diversity factors. Figure 1.1 displays a multilayer approach to diversity. Gardenswartz and Rowe (2003) identified four layers of diversity. The first layer consists of one's personality. The internal layer includes physical ability, gender, age, ethnicity, sexual orientation, and race. External layer includes geographic location, language accent, appearance, parental status, marital status, work experience, educational

background, religion, nationality, and military service. Organization layer includes job function, seniority, on-the-job experience, work location, job level, division/unit, and management status (Gardenswartz & Rowe, 2003). Future research on diversity in the U.S. environmental health workforce will address other elements of diversity. Regarding diversity in this research study, racial and ethnic differences among the workforce are the focus.

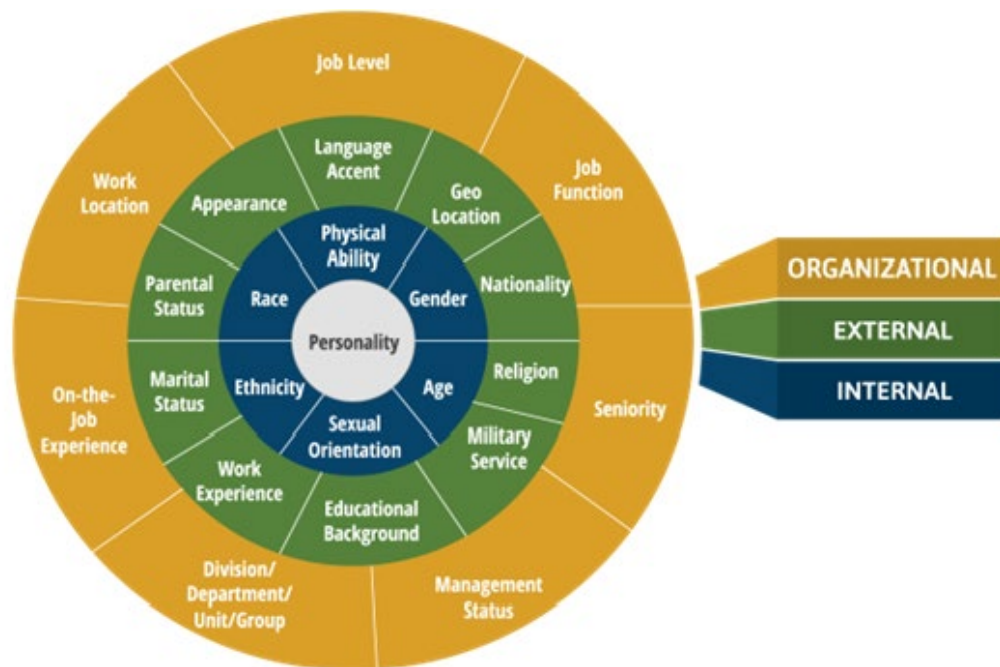


Figure 1.1 The Four Layers of Diversity adapted from Gardenswartz and Rowe (2003) (*Types of Diversity in the Workplace*, n.d.)

- **Environmental health professional (EHP):** An individual employee who is either a state, local, tribal, or federal environmental health specialist. The title Environmental Health Specialist (EHS) is used interchangeably.
- **Environmental justice:** Environmental justice is defined by the US Environmental Protection Agency as the “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development,

implementation, and enforcement of environmental laws, regulations, and policies(US Environmental Protection Agency, 2023).”

- **Equity:** Fairness and impartiality consider the characteristics and needs of individuals, the context of situations, and circumstances (Bailey et al., 2021). Equity promotes justice among procedures, processes, and the distribution of resources by institutions or systems (Lopez, 2022). **Health equity** means that all people have a fair and just opportunity to live healthy lives. Health equity involves removing barriers (e.g., social, economic, systemic, and contextual) to health and prioritizing those historically disadvantaged (de Beaumont Foundation, 2021).
- **Fairness:** Consists of the ability to make judgments without the inclusion of one’s feelings or interests (Velasquez et al., 2014). Fairness can be described as the absence of bias or fraud (Spier, 2012). For this project, fairness will be defined as treating people equally.
- **Inclusion:** The degree to which workforce experiences and organizations embrace all employees and enable meaningful contributions. Inclusion refers to a sense of belonging where members of the workplace feel welcomed to participate and achieve their potential (The University of Iowa, n.d.).
- **Justice:** The principle is that “equals should be treated equally and unequals unequally” (Velasquez et al., 2014). Justice in research requires researchers to ensure the burdens and benefits are distributed fairly, as well as ensure research participants are not taken advantage of (Shamoo & Resnik, 2015).

- **Minority:** Individuals belonging to underrepresented racial and ethnic groups, including African American/Black, Alaskan Native, Asian, Native American, Pacific Islander, and Hispanic.
- **Social Determinants of Equity:** Systems of power (e.g., racism, sexism, ableism, heterosexism, and economic systems). These systems govern the distribution of populations and resources through policies, practices, norms, values, and decision-making structures (de Beaumont Foundation, 2021).
- **Social Determinants of Health:** These are the conditions in the environments where individuals live, age, are born, play, work, worship, and learn that affect health, quality of life outcomes and risk, and functioning (de Beaumont Foundation, 2021).
- **Structural Racism:** A system by which cultural representations, institutional practices, public policies, and other norms work to perpetuate inequities among racial groups (de Beaumont Foundation, 2021).
- **Workforce:** The collection of environmental health professionals working in food safety, water quality, wastewater, hazardous materials, radiation, occupational health, safe housing, vector control, and other areas of environmental health. Environmental health professionals are also included within the public health workforce.

Conceptual Framework

The 10 Essential Public Health Services (EHPS) is the framework for the project. A federal working group developed the original EPHS in 1994 (The Public Health National Center for Innovations, n.d.). The EPHS describes the activities communities should undertake in public health. This framework aims to remove obstacles, systematic and structural barriers, and other forms of discrimination resulting in health inequities. Barriers to health include poverty, gender

discrimination, racism, and other methods of oppression. The EPHS provides a framework for public health to promote and protect the health of all people in all communities (CDC, 2021a).



Figure 1.2. 10 Essential Public Health Services (CDC, 2021a)

The EPHS framework centers around three core public health functions: assessment, policy development, and assurance. Assessment involves monitoring health statuses to identify and solve community health problems as well as diagnose and investigate health problems and hazards within the community. Policy development includes informing and educating people about health issues. Public health professionals also mobilize community partnerships to identify and solve problems. Policy and plan development occurs at this stand to support community and individual health efforts. Assurance includes enabling equitable access, building a diverse and

skilled workforce, improving and innovating, and building and maintaining a robust organizational infrastructure for public health (CDC, 2021a).

The EPHS services most relevant to this research project are: 1) build and support a diverse and skilled workforce, 2) improve and innovate through evaluation, research, and quality improvement, and 3) utilize legal and regulatory actions designed to improve and protect the public's health (CDC, 2021a). Increasing minority representation in environmental health will help build a diverse workforce. EHPs who are members of the National Environmental Health Association demonstrate a high level of dedication to the field and often pursue one of the five credentials they offer. The Registered Environmental Health Specialist/Registered Sanitarian (REHS/RS) and Certified Professional in Food Safety (CP-FS) are two common credentials EHPs obtain. To become a REHS/RS, the environmental professional must demonstrate knowledge in 15 content areas of environmental health by passing an examination. EHPs who are REHS/RSs also demonstrate they are skilled in their profession. Survey and interview questions will aid in capturing both diversity and skilled workforce elements.

To improve and innovate through evaluation and research, interview and survey questions guided by the EHPS framework will be used to investigate factors impacting racial and ethnic diversity among the EH workforce and guiding ethical principles. It is important to understand the experiences of non-minority and minority EHPs to foster an environment where professionals feel they are treated fairly and their expertise is valued within their organizations. Research and data are necessary for government entities, colleges, and universities if they want to make informed decisions on increasing racial and ethnic diversity within the workforce. Ideally, this project will encourage regulatory agencies to utilize legal and regulatory actions to promote diversity in the workforce by providing key recommendations.

Chapter Summary

The U.S. environmental health workforce has a history of not representing the populations it serves. A diverse environmental health workforce is needed to address the complex issues facing communities. Diverse EHPs can impact the community by providing in-depth insights to community issues, understanding the culture, and communicating issues in their language. This research project has two main objectives: investigate the backgrounds of diverse EHPs and investigate ethical principles of fairness, equity, inclusion, and justice among EHPs (diverse and non-diverse). Since there are many levels to diversity, this project will mainly focus on racial and ethnic diversity within the workforce. This project aims to answer two research questions. First, what experiences influence diversity among local, state, federal, and/or tribal EHPs? Secondly, what ethical factors influence diversity among local, state, federal, and/or tribal EHPs? These questions will be addressed through qualitative in-depth interviews and a survey. The 10 Essential Public Health Services are the conceptual framework for the project. The framework describes public health activities that the community should undertake in order to promote public health (CDC, 2021a). This project will aid in building a diverse and skilled workforce, improve and innovate workforce diversity through evaluation and research, and inform legal and regulatory actions to promote racial and ethnic diversity in the environmental health workforce.

CHAPTER 2: LITERATURE REVIEW

Significance of Racial & Ethnic Diversity in Public Health

Despite the U.S. population becoming more diverse, the public health workforce is not representative of the populations it serves. People of color comprise only 42% of the governmental public health workforce (Coronado et al., 2020; Frey, 2014; Sellers et al., 2019). It is estimated that by 2044, racial or ethnic minority groups will constitute 50% of the population (Frey, 2014). Disproportionate health disparities exist for minority groups despite health indicators improving for most Americans (Jackson & Gracia, 2014).

Minorities are at disproportionate risk of preventable and treatable illnesses (Jackson & Gracia, 2014). Research has shown that racial and ethnic minorities receive substandard care in comparison to their more affluent white counterparts (Mitchell & Lassiter, 2006). Diversity in the public health workforce yields professionals equipped to implement population-based approaches and address public health disparities (Cohen et al., 2002). Racial diversity can improve access to care for underserved populations (Mitchell & Lassiter, 2006).

In 2006, Mitchell and Lassiter researched addressing health care disparities and increasing workforce diversity. Their research showed current and projected racial and ethnic distribution within the U.S. population and among 2004 health professions graduates. Approximately 75% of public health doctoral graduates were white. Asian, Native Hawaiian, and Pacific Islanders made up 8.3% of public health doctoral graduates. Black, Hispanic, and Native American/Alaskan Native made up 4.7%, 2.4%, and 0.3% respectively (Mitchell & Lassiter, 2006).

The Public Health Workforce Interests and Needs Survey (PH WINS) has been instrumental in supporting the U.S. public health workforce. PH WINS measures gaps and

strengths within the workforce to help identify areas for investments in recruitment, training, funding, and retention. The survey was most recently conducted in 2021 by the de Beaumont Foundation and the Association of State and Territorial Health Officials. It is the only data source representative of the U.S. public health workforce. It captures demographics, public health worker perspectives, workforce engagement and morale, training needs, and emerging concepts (de Beaumont Foundation, n.d.).

Based on the 2021 survey report, the public health workforce is 54% white, 18% Hispanic or Latino, 15% African American, 7% Asian, 1% American Indian or Alaskan Native, and 4% two or more races. American Indian or Alaskan Native, Asian, and Hispanic or Latino populations have experienced a statistically significant increase nationally. However, the data for white public health professionals show a statistically significant decrease (69.5% to 53.7%). African American, Native or Pacific Islanders, and individuals with two or more races showed no significant changes. Nationally, BIPOC has increased from 30.5 to 46.3% from 2014 to 2021. This increase was statistically significant (de Beaumont Foundation, n.d.).

Research has shown that minority researchers in environmental health are underrepresented. The majority of environmental health research is conducted by white scientists from elite institutions (VanNoy, 2020). Among the research conducted, a small subset is focused on the needs of communities of color. The lack of environmental health research on minority communities exacerbates health disparities and hinders advancements in public health action (VanNoy, 2020). Challenges exist to recruiting and retaining environmental health researchers from diverse backgrounds. According to a 2016 report, approximately 10.2% of tenured faculty positions are made up of African American, Hispanic, and Asian American researchers. Less than 4% of research-intensive science departments include African American, Hispanic, or Native-

American tenured professors. Since minority researchers are more likely to study socially disadvantaged communities, the lack of diverse research faculty may adversely impact the inclusion of BIPOC participants in research studies (VanNoy, 2020).

This literature review aimed to explore published literature on diversity in the environmental health workforce. This literature review aims to answer: *What research has been published on increasing racial and ethnic diversity in the environmental health workforce?* Since diversity can include other factors, such as age and gender, the research question narrows the focus to the primary diversity factors for this project, race and ethnicity.

Methods

To identify relevant research articles specific to diversity in the environmental health workforce, an extensive literature search was conducted. Studies were identified using PubMed and grey literature searches (e.g., Google Scholar, official government websites, and publications). The initial list of key search terms is displayed in Table 2.1. Search terms were divided into four categories: racial diversity, environmental health, workforce, and career paths and training.

Table 2.1. Initial list of search terms.

Racial Diversity	Environmental Health	Workforce	Career paths and training
African American(s) BIPOC Latina, Latino, Latinx Minorities, Minority Marginalized Minoritized Ethnic group(s) Ethnicity Racism, Race	Environmental Health Occupational Health Environment Environmental Public Health Environmental Engineering Environmental medicine Water quality Food Safety Air quality Pollution Hazardous waste	Worker(s) Workforce Staff Employment Employees Labor force Occupation(s) Staffing Personnel Recruitment and Retention	Educational Diversity training Implicit bias Career paths Cultural competency Cultural humility

Due to the broad search term list, over 70,000 articles were identified. Therefore, the list of search terms was condensed into three categories to allow for more relevant articles to be identified. The final search terms are listed in Table 2.2. The final search code allowed for these keywords to be searched within subject headings and abstracts.

Table 2.2. Finalized Table of Search Terms.

Diversity/Demographics	Environmental Health	Workforce
Cultural diversity	Environmental Health	Workforce
Racial groups	National Institute of	Personnel Turnover
Racism	Environmental Health	Employment
Systematic racism	Sciences	Personnel selection
Minority groups	Journal of Environmental	
African Americans	Health	
Hispanic or Latino		
Demography		

There were 1510 studies imported to the literature review manager, Covidence, for review. After the 301 duplicates were removed, 1174 studies remained for review. Articles were included if they met the following criteria: published in the US, published in English, full-text available, and addressed diversity the environmental health workforce directly or indirectly. Articles were excluded in they were published outside of the US, published in another language, the full text was not available, and the context did not address diversity in the environmental health workforce. No time frame was designated for published articles to capture the most literature relevant to the research topic. Of the 35 full-text studies assessed for eligibility, six research articles were relevant to the research topic. The remaining articles were commentaries and editorials relevant to the research topic, but no research study was conducted. Explanation of findings will be discussed in the results.

Results

There were six research studies identified using the inclusion and exclusion criteria. The earliest study identified was written by Weintraub et al. in 2011. A key statement in the article addressed how the environmental health workforce does not adequately reflect the increasing racial and ethnic diversity of the U.S. population. Researchers recognized the need to diversify the workforce as an early environmental justice challenge. The research focused on the challenges college environmental health programs face in admitting qualified racial and ethnically diverse students. Using the Advanced Placement Environmental Science (APES). The most significant finding explains how colleges should target recruitment efforts to recruit high school minority students attending multicultural eco-high schools or students who performed well on the APES. This targeted recruitment will significantly increase the number of minority students in environmental programs and ultimately increase environmental professionals entering the workforce (Weintraub et al., 2011).

Jones et al. (2015) examined diversity in the workforce from a public health perspective. Using the database of registered TRAIN learners in the United States, they were able to create a profile of the workforce. TRAIN was created by the Public Health Foundation in response to the 9/11 attacks by rapidly providing training for public health workers and emergency responders. Thousands of public health workers registered for the training across the country. Among other demographics in the study, the findings show the racial composition of TRAIN learners as 88% white, 7% African American, 2% Asian, 2% multiracial, 0.6% American Indian, and 0.4% Native Hawaiian/Pacific Islander. The majority of public health learners in 49 states and the District of Columbia were white. The largest percentage of black learners were in the District of Columbia and Louisiana. Hawaii contained the largest percentage of Asian learners. In Oklahoma, Arizona, New Mexico, and South Dakota, American Indians made up significant portions of learners

(Jones et al., 2015). These findings are consistent with the PH WINS survey showing that most public health learners across the U.S. are white.

Gerding et al. (2019) developed an environmental health-specific profile. EHPs are included in overall public health surveys; however, researchers focused solely on environmental health to develop a more specific profile. Although EHPs were included in PH WINS, there was a need to gather information about the EH workforce composition, complex functions, and problems faced by EH professionals. Collaboration from the Centers for Disease Control and Prevention (CDC), NEHA, and Baylor University yielded the UNCOVER EH (Understanding the Needs, Challenges, Opportunities, Vision, and Emerging Roles in Environmental Health) initiative. This initiative allowed information to be collected directly from EHPs working in state, local, tribal, and territorial health departments (Gerding et al., 2019).

Of 8,996 EHPs invited to complete the survey, only 1,736 EHPs completed the entire survey. This yielded a 19% response rate nationally. The responses were considered relatively balanced with representation across many states. Based on the demographic responses provided, 86% of the respondents identified as white. Native Hawaiian or other Pacific Islanders made up the lowest percentage of respondents at 1%. The percentage of African American (7%), Asian (4%), and American Indian or Alaskan Native (3%) respondents was consistent with the overall field of public health figures. Ethnically, 6% of the respondents identified as Hispanic. Despite variation in race and ethnicity, male (51%) and female (49%) respondents show a relatively even number (Gerding et al., 2019). The racial and ethnic demographics show a lack of diversity, whereas the gender diversity is relatively even.

More recently, Balanay et al. (2022) examined racial and gender diversity among students and faculty at EHAC-accredited institutions (National Environmental Health, Science and

Protection Accreditation Council). Researchers conducted a retrospective trend analysis on secondary survey data from 2009 to 2021 (12 academic years). Results from this study showed that most environmental health students were female and white. White students made up 61.0% of the undergraduates and 50.7% of the graduates. The findings did support an increasing trend of female graduate and undergraduate students as well as minority undergraduate students. Minority undergraduate students increased from 40.0% to 48.2%. Racial groups consistently underrepresented in graduate and undergraduate students included Native American, Alaskan Native, Native Hawaiian, and Pacific Islander (Balanay et al., 2022). This research shows the lack of racial and ethnic diversity among EHAC programs; however, the increasing trend is promising for the future diversification of the workforce.

Two research articles were published in 2023 relating to diversity in the environmental health workforce. Jadotte et al. (2023) published a mapping literature review to identify gaps in research on diversity, equity, and inclusion (DEI) within the environmental health workforce. Of the 179 articles identified in the search, only three articles had strong DEI engagement. This suggests the need for additional DEI research within the workforce (Jadotte et al., 2023). The lack of research found by Jadotte et al. (2023) is consistent with the findings of this literature review, indicating more research is needed on the EH workforce and DEI, specifically.

Boyapalli et al. (2023) published a research article titled, “Increasing Diversity in Environmental Health Graduate Programs”. This study aimed to understand what motivates or deters minority students from pursuing degrees in environmental health. Researchers interviewed four self-identified minorities to participate in listening sessions held in December 2021 and February 2022. Financial support, mentorship, personal support, peer representation, and broader

support for faculty initiatives were identified as potential areas of improvement. These insights are significant to inform recruitment and diversity initiatives to increase minority representation.

Other Relevant Literature

Although only six articles were identified using the “research article” inclusion criteria, there were additional commentaries and editorials with relevant discussion of diversity in the environmental health workforce. The commentaries and editorials provide more context for the importance of conducting environmental health workforce diversity research. Many of the commentaries and editorials identified through the search were commonly cited in the research articles and other commentaries.

Researchers Walker and Spann (2008) published a commentary titled, “The Need for Diversity in the Environmental Health Workforce”. They found strong epidemiological evidence that poor and underserved communities are more likely to be exposed to environmental contaminants. Due to the complex environmental challenges within communities, a diverse workforce is needed. Traditionally, more focus has been placed on greater racial and ethnic diversity among the healthcare workforce; however, there was less emphasis on achieving diversity within the environmental health workforce. Underrepresented minorities in the environmental health workforce bring the community knowledge, experience, opinion, and credibility (Walker & Spann, 2008). Community engagement and support for environmental health initiatives are crucial to achieve public health. Therefore, having members of underrepresented communities in the workforce is ideal.

Prior to the 2008 commentary, Walker published a report titled, “Environmental Health and African Americans” in 1991. The report discussed efforts to increase the number of African-American scientists as well as increase their participation in scientific activities. In his

discussion, he identified federal programs that aimed to increase underrepresented minority participation (e.g., the National Institutes of Health (NIH) Minority Biomedical Research Support (MBRS) Program, the Minority Access to Research Careers (MARC), the National Science Foundation (NSF), and the National Aeronautics and Space Administration (NASA)). Non-federal initiatives to increase minority representation included the Southeastern Consortium of the Minorities in Engineering (SECME), the American Association for the Advancement of Science (AAAS), and the American Chemical Society career development program. The AAAS established a linkage program to improve science for minority and underrepresented groups by utilizing community relationships. The AAAS Black Church's program provided educational material and training for church groups interested in providing projects for black children. Over 500 churches participated in this program (Walker, 1991). The collection of efforts to increase minority participation in the sciences shows the long-term problem surrounding racial and ethnic diversity in environmental health.

NEHA's past presidents published similar commentaries in the *Journal of Environmental Health*. Dr. Welford Roberts published "Diversity in the Environmental Health Workforce" in 2008. He discussed how diversity in the environmental health workforce is important to the overall success of environmental health services. Like Walker and Spann, Roberts stated that diverse EHPs bring understanding and sensitivity to community engagement. Diverse EHPs increase communication and understanding, aiding in community acceptance of interventions (Roberts, 2009). Dr. Pricilla Oliver also published an article on diversity during her NEHA presidency. In 2020, she published "A Call for Diversity in Environmental Health". Oliver addressed the need for minorities to be included in environmental health and people from different backgrounds, gender, ethnicity, country of origin, and age. She identified four actions to increase diversity: plan, recruit, train,

and market the importance of the environmental health profession (Oliver, 2020). Both Roberts and Oliver have been commonly cited in articles discussing diversity in environmental health; therefore, it was important to include their input in this literature review.

Captain Daniel Harper, from the CDC's Environmental Health Services Branch, published a commentary on diversity in environmental health in 2007. The article titled "A Diverse Environmental Public Health Workforce to Meet the Diverse Environmental Health Challenges of the 21st Century" suggests that increasing workforce diversity is essential to ensuring the profession can manage the challenges of this century. The CDC recognizes that a diverse workforce fosters creativity, innovation, and fresh problem-solving approaches. The goal is continually recruiting, training, and retaining diverse environmental health employees from various backgrounds. Harper discussed how the Association of Environmental Health Academic Programs (AEHAP) has initiated diversity projects to improve diversity in environmental health programs nationwide. AEHAP's work has increased accredited environmental health programs at minority-serving institutions (Harper, 2007).

Approaches to Increasing Diversity

Recruiting diverse individuals for environmental health programs has been noted as challenging. To produce a workforce equipped to meet global environmental challenges, we must attract diverse students into the field. The field of geoscience has the lowest racial and ethnic enrollment of any science, technology, engineering, and mathematics (STEM) discipline. Walker (1991) mentioned several federal and non-federal initiatives to increase minority representation through recruitment. College students were the target recruitment population for initiatives except for the AAAS program focusing on children. Balanay and Richards (2022) identified recruitment as a method to increase diversity. They suggested recruitment from diverse students

within environmental health science graduate and undergraduate programs would be a considerable starting point for increasing workforce diversity. Additionally, they recommended engaging diverse high school students through courses, seminars, and promotional activities (Balanay & Richards, 2022).

Minority faculty and student representation can increase diversity in the workforce. Boyapalli et al. found that representation matters to students. It is important for students to have peers and faculty of similar backgrounds. Minority faculty and students could be influential in the recruiting and retention of diverse students (Boyapalli et al., 2023). In their research, one student applauded her programs' inclusion of underrepresented students in the admissions processes. She believes it would help attract a more diverse student population. Balanay & Richards support this idea stating “strong role models continue to be needed in the EHS field for underrepresented populations to encourage others to become a part of this essential workforce” (Balanay & Richards, 2022).

Funding could be a barrier for diverse students wanting to pursue a career in environmental health sciences. Often underrepresented students may not have the financial resources to attend a college or university for their undergraduate education or further their education in doctoral programs. Doctoral programs may not provide stipends for students leading to many students having to secure their own funding for research. Low-income minority students may have a difficult time justifying leaving a full-time job to pursue their studies without stable income (Boyapalli et al., 2023). Lack of funding can make environmental health programs less appealing than other fields.

Gaps in the Literature

Of the literature discussed, few were research studies conducted with individuals. Commentaries published by Walker and Spann, Dr. Priscilla Oliver, and Dr. Welford Roberts highlight the need for a diverse workforce but does not provide research to provide solutions. Balanay et al. and Harper's research focuses on surveying undergraduate students if efforts to gain insight on diversity in the workforce. Boyapalli et al. focused their research on increasing diversity in environmental health graduate programs. The research study focused on graduate student perspectives instead of EHPs who were currently out of school and in the workplace. Although this study does not focus on the working EHP, the findings were insightful for developing research questions for the qualitative section of this project.

Balanay & Richards identified a significant gap in the literature by addressing the lack of research conducted on diversity in the environmental health workforce, specifically. They expressed how diversity should be encouraged within the EHS academic and industry research community. Diverse researchers typically focus their efforts on advocating for the health of diverse communities (Balanay & Richards, 2022). Jadotte et al. (2023) identified a similar issue in their mapping review. Of all the published literature, there was an extremely low number of studies identified addressing diversity, equity, and inclusion in the environmental health workforce. The National Institute of Environmental Health Sciences (NIEHS) has encouraged underrepresented groups to participate in EHS research by increasing discussions of the significance of diversity in EHS training programs (Balanay & Richards, 2022). Hopefully, these efforts will lead to an increase in diversity research as well as research conducted by diverse individuals in environmental health.

This dissertation will contribute to the published literature by focusing on the working professional. The working diverse EHP was not the research focus of any research study

conducted on diversity in the workforce. Insights from diverse individuals actively working in environmental health have not been studied or published. The perspective from the diverse EHP is vital to fostering more racial and ethnic diversity in the field. Racially and ethnically diverse EHPs can provide meaningful insight on how they were able to navigate through life, undergraduate, and/or graduate school to become the working professional they are today. The survey and in-depth interviews will be able to provide more insight and recommendations to increase diversity in the workforce.

Chapter Summary

The overall public health workforce lacks racial and ethnic diversity. Approximately 54% of the public health workforce is white (de Beaumont Foundation, n.d.). Over 75% of public health doctoral graduates are white (Mitchell & Lassiter, 2006). Demographic data from Gerding et al. (2019) showed the majority of environmental health respondents were white (86%). African American, Asian, Native American/Alaskan Native, and Native Hawaiian/Pacific Islander made up the remaining 14% of respondents. Only 6% of respondents identified as Hispanic (Gerding et al., 2019). Research conducted by Balanay and Richards showed the lack of racial and ethnic diversity among students and faculty within EHAC-Accredited programs. The only literature review identified, conducted by Jadette et al., discussed the need for more diversity, equity, and inclusion research in the environmental health workforce. Most recently, the study conducted by Boyapolli et al. provides insights from environmental health graduate students to increase racial and ethnic diversity. Personal and departmental financial support, mentorship, peer representation, and broader faculty support were found to be significant factors to increasing diversity. Other relevant literature from environmental health leaders, such as former NEHA presidents Dr. Priscilla Oliver and Dr. Welford Roberts, stress the need to diversity

to address many environmental health challenges facing communities. The published literature mainly focuses on diversifying the environmental health workforce by targeting students, both undergraduate and graduate. This dissertation aims to expand on current research by targeting the working environmental health professional. This approach will help increase diversity by asking diverse EHPs how they navigated through different phases of life to become the professional we see today.

CHAPTER 3: ASSESSING DIVERSITY, EQUITY, AND INCLUSION IN THE U.S. ENVIRONMENTAL HEALTH WORKFORCE: CHALLENGES AND OPPORTUNITIES

Introduction

The Environmental Health (EH) workforce is a cornerstone of public health in the United States, tasked with a broad array of responsibilities that protect and improve community health outcomes. These professionals are engaged in a wide range of critical activities, from food safety and hazardous waste management to emergency response, making their role indispensable in maintaining public health standards. The need for an EH workforce that mirrors this diversity becomes crucial as the U.S. becomes increasingly diverse. In 2021, a national survey estimated that the largest racial or ethnic group among the governmental public health workforce was non-Hispanic White (54%) followed by Hispanic or Latino (18%), Black/African American (15%) and all others (13%) (Owens-Young et al., 2023).

The current racial and ethnic composition of a predominately White public health workforce does not fully reflect the nation's racial and ethnic diversity, which could impact the effectiveness and equity of public health interventions (Sellers et al., 2019). Public health agencies with diverse workforces are well-equipped to implement targeted approaches in communities where they are needed. This allows them to create systems that support specific needs and provide a wider range of effective solutions to help address health disparities. (Cohen et al, 2002; Jackson et al., 2014).

Until recently, few studies have examined racial diversity in the EH profession. Within the past few years, studies have emerged including Owens-Young et al. (2023), Jadotte et al. (2023), and Balanay et al. (2022), have begun to shed light on the dynamics of diversity, equity, and inclusion (DEI) within the environmental public health workforce. These studies reveal a

general perception of organizational commitment to DEI among public health employees. However, they also highlight significant variations in these perceptions across different demographic groups and organizational settings, with non-White employees often reporting lower levels of perceived commitment (Carthon et al., 2023).

Recent studies by Jadotte et al. (2023) and Balanay et al. have shed light on diversity, equity, and inclusion (DEI) within EH science programs and the broader workforce. However, these studies have limitations that need to be addressed. Both studies have narrow scopes, primarily focusing on EHAC-accredited programs, potentially overlooking the wider EH landscape. Additionally, there are concerns regarding the temporal coverage and methodological depth of these studies, which may impact the generalizability of their findings.

To advance the understanding of DEI in EH, future research should aim to broaden the scope beyond EHAC-accredited programs to encompass a more comprehensive view of the EH field. It is essential to include a wider range of programs and institutions to capture the full diversity of the EH workforce. Researchers should consider conducting longitudinal studies with more in-depth methodologies to provide a more nuanced understanding of the trends and challenges related to DEI in this field. By addressing these limitations and expanding the scope and depth of research, scholars can contribute significantly to the advancement of DEI initiatives within EH science programs and the workforce. This approach will help fill the existing gaps in knowledge and provide a more holistic understanding of the current state of diversity, equity, and inclusion in EH.

Problem Statement

A national-level assessment of DEI within the EH workforce, encompassing the diversity among the environmental public health workforce has yet to be conducted. The necessity to

move beyond mere representation to fostering an organizational culture deeply committed to DEI is crucial, especially as the U.S. demographics continue to diversify, at the same time, the public health workforce remains predominantly White. This disparity points to the critical need for an organizational culture that genuinely values and implements DEI principles to improve public health professionals' attitudes, practices, and retention. This study aims to fill this significant gap by assessing, on a national scale, the EH workforce's perceptions of their organization's commitment to DEI and the factors influencing these perceptions.

Research Objectives Categories, Questions, and Hypotheses

The purpose of this research is to create a comprehensive national profile of the EH workforce in the United States and to analyze differences in job satisfaction and perceptions of diversity, equity, and inclusion (DEI) factors between minority (BIPOC) and non-minority (White) EH workers. This study aims to utilize data from the Public Health Workforce Interests and Needs Survey (PH WINS) to better understand the perspectives of DEI issues among BIPOC EH workers in the U.S. The research objectives, questions, and hypotheses are outlined below.

Objectives

The primary objectives of this study are as follows.

1. To develop a demographic and work characteristic profile of the environmental health workforce in the U.S.
2. To assess differences of perceptions, opinions, and factors related to DEI between a representative sample of BIPOC and White EH workers in the U.S.

Research Questions and Hypotheses

The research topics, questions (RQs) and hypotheses for this study are listed under each category as shown below.

Environmental Health Workforce Composition

RQ 1: What are the demographic and workforce characteristics of the environmental public health workforce in the U.S.?

Environmental Health Workforce and Workplace Environment

This part of the study will examine and assess EH workers' perceptions of job satisfaction.

RQ 2: How does workplace satisfaction with job, organization, pay, and job security compare between BIPOC and White races in the EH workforce in the U.S.?

Environmental Health Worker Perceptions of Addressing DEI Public Health Issues

This part of the study will examine EH workers' perceptions and awareness of DEI and their level of confidence in addressing DEI public health issues

RQ 3: Is there a significant difference between BIPOC and White EH workers level of awareness of the DEI concepts, health equity, social determinants of equity, social determinants of health, structural racism, and environmental justice?

RQ 4: Are there differences in the level of agreement between BIPOC EH workers and White race EH workers in how they perceive how their organization prioritizes diversity, equity, and inclusion?

RQ 5: Does the perception of organizational effectiveness in addressing public health issues vary by racial background among EH workers?

RQ 6: Do BIPOC and White race EH workers view the importance of their work differently?

RQ 7: Do BIPOC and White EH workers have differences in opinions on workplace efforts to address racism as a public health crisis in their health department?

RQ 8: Are there differences between BIPOC and White EH workers on whether they feel that they have adequate funding to address racism as a public health crisis?

Hypotheses Testing

The hypotheses to be tested for this study using nonparametric statistical methods were as follows:

***Null Hypothesis (H_0):** There is no statistically significant variance in the median perception levels of health equity, structural racism, social determinants of equity and health, and environmental justice between BIPOC and White EH workforce.*

***Alternative Hypothesis (H_1):** There is a statistically significant variance in median perception levels of health equity, structural racism, social determinants of equity and health, and environmental justice present between BIPOC and White EH workforce.*

Methods

This study utilized data from the 2021 Public Health Workforce Interests and Needs Survey (PH WINS), a prominent national survey initiated by the de Beaumont Foundation and the Association of State and Territorial Health Officials (PH WINS, 2021). Conducted every three years since 2014, PH WINS offers a comprehensive insight into the demographics, experiences, and viewpoints of the U.S. public health workforce.

The data collected for the 2021 PH WINS survey was carried out from September 2021 to early January 2022. The survey targeted 137,446 public health workforce to create a nationally representative sample of 42,858 individuals participating (yielding a response rate of 35%). The survey, which is aimed at individual staff members rather than their organizations, covers a range of topics, including perceptions of the workplace environment, training needs, public health concerns, and demographic information for the 2021 survey. The survey includes various question types such as Likert scale, multiple-choice, ranking, and open-ended questions to capture the workforce's perspectives on job satisfaction, professional development, and emerging public health issues.

Measures

A series of Likert scale responses to survey questions were assessed to gauge EH workers' workplace satisfaction, their awareness and understanding of DEI concepts, their confidence in addressing these concepts, and their perceptions of their organization's effectiveness in addressing DEI issues.

Workplace satisfaction was measured using a five-point scale ranging from "Very Dissatisfied" (1) to "Very Satisfied" (5), allowing participants to reflect on their overall contentment with their job environment. Similarly, awareness of DEI concepts was assessed on a scale from "Not at all Aware" (1) to "Extremely Aware" (5), aimed at understanding the extent to which individuals are informed about DEI principles and issues within their professional context. Confidence in addressing DEI concepts was evaluated using a parallel scale, from "Not at all Confident" (1) to "Extremely Confident" (5), to capture participants' self-assessed readiness to engage with DEI challenges in their work. Lastly, perceptions of organizational effectiveness in addressing DEI were measured on a scale from "Not at all Effective" (1) to "A lot Effective" (5),

providing insight into employees' viewpoints on their organization's commitment and success in implementing DEI initiatives. These measures were designed to capture differences between BIPOC and White EH workers while gaining a comprehensive understanding of employees' experiences and attitudes towards DEI in the workplace. These findings were sought to gain insights into the current state of DEI integration within EH in the context of the broader public health workforce.

Data Analysis

Descriptive analysis consolidated the survey responses by calculating frequencies and percentages for each variable. Bivariate analyses were used to explore the variance differences in median rank scores between BIPOC and White groups, with statistical significance set at $p < 0.05$. The distribution of race/ethnicity was examined using the Chi-square test to determine if the proportions within categorical variables differed significantly between the groups. The Mann-Whitney U test was utilized to assess differences in the central tendency (median) of ordinal or continuous data between the two groups.

In hypothesis testing, the Mann-Whitney U test was used to test whether there were notable differences between the BIPOC and White groups in the variance of the median perception levels (ranked) of responses of health equity, structural racism, social determinants of equity and health, and environmental justice. This test was suitable given the non-normality of data and the presence of unequal variances and sample sizes between the groups. The alpha level was set at 0.05 to determine statistical significance.

Ethical Considerations

Data for this study, obtained through a Data Use Agreement with the de Beaumont Foundation, complied with ethical standards. The dataset was de-identified and public and considered exempt by the East Carolina University Institutional Review Board (ECU IRB).

Results

Racial and Ethnic Diversity in the EH Workforce

As shown in **Table 3.1**, among workforce demographics data on 4,728 environmental health workers revealed marked differences between BIPOC and White employees in various employment-related aspects. Gender disparities were evident; BIPOC men constituted 34.5% of their workforce group, significantly less than the 41.4% representation among their White counterparts. This trend was reversed for women, who were more prevalent in the BIPOC cohort. Age differences showed a greater proportion of younger workers (<31 years) among BIPOC employees and a higher representation of those over 51 in the White cohort. Notably, the difference in the older age bracket was not statistically significant, suggesting similar career longevity across races.

Table 3.1. EH Workforce Profile and Racial and Ethnic Diversity

Salary analysis presented a stark contrast, with a significant overrepresentation of BIPOC workers in the lowest salary bracket (\leq \$45,000), whereas White workers were more prevalent in the higher salary echelons. Educational attainment further highlighted workforce disparities, with White workers holding a larger share of Bachelor's degrees. The supervisory status showed White employees more often occupying supervisory and executive positions, a statistically significant observation that underscores the leadership gap. The employment status revealed that

BIPOC workers were more commonly found in non-permanent roles, while White workers dominated permanent staff positions. Moreover, BIPOC workers were more frequently employed at local government levels, whereas White workers were more likely to be found in state and non-governmental organizations, highlighting significant employment sector disparities.

Workplace Satisfaction

As shown in **Figure 3.1**, workplace satisfaction among BIPOC and White employees, job satisfaction was similar between the two groups, with BIPOC employees reporting a satisfaction rate of 42%, just slightly below the 42.9% reported by White employees. When it comes to pay, the satisfaction gap widened, with 24.3% of BIPOC employees content with their compensation, compared to 26.2% of White employees. BIPOC employees expressed a greater degree of satisfaction with their organization's climate and culture at 36.9%, slightly surpassing the 35.5% satisfaction level of White employees. In contrast to perceptions of job security, only 2.2% of BIPOC employees responded to feeling secure in their positions, a figure significantly lower than 5.6% of White employees who shared this sentiment. Finally, EH workers satisfaction with supervisors was higher among White EH workers (46.0%) compared to BIPOC employees (41.1%).

Figure 3.1. Workplace Satisfaction

Table 3.2. Differences in Workplace Satisfaction

In bivariate analysis, (**Table 3.2**), results indicated statistically significant differences in pay satisfaction and job security satisfaction between White and BIPOC respondents, with White respondents tending to report higher satisfaction levels (<0.001). There were no statistically

significant differences found in job satisfaction or organizational climate/culture satisfaction between the two groups.

Awareness of DEI Concepts

Overall, as shown in **Figure 3.2**, BIPOC and White respondents reported similarly across different DEI concepts with White EH workers reporting 88.7% and BIPOC reporting 86.1% awareness of Health Equity. In bivariate analysis (**Table 3.3**), statistically significant differences were found between BIPOC and Whites in awareness of health equity and social determinants of health (<0.001).

Figure 3.2. Awareness of DEI Concepts

Table 3.3. Differences in Awareness of DEI Concepts

Level of Confidence Addressing DEI Concepts

As shown in **Figure 3.3**, data indicates that White EH respondents generally reported a higher level of confidence compared to BIPOC respondents in addressing environmental justice (97.6% vs. 65.7%), social determinants of health (67.6% vs. 65.8%) and health equity (75.2% vs. 71.8%). Notably, BIPOC responses were higher compared to White when addressing structural racism (61.7% vs. 58.7%) and social determinants of equity (61.5% vs. 60.0%).

As shown in **Table 3.4**, confidence in addressing DEI concepts among EH workers showed significant differences between BIPOC and White groups. For health equity, the White group (N=2858) had a median rank of 2084.1, while the BIPOC group (N=1372) had a higher median rank of 2180.8, with the differences being statistically significant ($Z = -2.599$, $p < 0.009$). This suggests that BIPOC workers have greater confidence in addressing health equity than their White counterparts. A more pronounced difference was observed in social determinants of

equity, with BIPOC respondents demonstrating greater confidence (median rank of 2144.3) compared to White respondents (median rank of 1987.6), as evidenced by a Z-score of -4.490 and a p-value of less than 0.001.

Similar trends were found in the domain of social determinants of health, where BIPOC workers reported higher median ranks (2147.1) in contrast to White workers (2031.6), with this discrepancy being statistically significant ($Z = -3.098$, $p = 0.002$). The largest gap was noted in the context of structural racism, where BIPOC employees' confidence (median rank of 2151.2) significantly surpassed that of White employees (median rank of 1931.3), underscored by a Z-score of -5.984 and a p-value of less than 0.001. However, confidence levels regarding environmental justice did not significantly differ between the groups ($Z = -1.85$, $p = 0.65$), indicating a more uniform confidence level in this DEI concept across races. These findings reveal that BIPOC workers consistently reported higher confidence in addressing most DEI concepts, except environmental justice, where confidence levels were similar to those of White EH workers.

Figure 3.3. Level of Confidence Addressing DEI Concepts

Table 3.4. Differences in the Level of Confidence of Addressing DEI Concepts

Organizational Effectiveness Addressing DEI Issues

As shown in Figure 3.4, results indicated both BIPOC and White respondents believe more should be done to address racism as a public health crisis, with BIPOC respondents showing a slightly higher agreement. White respondents were more likely to believe that their organizations promote DEI. However, both groups reported low confidence in having adequate funding to address racism as a public health crisis, with White respondents reporting a marginally higher percentage.

Figure 3.4. Perceptions of Organizational Effectiveness of Addressing DEI Concepts

Table 3.5. Perceptions of Organizational Effectiveness of Addressing DEI Issues

Hypothesis Testing

The null hypothesis posited that there would be no statistically significant variance in the median perception levels across the examined DEI concepts between BIPOC and White EH workforce members. Contrary to the null hypothesis, the results unequivocally support the alternative hypothesis, demonstrating significant variances in perceptions between the two groups across several key DEI issues. Specifically, when asked if addressing racism as a public health crisis should be part of their work, both BIPOC (N=1498) and White (N=3029) workers showed a significant variance in perceptions, with a value of 11.14 and a p-value of less than 0.001. This indicates a statistically significant difference in how each group views the role of addressing racism within their professional duties, with the analysis suggesting potentially higher prioritization among one of the groups. Further, the perception of how organizations prioritize DEI also showed a significant difference between BIPOC (N=1504) and White (N=3041) EH workers, evidenced by a value of 18.84 and a p-value of less than 0.001. This substantial difference underscores the divergent views on organizational commitment to DEI between the groups. Additionally, when evaluating whether there is adequate funding to address racism as a public health crisis, a notable variance was again observed, with a value of 11.89 and a p-value of 0.008, indicating significant differences in perceptions regarding financial support for DEI initiatives between the groups.

Discussion

This study offers crucial insights into the Environmental Health (EH) workforce's perceptions of diversity, equity, and inclusion (DEI) within the United States. The survey, encompassing responses from both BIPOC and White EH workers, reveals significant disparities in perceptions regarding workplace satisfaction, awareness of DEI concepts, confidence in addressing these concepts, and views on organizational effectiveness in DEI issues. Notably, both BIPOC and White workers reported similar satisfaction levels in their job roles. However, differences emerged in pay satisfaction and job security, with White respondents expressing higher satisfaction levels. These findings suggest that while job contentment may be uniformly perceived, aspects related to remuneration and security manifest divergences that warrant attention.

Furthermore, the survey underscored significant differences in the level of awareness and confidence between BIPOC and White workers concerning DEI concepts. While awareness of health equity was relatively high across both groups, BIPOC workers displayed greater confidence in addressing health equity and structural racism, suggesting a deeper engagement or personal investment in these areas. Conversely, confidence levels in discussing environmental justice did not significantly vary, indicating a shared concern or interest in this domain among all EH workers. These distinctions in confidence and awareness levels point to the nuanced understanding and engagement with DEI issues across different demographic groups within the EH workforce.

Strengths and Limitations

The study leveraged data from the Public Health Workforce Interests and Needs Survey (PH WINS) 2021, providing a comprehensive and nationally representative sample of the

environmental health (EH) workforce in the United States. This extensive dataset allowed for a nuanced exploration of diversity, equity, and inclusion (DEI) within the EH sector, offering insights into the perceptions, experiences, and satisfaction levels across different racial groups. Additionally, the use of validated Likert scale measures to assess workplace satisfaction, awareness of DEI concepts, confidence in addressing these issues, and perceptions of organizational effectiveness ensures the reliability of the findings.

However, the study is not without limitations. The cross-sectional design restricts the ability to infer causality or track changes over time, suggesting the need for longitudinal research to observe trends and the impact of interventions. Furthermore, self-reported data may introduce response bias, as individuals' perceptions and willingness to disclose may be influenced by various factors. Lastly, the study's focus on the EH workforce may limit the generalizability of the findings to other sectors within public health, highlighting the necessity for similar research across different public health domains.

Conclusion and Recommendations

The study's insights underscore the critical need for targeted efforts to address the identified disparities within the EH workforce. To foster a more inclusive, equitable, and effective public health environment, the following recommendations are proposed:

1. **Implement Targeted Training Programs:** Develop and introduce DEI-focused training initiatives tailored to enhance understanding, awareness, and confidence in addressing DEI issues among all EH workers, with particular emphasis on areas exhibiting significant disparities.

2. **Promote Equitable Workplace Policies:** Review and adjust organizational policies to ensure transparency in pay structures and equitable job security measures, aiming to mitigate the disparities in satisfaction levels between BIPOC and White workers.
3. **Foster an Inclusive Organizational Culture:** Encourage a workplace culture that values diversity and inclusion, recognizing the unique contributions of all workers and creating spaces for open dialogue and shared learning on DEI issues.
4. **Conduct Longitudinal Research:** Future studies should employ longitudinal designs to track changes over time, assess the impact of DEI interventions, and explore causality in the relationships between workforce diversity and public health outcomes.
5. **Expand Research Beyond EH:** Extend similar research efforts to other sectors within the public health domain to gain a holistic view of DEI across the broader field, ensuring comprehensive strategies to enhance diversity and inclusion.

By addressing these recommendations, EH organizations and the wider public health community can make significant strides towards creating a workforce that not only reflects the nation's diversity but also effectively leverages this diversity to improve public health interventions and outcomes for all communities

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Table 3.1. Demographic and Workforce Characteristics of BIPOC and White Race Environmental Health Workers in the U.S. (PH WINS, 2021, N = 4,728)

Workforce Characteristics	EH n(%)		X^2
	BIPOC	White	<i>p-value</i>
Total	1513(100.0)	3056(100.0)	
Gender			
Man	522(34.5)	1265(41.4)	<0.001
Woman	943(62.3)	1753(57.4)	<0.001
Other	48(3.2)	36(1.2)	<0.001
Age (M, SD)			
<31 y	260(18.9)	432(15.3)	<0.002
31-50 y	691(50.2)	1396(49.3)	<0.001
51+ y	426(30.9)	1004(35.5)	<0.588
Current Salary			
≤\$45,000	444(31.7)	673(23.1)	<0.001
\$45,000-\$55,000	222(15.7)	526(18.1)	<0.005
\$55,00-\$75,000	409(28.9)	861(29.5)	<0.001
\$75,000-\$105,000	243(17.2)	653(22.5)	<0.001
\$105,000 +	100(7)	199(6.8)	<0.850
Education			
Less than an Associate degree	139(9.2)	259(8.5)	0.463
Associate degree	86(5.7)	127(4.2)	0.029
Bachelor's degree	766(50.9)	1688(55.4)	0.004
Master's degree	429(28.5)	810(26.6)	0.186
Doctoral degree	84(5.6)	161(5.3)	0.724
REHS/RS	364(28.9)	845(33.0)	<0.001
Supervisory Status			
Non-supervisor	1172(77.5)	2134(69.8)	<0.001
Supervisor	208(13.7)	541(17.7)	0.001
Manager	103(6.8)	279(9.1)	0.009
Executive	30(2.0)	102(3.3)	0.017
Employment Status			
Contractor	24(1.6)	45(1.5)	0.089
Permanent staff	1402(93.2)	2950(96.7)	<0.001
Intern	10(0.7)	7(0.2)	0.017
Temporary	61(4.1)	43(1.4)	<0.001
Federal employee	7(0.5)	6(0.2)	0.145
Employer			
Local	712(47.4)	1270(41.8)	<0.001
State	776(51.7)	1728(56.9)	<0.001
Federal	5(0.3)	4(0.1)	0.145
Non-governmental	8(0.5)	34(1.1)	<0.001

Note: Because of missing data, totals may not add up 100.0%

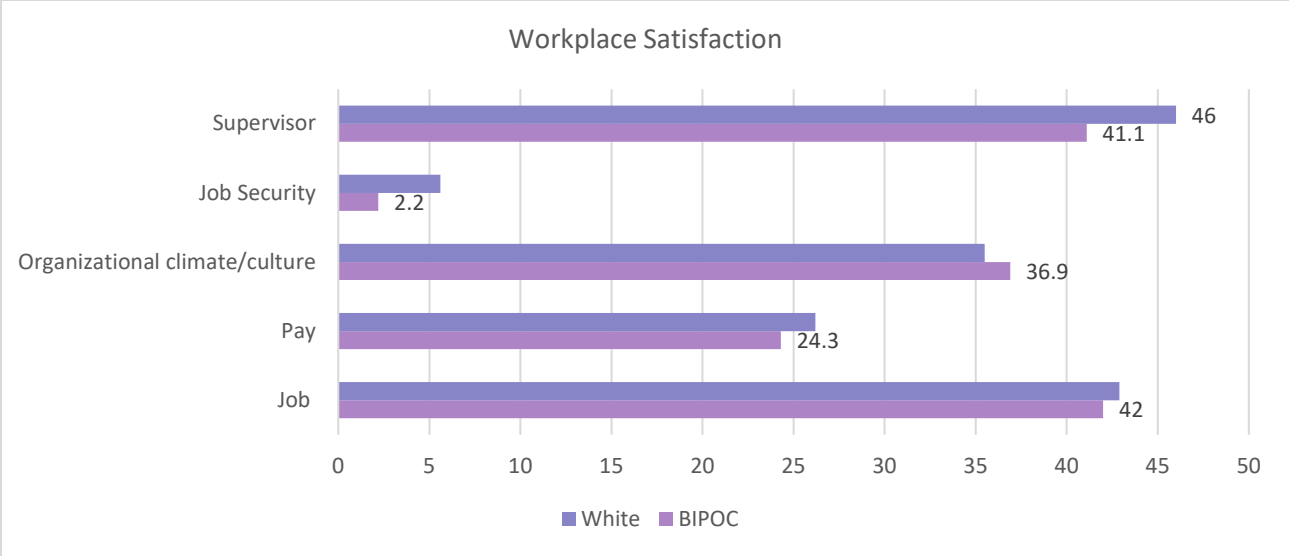


Figure 3.1. Percent of Self-Reported Responses to Workplace Satisfaction Questions Among BIPOC and White EH workers in the U.S

Notes: Likert scale response categories included “Very Satisfied” or “Somewhat Satisfied

Table 3.2. Differences in Workplace Satisfaction Among Minorities (BIPOC) and Non-Minorities (White) Environmental Health Workforce in the U.S. (PH WINS, 2021).

Work and Workplace Environment Satisfaction Factor	Group	N	Median Rank	Z	p-value
Supervisor Satisfaction	White	2176	1602	-2.56	.010
	BIPOC	1028	1526		
Job Satisfaction	White	2127	1582.6	-.480	.721
	BIPOC	1028	1568.4		
Pay Satisfaction	White	2127	1586.5	.248	<0.001
	BIPOC	1028	1557.6		
Organizational Climate/Culture Satisfaction	White	2127	1580.5	-.319	0.936
	BIPOC	1028	1572.9		
Job Stability Satisfaction	White	2127	1586.7	-.860	<0.001
	BIPOC	1028	1561.3		

Note: Ranked Likert scale analysis, Z-score in the context of the Mann-Whitney U test is a standardized measure that helps determine if the difference in ranks between two groups is statistically significant. A Z-score close to 0 indicates that the observed outcome is close to the expected mean under the null hypothesis, suggesting little to no difference between the groups.

A positive Z-score indicates that the observed outcome is above the expected mean, while a negative Z-score indicates it is below

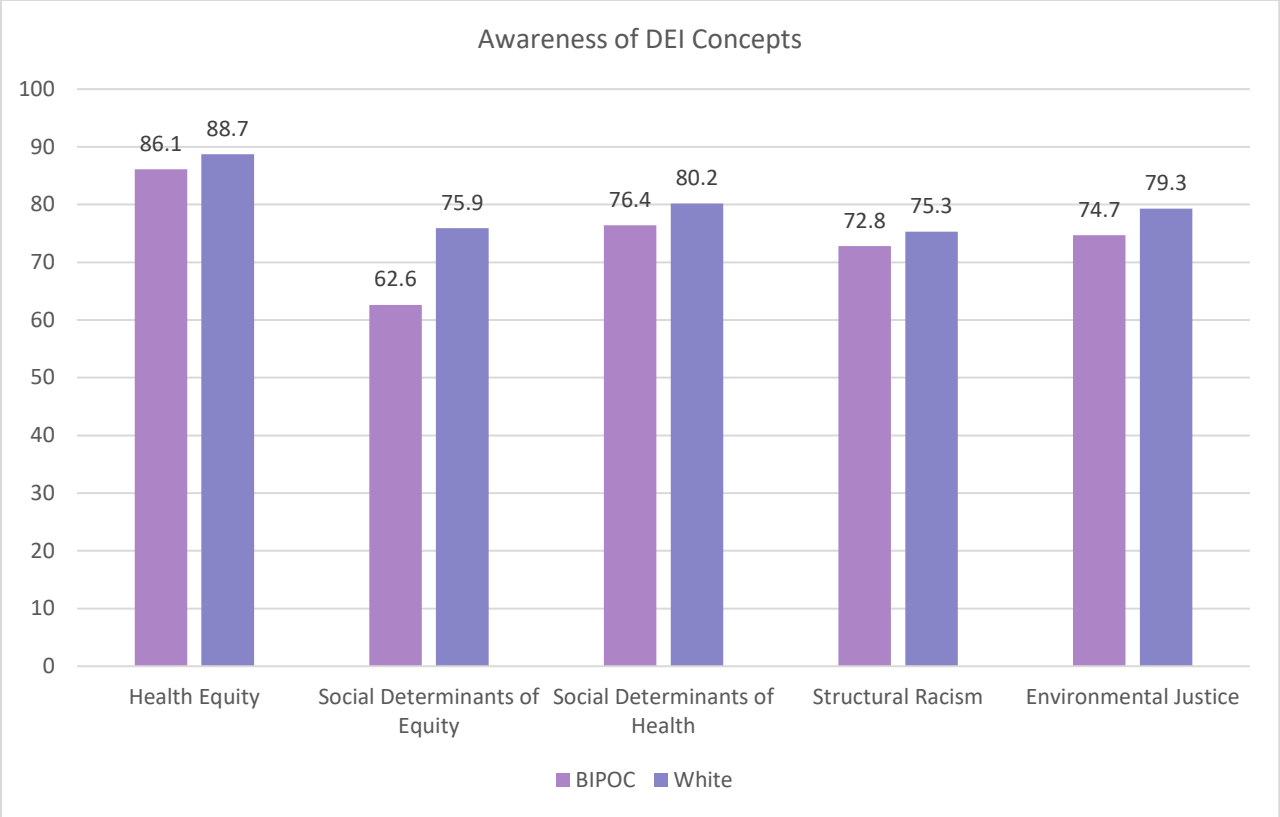


Figure 3.2. Percent Self-reported Awareness of DEI Concepts Among BIPOC and White EH workers in the U.S.

Notes: Likert scale response categories ranged from “Not at all” to “A lot”

Table 3.3. Differences in Awareness of DEI Concepts Between Minority (BIPOC) and Non-Minority (White) Environmental Health Workers in the U.S. (PH WINS, 2021).

DEI Concept	Group	N	Median Rank	Z	p-value
Health Equity	White	3030	2296.7	-2.973	0.003
	BIPOC	1493	2191.5		
Social Determinants of Equity	White	3030	2277.6	-1.138	0.255
	BIPOC	1495	2233.3		
Social Determinants of Health	White	3026	2314.4	4.490	<0.001
	BIPOC	1493	2149.8		
Structural Racism	White	3030	2267.4	-.347	.729
	BIPOC	1495	2254.0		
Environmental Justice	White	3031	2288.5	-2.027	0.43
	BIPOC	1494	2211.4		

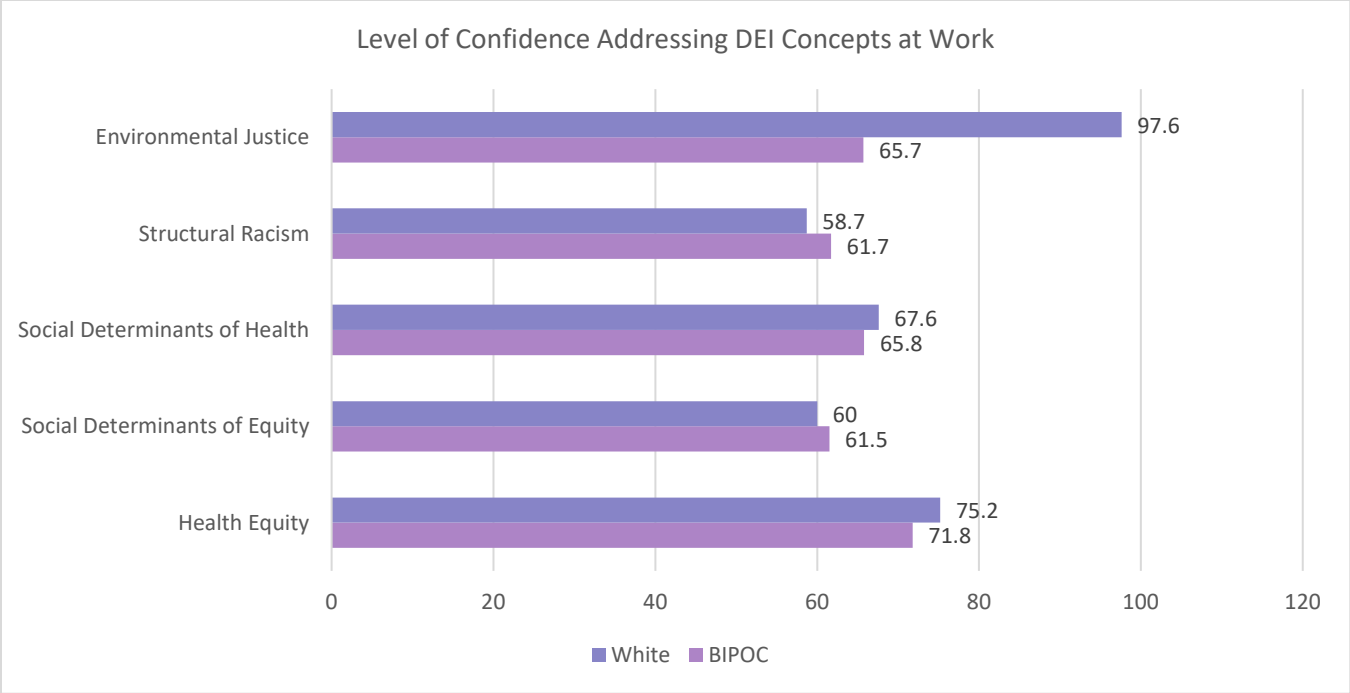


Figure 3.3. Percent Self-reported Level of Confidence Addressing DEI Concepts at Work Among BIPOC and White EH workers in the U.S.

Table 3.4. Differences in Level of Confidence Addressing DEI Concepts Between Minorities (BIPOC) and Non-Minorities (White) Environmental Health Workers in the U.S. (PH WINS, 2021).

Confidence Addressing DEI Concept	Group	N	<i>Median Rank</i>	Z	p-value
Health Equity	White	2858	2084.1	-2.599	0.009
	BIPOC	1372	2180.8		
Social Determinants of Equity	White	2741	1987.6	-4.490	<0.001
	BIPOC	1323	2144.3		
Social Determinants of Health	White	2796	2031.6	-3.098	0.002
	BIPOC	1341	2147.1		
Structural Racism	White	2708	1931.3	-5.984	<0.001
	BIPOC	1296	2151.2		
Environmental Justice	White	2759	2019.3	-1.85	0.65
	BIPOC	1323	2087.6		

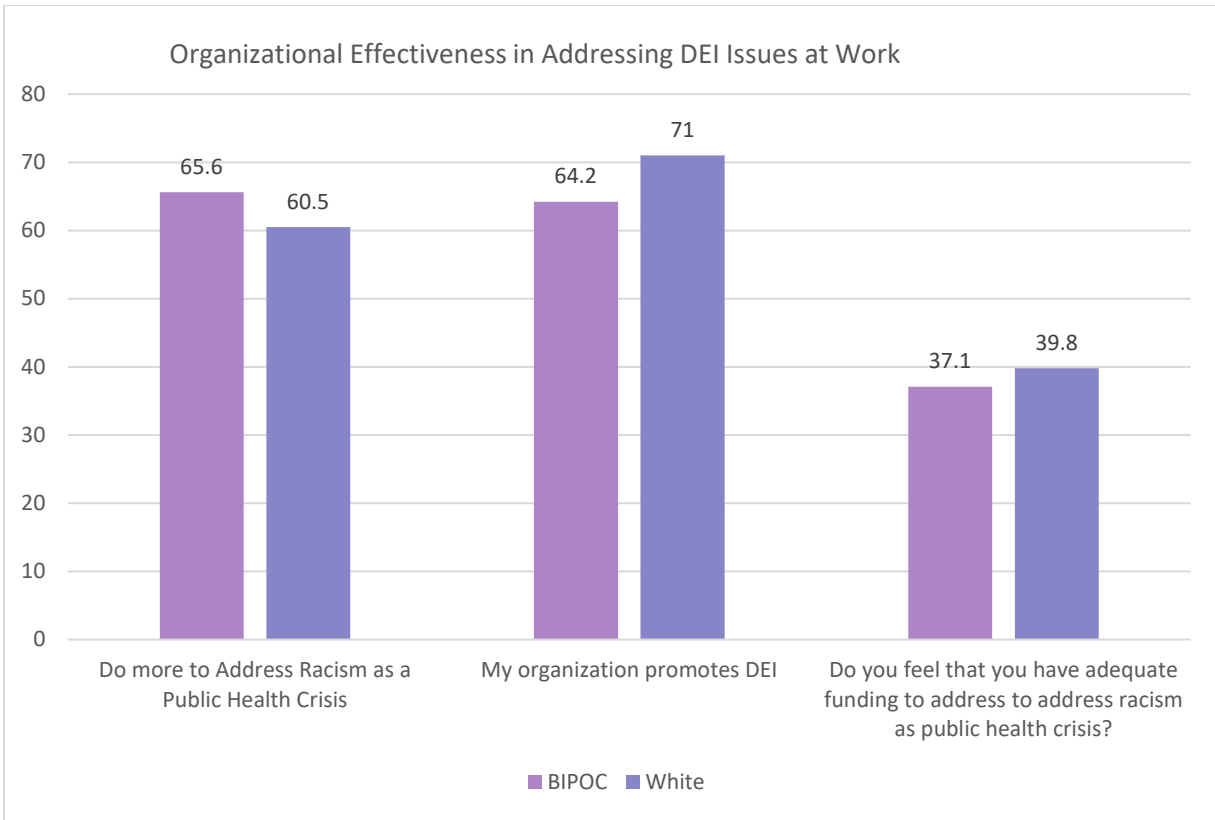


Figure 3.4. Percent of Self-reported Responses on Perceptions of Work Organization’s Effectiveness of Addressing DEI Concepts Among BIPOC and White EH workers in the U.S.

Table 3.5. Perceptions of Organizational Effectiveness of Addressing DEI Issues Among Minorities (BIPOC) and Non-Minorities (White) Environmental Health Workers in the U.S. (PH WINS, 2021).

DEI Issues Public Health	Group	N	Value	df	p-value
Do you believe that addressing racism as a public health crisis should be part of your work in the health department?	White	3029	11.14	1	<0.001
	BIPOC	1498			
Are there differences between BIPOC EH workers and White race EH workers in how they perceive their organization's prioritizes diversity, equity, and inclusion?	White	3041	18.84	1	<0.001
	BIPOC	1504			
Are there differences between BIPOC and White EH workers and whether they feel that they have adequate funding to address racism as a public health crisis?	White	1814	11.89	1	.008
	BIPOC	968			

Note: Chi Square test of independence - Yes/No

CHAPTER 4: A MIXED-METHODS STUDY ON DIVERSITY IN ENVIRONMENTAL HEALTH: INSIGHTS FROM ENVIRONMENTAL HEALTH PROFESSIONALS FROM ACROSS THE UNITED STATES

Introduction

Environmental health professionals (EHPs) working in local, state, and federal health departments are critical to protecting public health. EHPs comprise a significant portion of the overall public health workforce. Historically, the EH workforce has not represented the racial and ethnic diversity within the communities they serve. In 2019, the environmental health workforce was 68% white based on results from the UNCOVER EH (Understanding the Needs, Challenges, Opportunities, Vision, and Emerging Roles in Environmental Health) survey (Gerding et al., 2019). Over 1,700 EHPs from health departments nationwide participated in the survey.

When examining environmental health issues within communities, low-income and minority communities experience more severe environmental health impacts. Organizations, like the Association of Environmental Health Academic Programs (AEHAP), have initiated many diversity projects. AEHAP's efforts increased the number of accredited environmental health programs at minority-serving institutions (Balanay & Richards, 2022). Their efforts are working to increase racial and ethnic diversity in environmental health students (Harper, 2007; Balanay & Richards, 2022). In environmental health, racial and ethnic diversity is important due to the level of community engagement involved in routine work. EHPs work within communities by providing education to the public, conducting inspections at facilities, collecting environmental samples, performing investigations on environmental health hazards, etc. A diverse workforce ensures cultural knowledge that supports community relations and builds trust (Boyapalli et al., 2023).

This research aimed to understand the experiences of diverse EHPs, provide recommendations to increase racial and ethnic diversity in environmental health, and compare experiences and perceptions among minority (BIPOC) EHPs and non-minority (white) EHPs. Exploring the background of minority EHPs provided insight on their initial interest, career path, and types of experiences. Since minority EHPs have found a way to enter the field despite the overall lack of diversity, understanding their pathways is crucial for recruiting racial and ethnically diverse EHPs. This project compares the perceptions of minority EHPs to the perceptions of non-minority EHPs. Based on their experiences in the field, minority EHPs and non-minority EHPs may have varying perspectives on diversity, inclusion, justice, and other ethical principles in the workplace.

Methods

Study Overview

This research project followed a mixed methods research design. A phenomenological qualitative research design was implemented for the in-depth interview portion of the project. Phenomenology is defined as “the study of structures of consciousness as experienced from the first-person point of view” (Smith, 2018). The domain of phenomenology covers the range of experiences that includes both passive and active experiences. This research project aimed to understand the experiences of minority EHPs. These experiences shape character, perceptions, thoughts, and beliefs. The phenomenological qualitative research design provides the most meaningful insight on factors that influence diverse individuals becoming EHPs.

An online survey was conducted for the quantitative portion of the project. This survey explored the experiences of non-minority (white) and minority (BIPOC) EHPs through their own perceptions and beliefs. Demographic data regarding participants were collected, including age

range, race, ethnicity, and biological sex. Participants were asked nine questions relating to workplace diversity, fairness, and justice. Details are provided below.

Qualitative Interview Sampling

The qualitative sample consisted of racial and ethnic minorities who participated in 20 in-depth interviews. The purpose of sampling racial and ethnic minorities was to help identify areas to increase minority participation and representation in environmental health. Minority EHPs have unique backgrounds and experiences that have led them into an environmental health career field. Gathering perspectives from minority EHPs provides insight into how and where environmental health recruitment efforts can be directed. Initially, study participants recruited for the in-depth interviews had to meet the following criteria to be included in the study: must be actively working in environmental health in the US for at least one year; at least 18 years of age; member of the National Environmental Health Association (NEHA); identify as a racial or ethnic minority; be willing to participate in the interview.

An amendment was submitted to the UMCIRB during the project to adjust the inclusion criteria. First, the NEHA membership requirement was removed because many minority EHPs identified as meeting most of the criteria were not members of NEHA. Some individuals identified to participate in the study were unfamiliar with NEHA. Therefore, this requirement was removed so that more minority EHPs would qualify to be interviewed. The requirement for minority EHPs to work in the field for at least one year was also removed from the inclusion criteria. Minority EHPs who recently entered the profession still have valuable insights to provide. Removing the one-year working requirement allowed more minority EHPs to qualify for interviews.

Interview Recruitment

Participants were recruited in collaboration with NEHA at the 2023 Annual Education Conference in New Orleans, Louisiana, and through the online membership community. Using the directory of EHPs from NEHA, a purposive sample among minority members and conference attendees was collected. Purposive sampling method was used because the principal investigator and NEHA collaborators have specialized knowledge and experience in the field of environmental health as well as connections with other NEHA members. After removing the NEHA membership requirement from the inclusion criteria, more minority EHPs were eligible to participate in the interviews using the purposive sampling method. An amendment was submitted to the IRB to allow interviewees to refer individuals to be interviewed. This amendment was significant because determining whether someone identifies as a racial or ethnic minority can be uncomfortable and misleading. Basing racial and ethnic minority status off appearance enters the realm of stereotyping. To eliminate potential stereotyping, interviewees referring individuals who they already know as a racial and/or ethnic minority was a preferable recruitment strategy.

Interview Guide

An interview guide was developed consisting of five main questions. Microsoft Teams was used as the hosting platform for the interviews. Scheduling, recording, and transcription were conducted through Microsoft Teams. Virtual interviews allowed more flexibility for the Principal Investigator and participants across the United States. The invitation provided participants with the Consent to Participate (Appendix F) as an attachment. The research project details provided in the interview guide (Appendix C) were read to the participants before conducting the interview. After receiving verbal consent, the recorder was turned on, and the

interview began. The interviews were conducted in English. Questions were orally stated to the participants for feedback.

A full 45-minute interview block was designated for each interview. It was not anticipated that the entire 45-minute block would be needed due to practice interviews with peers and relatives, which lasted approximately 30 minutes. The data collected from the practice interviews was not used for the research study. After conducting several interviews, an amendment was submitted to adjust the time allotted for interviews to 30 minutes. This adjustment was based on the average time of interview completion being well under 30 minutes. The adjustment also encouraged participation because interviewees did not have to take as much time away from their workday to participate in the study. Their interview could be completed during the lunch hour, before fieldwork, in the evening, or over the weekend.

Interview Data Analysis

Interview data were analyzed by coding and using qualitative analysis software (NVivo 14). First, two data-rich interviews were selected to be individually coded by both researchers and then compared to develop the consensus codebook. After developing and defining initial codes for the consensus codebook, the consensus codebook was applied to two more interviews to ensure relevant ideas and key themes were captured. The two data coders met to discuss coding decisions and discrepancies, clarify the codebook, and come to consensus on coding decisions. The remaining interviews were coded individually using the consensus codebook and compared during 30-to-60-minute virtual meetings to reach a consensus. Additional codes were identified and added to the consensus codebook during the individual and consensus coding process. The coding frequency and depth of discussion were used to determine major themes. Coding matrices were generated to determine sub-themes for each of the major themes. We

defined a sub-theme if it was mentioned three or more times within each major theme. However, for the theme related to recommendations to increase diversity in environmental health, we included all recommendations, because we did not want to lose any important suggestions that could be implemented and tested in the future.

Quantitative Survey Research Design

The online survey was developed consisting of 16 questions (Appendix H). Individuals were invited to participate in the survey through the NEHA online community. The purpose of utilizing the online community was to ensure that all participants would be members of NEHA. The main objective of the NEHA online survey was to gain insight from both minority and non-minority EHPs to compare their experiences. The survey was posted on the NEHA Online Community on August 29, 2023. The survey remained open for two weeks and closed on September 12, 2023. It was projected to take approximately 5-10 minutes to complete the survey. The average survey time was slightly over 3 minutes. The survey was conducted in English. Questions included yes/no, multiple choice, and Likert scale responses. Eight of the survey questions included demographic information regarding age, location, race, ethnicity, student status, credential status, and type of employment. The remaining eight questions addressed diversity, equity, fairness, inclusion, and justice principles as defined in the operational definitions in Chapter 1.

Participants were also asked about NEHA credential status. Participants were asked about their workplace region. They were asked if they were employed in a community with a high population (>50%) of racial/ethnic minorities to evaluate the diversity within their workplace community. To evaluate workplace diversity, participants were asked to rate the level of racial and ethnic diversity in their current workplace. Participants were also asked to rate to what extent

their racial or ethnic background has impacted their professional careers. Participants were asked if their current workplace encourages diverse ideas and perspectives. To evaluate inclusion, participants were asked to rate their level of comfort to share their ideas with others. To evaluate justice and fairness in the workplace, participants were asked to rate how they were treated in relation to their peers at their current workplace.

NEHA Online Survey Sampling

Voluntary sampling methods were used for the online survey. The survey invitation was posted on the NEHA online community discussion board with permission from NEHA online community administrators. The NEHA online community has over 6,000 members spanning across the US. It was anticipated that all members would not participate in the survey, but exposure by posting on the only community page would promote participation. The survey was hosted on Microsoft Forms. The online survey was posted to the community page to gain insights from all individuals in environmental health, regardless of race or ethnicity.

Eligibility to participate in the quantitative survey was expanded to minority and non-minority EHPs. The purpose of including non-minority participants was to compare experiences as they relate to fairness, equity, inclusion, and justice. Participants recruited for the survey had to meet the following criteria: must be actively working in environmental health in the US; at least 18 years of age; members of NEHA; and willing to participate in the survey. Individuals would be excluded from participating in the survey if they practiced environmental health outside of the US or were not working in the field at all. Individuals who worked in the environmental health field for less than one year were also excluded from the survey. The goal was to gain the most meaningful insight from the working professions. EHPs having less than

one year of environmental health work would not provide the most insightful data. The survey would remain open for responses for two weeks from the posting date.

Survey Data Analysis

The survey responses were analyzed by comparing the non-minority EHP and the minority EHP responses to questions regarding workplace diversity, career impact, diverse perspectives, workplace inclusion, workplace justice, workplace fairness, and feeling valued. Descriptive statistics were reported on the demographics of survey participants. T-tests were performed for each of the seven variables to compare the responses of non-minority (white) and minority (BIPOC) respondents. P-values were calculated for each variable to determine whether the relationship between race/ethnicity was significant to any of the seven variables. ANOVA tests were performed for each variable to determine the difference in the means of responses. The 5-point Likert scale responses were assigned numbers 1-5 (e.g., 1 for strongly disagree, 2 for disagree, 3 for neither agree nor disagree, 4 for agree, and 5 for strongly agree).

Human Subjects Protection and IRB

Since this research project involves human subjects, an IRB request was submitted and approved by the University & Medical Center IRB on August 23, 2023. The research study has been certified as exempt under category 2 – research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures or observation of public behavior if at least one of the following criteria is met: a.) information obtained is recorded in such a manner the human subjects cannot be easily identified and b.) any disclosure of the human subjects' responses would not reasonably place the individual at risk of criminal or civil liability or be damaging to the person's financial standing. The participants in the study remained anonymous so that their responses could not be linked back to them in any way.

Minimal risks were associated with this study. Considerable efforts to protect the privacy and confidentiality of participants were made.

To maintain anonymity, interview participants were given an ID number comprising their workplace region and random number assignment. Each US census region was coded (e.g., Northeast (N), South (S), West (W), and Midwest (M)). Participants were randomly assigned a number 1-20. The numbers were not linked to participants' names or other identifying information. For example, a participant from Alabama would be coded as South (S) and assigned number 4 would have the study ID S4. Once a number was assigned, it was not assigned to another study participant. The interview demographic questionnaire (Appendix D) captured demographic information from interview participants. The study ID number associated the interview transcript with the demographic questionnaire. Per IRB protocol, to ensure anonymity for participants, the recorded audio and video were destroyed once transcribed for analysis. No personally identifiable information (PII) was collected from participants for this study. The principal investigator informed participants that all data and information collected by ECU and NEHA investigators will be kept confidential and maintained securely to the extent permitted by ECU and governing laws.

Each interview participant received a copy of Appendix F – Consent to Participate. It outlined the purpose of the research project and their right to end participation at any time for any reason without penalty. The interviews were projected to take 30-45 minutes of their time. Interview participants were offered a \$20 Visa or e-Visa gift card for their time. An informed consent paragraph was provided at the beginning of the survey (Appendix G). Survey participants may also end the survey for any reason without penalty. There was no monetary

incentive provided for the online survey. The survey was designed to be completely anonymous. No information linking the participants to their responses was collected for this project.

Results

In-depth Interview Results

There were 20 participants interviewed; however, one interview was not included in the results due to technical issues with the recording. Table 4.1 includes the full demographic data from the interviews. Black/African Americans (n=14) made up the majority of interview participants. An equal number of survey participants from ages 25-34 (n=6) and 35-44 (n=6) participated in the survey. Eleven interview participants were female. Interviewee experiences ranged from one to 21+ years working in the US Environmental Health field. Most of the interviewees have worked in the field between 1-10 years (n=11). Regarding NEHA membership, 12 interviewees are current members. Six of the interviewees were currently students in EH. All participants obtained at least one college degree.

Table 4.1 Interviewee Demographics (n = 19)	
Race*	# of Participants
Asian	3
Black/African American	14
Native American/Alaskan Native	1
Native Hawaiian/Pacific Islander	0
White/Caucasian	3
Ethnicity	
Hispanic	2
Non-Hispanic	17
Age	
18-24 years	3
25-34 years	6
35-44 years	6
45-54 years	1
55-64 years	2

65+ years	1
Gender	
Female	11
Male	8
National Environmental Health Association Credentials	
Registered Environmental Health Specialist (REHS/RS)	5
Certified Professional – Food Safety	4

*Numbers add to more than 19 due to multiple races and ethnicities selected for three participants.

The main themes fell within five broad areas of: (1) initial interest in environmental health, (2) education, (3) negative and most challenging experiences, (4) positive and most rewarding experiences, and (5) recommendations to increase diversity in environmental health. The theme “initial interest in environmental health” included information about how the participant first became interested in the field and what may have been their first exposure. The theme “education” was critical to understanding the participants’ educational backgrounds, which varied greatly in the types of degrees and colleges attended. Participants also discussed their negative and most challenging experiences since pursuing their environmental health career, as well as their most positive and rewarding experiences. Lastly, participants recommended ways to increase racial and ethnic diversity within environmental health. Table 4.2 is the codebook with operational definitions, and Table 4.3 is a thematic analysis with major themes, sub-themes, and illustrative quotes.

Code	Operational Definition
Initial Interest EH	Anytime a participant discusses how they initially became interested in environmental health.
Positive Experiences	Anytime a participant discusses their experiences in the field or leading up to their career positively, or mentions positive aspects of working in environmental health.
Negative Experiences	Anytime a participant discusses their experiences in the field or leading up to their career negatively, or mentions negative aspects of working in environmental health.
Most Rewarding Experiences	Anytime a participant discusses their most rewarding, beneficial, or positive experiences.

Most Challenging Experiences	Anytime a participant discusses their most negative or challenging experiences.
Education	Anytime a participant discusses where they went to college (undergraduate and/or graduate education) and the degree(s) they obtained.
Accreditation	Anytime a participant mentions the accrediting body for their degree program.
Interoffice relationships	Any time participant discusses relationships within their environmental health department.
Mentorship	Anytime a participant discusses mentorship in their educational or professional careers. This can refer to formal or informal mentors.
Scholarships	Anytime a participant states they received scholarships during their time in college.
Diversity Classmates	Anytime a participant discusses the level of racial and ethnic diversity among their classmates.
Diversity Faculty	Anytime a participant discusses the level of racial and ethnic diversity among their faculty.
Diversity Work	Any time participant discusses the level of racial and ethnic diversity among their co-workers.
Recommendations To Increase Diversity EH	Anytime a participant makes 3-5 recommendations to inspire racial and ethnic minorities to pursue a career in environmental health.
Family Influence	Anytime a participant states they became interested in EH because of a parent or family member or mentions how their family members or parents influenced their job choice or educational background related to environmental health.
Internship Opportunity	Anytime a participant mentions they participated in an internship and/ or how an internship increased their interest in environmental health.
Career Path	Anytime a participant discusses the steps they took towards their career in EH.
Environmental Justice	Any time participant mentions how environmental justice, systemic racism, or other community influences really impacted their passion and decision to pursue environmental health
Discrimination	Any time participant notes discrimination or racism as a negative aspect of their environmental health career. This can also include compromising behavior, such as asking an inspector to “give one a break” due to being of the same racial or ethnic background.
Politics	Any time a participant mentions how politics plays a role in environmental health.
Environmental Nature Enjoyment Preservation	Any time a participant mentions enjoying nature or wanting to protect the environment.
Great quotes	Any time participant says something that really captures the issues at hand.
Noteworthy Thought	Any time participant says something that seems noteworthy, we are unsure how to code it.

Table 4.3 Thematic Analysis

Themes	Illustrative Quotes
<i>Initial Interest in Environmental Health</i>	“So 8th grade I took earth science and I loved it. It was easy for me. Everything kind of clicked, so the rocks the like the wildlife in terms of how animals and plants all interplay together.” -Participant S11
Education	“I started out as a microbiologist in my undergraduate and the looking at Nigeria, their public health sector and the A personal history of how what happens to my dad before he passed out. So I felt like going into public health, we have me like.” -Participant S10

Career Path	“So I did pursue an undergrad bachelor's degree in public health, so I kind of started there. It was in the middle of going through the entire process of being in the military though, so it was kind of intertwined. And then when I got out just kind of used my references, the connections I had made during my time in the military to crossover into the civilian world doing the same thing. So it was kind of a mixture of experience and education that kind of carried me over to this position.” -Participant S14
Internship	“So I worked and I was going to school. I did an internship with one place and then I went and did an internship at another place and this place was called Omaha Healthy Kids Alliance.” -Participant S20
Family Influence	“I started looking for something that would would help me make a difference to change that right to to save other people. I couldn't save my family members, but I could help save other people.” -Participant S18
Environmental Justice	“So my interest in the field environment health comes from my past experience in working as a Community health outreach worker for adequate access to drinking water and clean water in the Philippines and first hand I witness umm some of my fellow citizens developing waterborne illnesses such as like cholera and leptospirosis, by not being able to access having access to clean water at the same time not receiving the appropriate education on clean water.” -Participant S17
<i>Education</i>	“So I would say it started off after I finish undergrad. I got my undergrad in biology.” -Participant S20
Accreditation	“It is accredited now it was accredited by CEPH, where I basically pursued an MPH as a generalist.” -Participant S17
Mentorship	“I had a mentor and I still she still mentors me even though I'm no longer in the sports field.” -Participant S1
Internship Opportunity	“To actually get my undergrad degree, we all had to do internship, so that's what I did.” -Participant S19
<i>Negative or Most Challenging Experiences</i>	“I would say sometimes, like with training, training could be a bit tricky sometimes, just because you're trying to get into the role.” -Participant S6
Discrimination	“We had our first meeting and she immediately looked at me and said that I was unteachable and that she would not teach me, umm. And she didn't tell us to me, she told this to my mentor, the Environmental Division chiefs.” -Participant N12
Interoffice relationships	“And I think the only reason why is because I was African American and it didn't make sense to me. And it made me feel uncomfortable because it's clear that I look different.” -Participant N8
<i>Positive or Most Rewarding Experiences</i>	“Some positive experiences, of course, was me getting the certification and passing.” -Participant S15
Interoffice Relationships	“It's a work culture that I don't want to say is tailored to me, but it definitely promotes my growth, my career for my career growth, my growth as an individual, and I definitely feel that my current workplace and employer or my current team.” -Participant S1
Mentorship	“Now positive experiences...I've had a pretty good and supportive mentorship network. The vector borne diseases director at the Tennessee State Health Laboratory is also a Vanderbilt professor....mentorship with him has been amazing.” -Participant N12
Great Quotes and Noteworthy Thoughts	“You're in the environment too, so you know, it kind of builds that appreciation for the environment and how we're supposed to be good stewards of it.” -Participant S11

<i>Recommendations to Increase Diversity in Environmental Health</i>	“I would recommend individuals who are interested in EH shadow environment health professionals” -Participant S17
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Initial Interest in Environmental Health

Participants noted several factors that influenced their initial interest in environmental health, including education, career path, internship opportunities, family influence, and environmental justice. *Education* was an important factor in the decision to pursue environmental health. For example, participant S20 stated, “I would say it started off after I finished undergrad. I got my undergrad in biology. I was looking at the next step in terms of, umm, professional development and then I came across public health.” Participant S6 stated they attended undergrad for earth science and “which landed me a role in this....in the environmental health field.”

Participants referenced their *career path* when describing their initial interest in environmental health. Participant S16 discussed how they entered the field by accident. A former coworker reached out to them after starting a new job and explained the job of a sanitarian. Participant S16 shared that they “researched and found out what it entailed and was like”. This participant was satisfied they were able to use their degree. One participant discussed how their military service led them to environmental health. For example, participant S2 shared, “I was gonna go to college once I got out. And probably the last year before I got out of the military, I was going across the base and I saw this sign that says preventative medicine and environmental health.” From that experience, participant S2 went on to complete their undergraduate degree in environmental health. Participant S4 discussed completing their master’s degree and going to work for the USDA as a food safety inspector. Participant S4 shared, “I was a poultry line inspector and that was a good experience, but it was something....was very hands on.” This

participant later went on to discuss pursuing a doctoral degree and working in the local health department.

Internship opportunities were shared as part of their initial interest in environmental health. For example, participant S9 shared, “the environmental health instructor kind of referred me to the Florida Department of Health, where I got an internship.” Participant S10 interned for their country’s equivalent of the Food and Drug Administration. Participant S10 stated the internship strengthened their interest in going into public health.

Family influence was another factor that sparked an initial interest in environmental health. For example, participant N8 shared, “I just feel like my main goal is to make sure, you know, the public is safe.... especially dealing with my mother who is autoimmune and does have different, you know, restrictions when it comes to food and food handling.” Participant S18 discussed how their mother was a key motivator for them to pursue environmental health. They stated, “Mom kind of urged me into it.” Participant S10 shared that their father’s passing influenced them to pursue a career in public health.

Lastly, *environmental justice* was identified as a sub-theme within initial interest to environmental health. Participants shared how witnessing the poor health of family members or community members influenced them. For example, participant N12 discussed cases of smog in their community. They shared, “our environmental health disparity is huge within the city itself.” Participant N12 stated how this situation troubled them because they saw their family and people in the neighborhood suffering from different issues, but when they attended a nicer school, everyone there was completely fine. Participant S18 discussed growing up in an area located near a paper mill. They shared, “our water quality wasn’t that great. We were all on a well. We didn’t know anything, but as I got older, I realized that increasing numbers of my family

members had different kinds of cancers or other kinds of environmentally induced terrible disease.”

Education

Many themes related to education were related to the participants’ career paths. All the interview participants obtained college degrees. Participant majors varied including organismal biology, biology, environmental health, public health, food science, exercise science, microbiology, and environmental science. At least four participants attended an HBCU (historically black college and university). There were three themes identified under education based on the interview questionnaire: accreditation, mentorship, and internship opportunities. Four participants stated their programs were accredited. Most participants were unfamiliar with the accrediting body for their degree program.

Mentorship was identified as a sub-theme within education. Participants often discussed mentorship during their time in college. Participant S10 was encouraged by their mentor to pursue their doctoral degree at their current institution. They shared how they were able to work with their mentor from their master’s program at their current institution. Participant S1 shared their experience with their mentor during their master’s program. They shared, “So she definitely challenged me and allowed me to evolve do better.” Participant S1 mentioned they continue to stay in contact with their mentor.

Internship opportunity was also identified as a sub-theme of education. Participants discussed internship opportunities they participated in while in school. Participant N8 discussed their internship with the health department. They shared, “they [health department] helped groom me and helped me get into this space that I'm in now and allow me to learn a lot.” Participant S9 also interned for the health department over a summer. They discussed how the internship

opportunity led to a permanent position. During their college education experience, Participant S20 interned at two separate locations while working.

Negative and Most Challenging Experiences

Participants described various situations they considered as negative or most challenging in their careers. The sub-theme interoffice relationships was double-coded with discrimination – thus, all negative interoffice relationships were related to discrimination. Some participants faced discrimination in the office with leadership and co-workers. For example, participant N12 described how they were discriminated against based on their race. Their supervisor stated they were “unteachable” and she would not teach them. Participant N8 faced discrimination in their office environment. They stated, “I have other people who are Caucasian, typically who are above me and who don’t necessarily understand me.” Participant N8 described scenarios where they were treated differently and judged more harshly than their Caucasian peers. Participant S1 faced discrimination in the office and felt like their “intelligence was in question.” Participant S11 discussed their feelings about being the only minority in their last workplace. They shared, “I may have felt a bit more at home if there were more minorities.”

Positive and Most Rewarding Experiences

Participants discussed their positive and most rewarding experiences throughout their environmental health career. Key sub-themes identified included interoffice relationships, mentorship, and internship opportunities. Participant S1 discussed interoffice relationships at their new job and how the atmosphere has been supportive to their growth. Participant S14 discussed their experience working in a positive environment that “fosters a bit of teamwork”. They stated, “I would definitely say that inside the actual department, within the field, it’s very close knit”. Participant S6 discussed how their current work atmosphere is “very nice and

everybody is very easy to get along with”. Participant S6 shared other EHPs are helpful when they have questions, and the overall work environment was positive.

Many of the participants had formal or informal mentorship during some time in their career. Participant N12 discussed a “supportive mentorship network” during their time working at the state health laboratory and during their college education. Participant N8 highlighted mentorship as a positive experience. They shared their mentor had helped them grow and helped them through the process. Participant N8 stated it was “one of the greatest experiences that I had”. Participant S19 had a teacher who they viewed as a strong mentor. Participant S19 shared her forcefulness, sternness, and ambition were qualities they appreciated today. They said, “that was a positive aspect in my career, in my life, in the education realm.”

Two participants discussed their internship opportunities as positive or most rewarding experiences. Participant S10 discussed how they completed an internship with one of the largest hospitals in the United States. They stated that internship gave them exposure to hospital management and hospital operations. Participant S7 identified their internship abroad as a positive experience. The opportunity was recommended by their professor. Participant S7 stated they went to England for a year and took “built environment type courses”.

Recommendations to Increase Diversity in Environmental Health

The recommendations to increase diversity in environmental health can be divided into two categories: recommendations for reaching individuals who may be considering a career in EH, and recommendations for educational institutions trying to attract a more diverse group of EH students. Some of the recommendations provided by participants were encouragement to potential EH students. Recommendations for reaching out to individuals who may be considering an EH career included (1) providing good mentors and internships, (2) providing educational

materials regarding the specialties within EH, and (3) encouraging the individual to find their niche in EH. Participant N12 discussed how “trying to find a mentor can be a bit more difficult” in specialty areas of environmental health. Educational materials can be useful to students and their parents understand the field better. Two participants shared that their parents did not know what they were studying. One participant mentioned their parents thought they were going into sanitation and waste management. Therefore, the recommendation to develop educational materials about the field of EH is important to educate both students and parents alike. They also emphasized the importance of finding your niche in environmental health because there are many specialty areas, like swimming pools, infectious diseases, and food safety. Participant S11 stated, “I would look for internships...volunteer opportunities.” They shared that the opportunity helped them get a “feel for what I wanted to do in the environmental field”.

The second category of recommendations includes suggestions for educational institutions seeking to attract a more diverse group of EH students. These suggestions include (1) recruitment from HBCUs, Hispanic universities, and high schools, (2) providing scholarships, (3) ensuring that students have good mentors, (4) advertising and marketing the field of environmental health, (5) providing internship opportunities, (6) providing network opportunities, (7) ensuring that administrators and professors are reaching out to minority students. Participant S15 shared how there are so many opportunities for institutions if they “reached out to HBCUs as well as historically Spanish institutes.” Participant S19 discussed the importance of reaching out to high schools and having environmental health in the high school curriculum.

To support the need for scholarships in environmental health, Participant S16 shared, “I think money is a thing that keeps a lot of people from pursuing this [environmental health].”

Mentorship was a common recommendation. Many participants discussed their mentorship opportunities at their college or university and the impact they had on them pursuing a career in environmental health. Environmental health advertisement and marketing were recommended. Participant S19 discussed how they had “never seen an environmental health advertisement,” but they had seen advertisements for the army. Participants S7 and S9 discussed seeing examples of environmental health professionals on television. Environmental health inspectors were depicted in both the movie *Deliver Us from Eva* and the television show *Bob’s Burgers*.

Participants encouraged students to participate in internships. Participant S11 shared, “I would say look for internships.” Many participants had an environmental health internship leading up to their careers in the field. Participants discussed the benefit of having networking opportunities. Participant S19 discussed networking opportunities and how they could help with job placement in the field. Participant S19 also shared the importance of college administrators treating minority students with kindness and the need to eliminate roadblocks. Participant S2 discussed the importance of professors helping minority students feel welcomed and encouraged. They shared, “I try to tell faculty here is to reach out to those students of color....we just want to feel a part of this whole process.”

NEHA Online Survey Results

Of the 6,917 members listed in the directory, 3.5% (n=24) participated in the online survey posted on the NEHA online community page. The racial and ethnic demographics are presented in Table 4.4. Most of the survey participants self-identified as white (n=16). Five individuals self-identified as African American/Black, two identified as two or more races, and one individual identified as Asian. There were no Native American, Alaskan Native, Native

Hawaiian, or Pacific Islanders who participated in the online survey. The majority of participants identified as non-Hispanic.

Table 4.4 Online Survey Demographics (n = 24)	
Race	# of Participants
Asian	1
Black/African American	5
Native American/Alaskan Native	0
Native Hawaiian/Pacific Islander	0
White/Caucasian	16
Two or more races	2
Ethnicity	
Hispanic	2
Non-Hispanic	22
Age	
18-24 years	1
25-34 years	3
35-44 years	7
45-54 years	4
55-64 years	6
65+ years	3
Gender	
Female	12
Male	12
Employment	
Health Department	19
Other	5
National Environmental Health Association Credentials (NEHA)	
Registered Environmental Health Specialist/Registered Sanitarian	17
Certified Professional in Food Safety (CP-FS)	3
Food Safety Auditor	1
No credentials	5

Although participant numbers were roughly the same throughout the country, the US Midwest had the highest number of participants (n=7). Both the US Northeast and US West had

6 participants each. The US South region had 5 participants. No EHPs identified as working outside of the US. Most of the respondents answered no (n=14). Only 6 participants answered yes to being employed in a community with 50% or more racial and ethnic minorities. Four participants were unsure of their community composition.

There were 10 individuals who answered little racial and ethnic diversity (42% of respondents). Of the 10 respondents, 90% answered they did not work in a community of 50% or more racial or ethnic minorities. There were 7 participants (29%) that answered moderate racial and ethnic diversity and 7 participants (29%) who answered significant racial and ethnic diversity. Over half the participants (58%) felt that they worked in a racially and ethnically diverse workplace. 50% of the participants shared that their racial or ethnic background has no impact on their professional career. Of the 12 participants that answered no impact, 84% self-identified as Caucasian/White. 50% of participants selected their current workplace encourages diverse ideas and perspectives, while 29% of participants selected strongly encourages. The majority of participants (79%) felt like their current workplace encourages diverse ideas and perspectives. Only 8% of participants felt that their workplace discourages diverse ideas and perspectives. The remaining 13% of participants answered neutral.

50% of participants felt comfortable sharing their ideas with others and 33% felt very comfortable sharing their ideas with others. Only 8% of participants felt uncomfortable or very uncomfortable sharing their ideas with others, with 8% rated their level of comfort as neutral. Participants were also asked rate their level of agreement with the following statement: I feel comfortable standing up for what I believe is right at my current workplace. There were 12 participants (50%) who agreed they felt comfortable standing up for what they believe is right at their current workplace. 33% of participants strongly agreed with the statement. There were two

participants who either disagreed or strongly disagreed. They did not feel comfortable to share their ideas with others.

The majority of participants felt they were treated fairly and very fairly, 42% and 46% respectively. There were 2 participants (8%) who selected neutral and 1 (4%) who selected they are treated unfairly in relation to their peers. Of the 11 participants (46%) that answered very fairly, 91% of self-identified as Caucasian/White and Non-Hispanic/Latin American. Lastly, participants were asked to rate how their opinions and expertise were valued at their current workplace. Most respondents (n=19) answered their opinions and expertise were valued at their current workplace. Only 4 respondents answered their opinions and expertise were valued sometimes. The results of the two-tailed t-test indicated there was no significant difference between the minority (BIPOC) and non-minority (white) survey responses. The t-test results show there is no significant difference in the means. Minority (BIPOC) and non-minority (white) responses were similar, indicating there was no significant difference in their experiences as they relate to workplace diversity, race/ethnicity impacting their career, whether diverse perspectives are valued, if they felt included, workplace justice, whether they were treated fairly, and feeling valued in the workplace. Further analysis was conducted to determine whether there was a difference in the means of the responses for each group.

A one-way ANOVA was performed to compare the effect of race and ethnicity on participants responses. The mean responses for minority EHPs were slightly lower than the responses for non-minority participants for workplace diversity, career impact, diverse perspectives, workplace fairness, and workplace value. Non-minorities felt like their workplace diversity was neutral, their racial and ethnic background had no impact on their career, diverse perspectives were encouraged in the workplace, they were treated fairly in the workplace, and

their expertise and opinions were valued most of the time. The mean responses for minorities were slightly higher for workplace justice and inclusion. Minorities felt comfortable sharing their ideas with others in their workplace and standing up for what they believed.

Based on the results, there is no significant difference in the responses from the minority and non-minority EHPs on (1) the level of racial and ethnic diversity in their current workplace ($p=.969$), (2) the extent that their racial or ethnic background has impacted your professional career ($p=.079$), (3) whether their workplace encourages or discourages diverse ideas and perspectives ($p=.157$), (4) their level of comfort in sharing ideas with others in the workplace ($p=.799$), (5) their level of comfortability in standing up for what they believe is right ($p=.799$), (6) how they would describe their treatment in relation to their peers in the workplace ($p=.752$), and (7) whether their opinions and expertise are valued in the workplace ($p=.100$).

Discussion

The results of the qualitative component of this study show the diverse pathways that minority EHPs take to enter the field of environmental health and key recommendations to increase racial and ethnic diversity in the workforce. Many of the interview participants did not have a degree in public health or environmental health. Their educational backgrounds included degrees in biology, food science, environmental science, and related fields. Mentorship played an important role in developing minority EHPs. Mentorship was identified as a sub-theme in both the theme of education and that of positive and most rewarding experiences. Internships were influential for some participants because they gave them initial exposure to environmental health. For some participants, their internship motivated them to continue working in environmental health by giving them real world experience.

Interoffice relationships impacted minority EHPs in different ways. Some participants experienced negative and challenging interoffice relationships. Some participants were discriminated against because of their race, treated unfairly in relation to their peers, and experienced a toxic work environment. Although these experiences were identified as negative or most challenging, participants were not deterred away from the field. They persisted against those challenges and continued to find gratification in environmental health work. This was surprising, but encouraging to hear from participants. Interoffice relationships for some participants were viewed as their most positive and rewarding experiences as well. Participants described being in a supportive environment and feeling welcomed. The experiences they described showed how they felt valued and included in their workplace.

Mentorship was viewed as a positive and rewarding experience. This recommendation to increase diversity was not surprising because mentorship promotes career development. Mentorship allows students to learn from other professionals' experiences while obtaining additional knowledge through academic courses. Mentors may be aware of internship opportunities, can connect individuals with other EHPs, and help facilitate their professional development. A great example was one of the participants discussed how their college mentor recommended that they pursue an internship at the health department during the summer. During the summer, the participant learned about environmental health, shadowed other EHPs in the office, and was eventually allowed to conduct field inspections on their own. That participant was still employed with a local health department during the interviews. These valuable experiences help shape the next generation of EHPs.

Implications

The results of this study were consistent with a similar study by Boyapalli et al. (2023). There were four key similarities in the recommendations identified: funding, mentorship, and exposure to environmental health. One of the interview participants discussed funding and scholarships as a recommendation to increase diversity in environmental health. Funding can often be a barrier for students, especially minority students from low socioeconomic backgrounds. Recommendations from their research included funding such as guaranteed research funding and year-round stipends for graduate students. Mentorship was identified in this project and their research article. Interview participants from this research project discussed the importance of mentorship and how their mentors provided guidance to entering the field.

Lastly, the recommendation to introduce environmental health topics into broader disciplines and high schools mentioned in the research article was also a recommendation from an interview participant. This recommendation is important because many of the participants did not major in environmental health. Expanding into other disciplines would introduce them to environmental health and may encourage them to pursue a career in the field. Introducing environmental health to high school students would give them an opportunity to learn about environmental health and spark interest in the field. These students may take a more direct path into the field by majoring in environmental health and entering the workforce after graduation.

The results of this study suggest that programs targeting students in both college and high school, providing mentorship, and providing scholarships are recommended methods to increase racial and ethnic diversity based on recommendations from minority EHPs. Interview participants recommended recruiting from HBCUs and Hispanic institutions. Recruitment from these minority institutions can increase racial and ethnic diversity in environmental health. Eastern Kentucky University (EKU) and CDC formed the National Environmental Health

Diversity Recruitment Task Force (NEHDRTF). This task force determined these factors most important to the program's success. Targeted recruiting in diverse communities was a factor identified (Harper, 2007).

Conclusion

Despite the traditional lack of diversity in the environmental health workforce, this research highlighted the experiences of minority individuals employed in environmental health. Minority individuals who participated in the research study had a passion for the field despite the negative and challenging experience they faced. These individuals made many recommendations to increase racial and ethnic diversity in EH, including scholarships/funding, mentorship, internships, and recruiting at HBCUs and Hispanic institutions. Interview participants were encouraging to future minority EHPs. They advised them to find their niche among the many environmental health disciplines. Environmental health can be viewed as a calling. When pursuing a career in environmental health, it is crucial to remember the goal is to protect public health.

Environmental health exposure is vital to draw more individuals into the field. Students need to know that environmental health exists as a career choice and the pathway to becoming a professional. Advertising environmental health on television and social media could be helpful in recruiting minority EHPs to the field. Marketing at HBCUs and Hispanic institutions would give minority students exposure, as well as introducing environmental health to high school students. The earlier students are exposed to environmental health, the earlier they can determine whether this career path is a good fit.

Further research on this topic could include conducting additional qualitative interviews to understand if there are experiences and recommendations unique to specific minority groups.

For this research study, all non-white individuals were included in the minority group. However, examining African American, Asian, Alaskan Native, Pacific Islanders, Hispanic, and Native American EHPs individually may provide further insights. Since Alaskan Native, Pacific Islanders, and Native American EHPs are most underrepresented in research studies and surveys, it would be meaningful to know what experiences they would share regarding their initial interest in environmental health and recommendations.

Ultimately, the purpose of increasing diversity in environmental health is to ensure cultural competency since EHPs are community facing members of local, state, and federal health departments. Racial and ethnically diverse EHPs can provide insight into the culture and practices of the community. For example, consider food safety inspectors. In the food industry, there are a multitude of ethnic restaurants serving authentic cuisine. Operators speak various languages and perform an assortment of food preparation techniques that may be unfamiliar to an inspector who is not of that community. Food safety inspectors educate facilities on proper food safety practices and procedures. Operators are typically more receptive when they feel they can relate to the inspector and are more likely to implement long-term corrective action plans. The inspector may also find it easier to communicate food safety risks to the operator during inspections. These types of relationships are important for protecting public health and ensuring food safety.

CHAPTER 5: SUMMARY, IMPLICATIONS, AND CONCLUSIONS

Discussion

PH WINS and the EH Workforce

The data analyzed from the PH WINS was a valuable resource for developing a profile of the public health and environmental health workforce. PH WINS is the largest online survey of governmental workers in public health agencies. It was the first and is the only representative survey looking at the needs and interests of the governmental public health workforce (de Beaumont Foundation, n.d.). The data collected from the survey shows the overall public health workforce is still predominantly white; however, mostly women participated in the survey. Even among environmental health, the workforce is 64% white with almost 60% of the workforce identifying as women (de Beaumont Foundation, n.d.).

The findings from PH WINS differ from the UNCOVER EH (Understanding the Needs, Challenges, Opportunities, Vision, and Emerging Roles in Environmental Health) survey conducted in 2019. The UNCOVER EH gathered information from over 1,700 EHPs across the United States. The findings indicate the environmental health workforce is about half women and over 85% white (CDC, 2021b; Gerding et al., 2019). Native American, Pacific Islanders, and Native Hawaiians were underrepresented in both PH WINS and UNCOVER EH surveys and represented less than 5% combined. African Americans and Asians were the largest racial groups identified in both surveys. The data from both surveys shows that women have become more involved in environmental health. However, racial and ethnic diversity has not caught up to the increase in gender diversity within the workforce.

Reflections from In-depth Interviews

The background and experiences of the participants varied greatly. EHPs take diverse pathways into environmental health. Degree fields included microbiology, organismal biology, food science, public health, environmental science, environmental health, etc. This shows that having a degree in environmental health specifically was not a determining factor on whether a participant worked in the field. Most of the degrees were relevant to the field of environmental health and could be easily applied to an aspect of fieldwork or research. These findings support strategies suggested by Coronado et al. (2020). Their research suggests diversifying the educational pipeline and developing strategies to improve worker recruitment can improve workforce diversity (Coronado et al., 2020). Based on the diverse degree backgrounds from participants in the in-depth interviews of this study, implementing the strategies recommended in their article could have long term implications for increasing diversity.

There were several participants in the interviews who identified themselves as immigrants. They shared a different experience from the US-born minority EHPs. When asked about their negative or challenging experiences, EHPs who were not born in the US often did not view their experiences as negative. Some US-born EHPs discussed challenges with interoffice relationships and outright discrimination. Although these were challenging situations, they did not deter the participant from pursuing a career in environmental health or discourage their passion for the field. Despite any negative experiences that were mentioned in the study, participants found enjoyment and purpose in environmental health.

The in-depth interviews were insightful in identifying recommendations to increase diversity in the environmental health workforce. Recommendations included mentorship, scholarship, internship opportunities, marketing and advertisement, and recruitment at HBCUs, Hispanic institutions, and high schools. These recommendations were consistent with methods

used to increase diversity environmental health and other disciplines. Graduate students who participated in the research project conducted by Boyapalli et al. (2023) received similar recommendations from their interview participants. Recommendations identified in this study included financial support, mentorship, and introducing environmental health into other disciplines and in high schools (Boyapalli et al., 2023). These findings were similar to the recommendations from the participants in the in-depth interviews of this study.

Mentorship was considered a positive and rewarding experience for participants. Mentorship can help potential EHPs by providing guidance and promoting career development. Future EHPs can learn from the experiences of other professionals while attaining knowledge in academic courses. Mentors may be well connected in the environmental health professional community and share internship and scholarship opportunities with students. An example of this scenario came from one of the participants. Their mentor shared an internship opportunity with them at a health department. The participant was able to learn about environmental health and learn from other EHPs in the office by shadowing them conducting field work. Eventually, the participant was able to conduct field work independently and is currently employed with a local health department office. Mentorship can have a significant impact on the lives of minority EHPs pursuing environmental health as a career.

Perceptions from the Online Survey

The online survey aimed to identify differences in perceptions from minority EHPs and non-minority EHPs on diversity, equity, inclusion, and related topics. Although statistically, there was no significant difference between the responses for each group, there were a few interesting perceptions from the participants. Participants who shared their workplace has little racial and ethnic diversity worked in a community that was not considered a minority community.

Therefore, it may be possible for their office to resemble the communities that they serve. Most participants were comfortable at the workplace and felt that their workplace encourages diverse ideas and perspectives. Participants felt comfortable standing up for what they believe is right in their current workplace, indicating a strong sense of justice. Almost all the participants felt they are treated fairly in their current workplace and their opinions are valued. This suggests that participants are working in an environment where they are included and valued as professionals.

Implications for Environmental Health

This research project is the first of its kind to conduct qualitative interviews with working professionals in the US. Most of the research identified during the literature review focused on increasing diversity by interviewing students. This project explored the pathways of the working minority EHPs. Minority EHPs identified a pathway to an environmental health career and shared their career path during the interview process. Some entered the profession through education, mentorship, and internships. Some participants gained interest in environmental health because they saw the health disparities and environmental justice issues within their own communities. These insights were valuable to identify areas to focus recruitment efforts to increase racial and ethnic diversity in environmental health.

This research is unique because it is the only known study to examine the environmental health workforce from the PH WINS dataset. Data from PH WINS shows that the majority of the environmental health workforce is white. Jensen et al. (2021) identified white non-Hispanic individuals as the most prevalent racial and ethnic group in the United States. However, the population of the United States is becoming more and more racially and ethnically diverse. From 2010 to 2020, the census data indicated the has become more racially and ethnically diverse than

measured by the 2010 census (Jensen et al., 2021). With racial and ethnic diversity increasing, it is important to have an environmental health workforce that looks like the communities it serves.

This research project addressed commentary and research from environmental health leaders and researchers. In 1991, Walker published *Environmental Health and African Americans* in the American Journal of Public Health. Walker discussed how “far too few African Americans want, or are prepared, to pursue careers in sciences” (Walker, 1991). Based on the findings from this dissertation research, African Americans are degreed in various sciences and have a desire to work in environmental health. This shows a significant change from the 1991 article in which past perceptions, limited opportunity, and a hostile climate for science education and practice have been improved (Walker, 1991).

Additional commentary and research articles were published between 2006 to 2023. Mitchell and Lassiter (2006) discussed how the racial and ethnic composition of the nation was changing and that the health professionals needed to improve their efforts to create a culturally competent workforce. Increasing diversity would create positive change, could help overcome cultural and language barriers, and ensure the workforce and its leadership reflect the diversity of communities it serves (Harper, 2007). Walker and Spann’s 2008 article, *The Need for Diversity in Environmental Health*, furthered Walker’s previous commentary that in order to address the environmental risk factors that persist in poor and underserved communities, the workforce must include underrepresented minorities (Walker & Spann, 2008). Commentary written by past NEHA presidents in 2009 and 2020 both addressed the need for diversity within the workforce (Oliver, 2020; Roberts, 2009). In 2022, two articles were published in Environmental Health Insights addressing insights into diversity in the environmental health workforce and racial and gender diversity among students and faculty in Environmental Health Accreditation Council

(EHAC) programs (Balanay et al., 2022; Balanay & Richards, 2022). This research project contributes to the body of knowledge addressing diversity in the environmental health workforce, specifically racial and ethnic diversity.

Leadership Training in Environmental Health

When discussing the experiences of minority EHPs, discrimination was often coded with interoffice relationships. Unfortunately, the workplace environment was a source of discrimination for participants. The relationships were often described as discrimination from environmental health leadership towards an environmental health professional. There is an opportunity to turn these negative interoffice experiences into teachable moments and provide leadership training. Leadership training could include methods to address bias, diversity, equity, and cultural sensitivity within the workplace. While environmental health organizations are working to increase racial and ethnic diversity within the workforce, it is important to ensure minorities in the profession feel welcomed and valued as members of the team.

Challenges for College Admissions

Current efforts to increase racial and ethnic diversity in environmental health heavily involve reaching students at colleges and universities. On June 29, 2023, the Supreme Court ended affirmative action. Colleges and universities can no longer consider race, among many other factors, when determining which qualified applicants are to be admitted (Totenberg, 2023b). Since race can no longer be considered as part of the admissions process, colleges and universities will have to use other methods to admit racially and ethnically diverse candidates. Researchers Hamilton and Deng (2024) recommend focusing on socioeconomic status rather than race to promote equality of opportunity. The development of a new methodology to recruit

diverse candidates will be necessary for colleges and universities to ensure a racially and ethnically diverse student body.

Limitations of the Study

Participation in the online survey was a key limitation identified. The NEHA online community was launched earlier this year. Some members have not activated their account on the online community or members that have activated their account have not monitored it regularly. New posts are emailed out to members under the subject line NEHA member digest. Based on this, participation in the survey was relatively low in comparison to the total number of members. The insights of the participants are still relevant to the project and will be reported in Chapter 4 Results.

Timing was a limitation of the interview portion of the project. Due to the timing of the submission and IRB approval, in-person interviews could not be arranged during the 2023 NEHA AEC. The conference brought EHPs from across the nation together for professional development, presentation of research, and networking. That setting was ideal for discussing diversity in the workforce and gathering ideas. Although the interviews could not be conducted during the conference, the networking opportunities provided potential interview candidates.

The inclusion and exclusion criteria were significant limitations for the in-depth interview portion of the project. Since NEHA is nationally recognized, it was assumed that making NEHA membership a requirement would be beneficial to the study. However, this requirement greatly limited the number of individuals who could participate in the study using purposive sampling methods. Many individuals identified had either never heard of NEHA, had NEHA membership that lapse, or the cost limited them from joining prior to this research project.

Lastly, the sampling methodology could be considered a limitation to the study. Purposive sampling was used because it allows the researcher to intentionally select candidates meeting the inclusion criteria and can provide the most relevant information. This sampling method yielded data-rich interview data and was an efficient use of time and resources to identify participants. However, with this type of sampling, there is a potential for research bias and limited generalizability due to the sample size. Despite these limitations, the insights gained from this research project are meaningful.

Conclusions

This research aimed to develop a profile of the US environmental health workforce, examine perspectives and opinions regarding diversity equity and inclusion factors, and identify recommendations to increase racial and ethnic diversity in environmental health. The most recent data available shows the workforce is predominately white, but the field has witnessed an increase in women in environmental health. African American and Asians comprise the largest minority groups in environmental health. Native American, Native Hawaiian, and Pacific Islanders are underrepresented in workforce. Further research would be needed to identify specific strategies to increase their representation in the workforce.

Several recommendations to increase diversity in environmental health were identified through the in-depth interviews with minority EHPs. They included mentorship programs, internship opportunities, scholarship, advertisement, marketing, and recruiting at HBCUs, Hispanic institutions, and high schools. Potential environmental health candidates need opportunities to learn about environmental health as early as possible and have opportunities for growth and development while pursuing their education. Implementing these recommendations is likely to increase racial and ethnic minority participation in environmental health.

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Appendix A: UMC-IRB Notification of Exempt Certification (23-000275)



EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board
4N-64 Brody Medical Sciences Building · Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · rede.ecu.edu/umcirb/

Notification of Exempt Certification

From: Social/Behavioral IRB
To: [Maurica Bynum](#)
CC: [Gregory Kearney](#)
Date: 8/23/2023
Re: [UMCIRB 23-000275](#)
Increasing Racial and Ethnic Diversity in Environmental Health

I am pleased to inform you that your research submission has been certified as exempt on 8/22/2023. This study is eligible for Exempt Certification under category # 2AB.

It is your responsibility to ensure that this research is conducted in the manner reported in your application and/or protocol, as well as being consistent with the ethical principles of the Belmont Report and your profession.

This research study does not require any additional interaction with the UMCIRB unless there are proposed changes to this study. Any change, prior to implementing that change, must be submitted to the UMCIRB for review and approval. The UMCIRB will determine if the change impacts the eligibility of the research for exempt status. If more substantive review is required, you will be notified within five business days.

Document	Description
Consent to Participate in Research_v2.docx(0.01)	Consent Forms
Interview Guide v2.docx(0.01)	Interview/Focus Group Scripts/Questions
Introduction for Exempt Survey Research_v2.docx(0.01)	Consent Forms
Online Survey Link(0.01)	Additional Items
Online Survey Questions v3.docx(0.01)	Surveys and Questionnaires
Recruitment Script_v1 (2).docx(0.02)	Recruitment Documents/Scripts
Research Protocol - Increasing Racial and Ethnic Diversity in EH v3.docx(0.01)	Study Protocol or Grant Application

For research studies where a waiver or alteration of HIPAA Authorization has been approved, the IRB states that each of the waiver criteria in 45 CFR 164.512(i)(1)(i)(A) and (2)(i) through (v) have been met. Additionally, the elements of PHI to be collected as described in items 1 and 2 of the Application for Waiver of Authorization have been determined to be the minimal necessary for the specified research.

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418

Appendix B: NORC at the University of Chicago Exemption Letter (21-08-422)



Institutional Review Board Certification Exemption

Principal Investigator/Project Director: Elizabeth Allen

Department: Stats and Methodology

IRB Protocol Number: 21-08-422

Protocol Title: PH WINS 2019

Approval Date: August 27, 2021

This certifies that the research activities regarding human subjects in the protocol described above have been found to be exempt by the NORC Institutional Review Board (IRB00000967), under its Federalwide Assurance #FWA00000142, which is valid through July 19, 2023.

If not federally funded, the protocol described above has been found to be exempt, consistent with the exemption category/categories specified below, by the NORC Institutional Review Board (IRB00000967) in following the principles of the Belmont Report.

Exempt Category/Categories: 2

2. EDUCATIONAL TESTS (COGNITIVE, DIAGNOSTIC, APTITUDE, ACHIEVEMENT), SURVEY PROCEDURES, INTERVIEW PROCEDURES, OR OBSERVATION OF PUBLIC BEHAVIOR (INCLUDING VISUAL OR AUDITORY RECORDING): Research involving these procedures is exempt, IF one of the following is correct:
 - iii. Any information obtained is recorded by the investigator in such a manner that the identity of the human subjects CAN readily be identified, directly or through identifiers linked to the subjects, AND an IRB conducts a Limited IRB review to make the determination required by 45 CFR 46.111(a)(7) and the research is not subject to 45 CFR 46 Subpart D.

Any changes to this protocol must be submitted for review by the IRB as the changes may affect the determination.

Please notify the IRB when your study has closed.

A handwritten signature in black ink, appearing to read "Karen Grigorian".

Karen Grigorian

Appendix C: CEPH Competencies Addressed

This dissertation addressed foundational and concentration competencies outlined in the DrPH Environmental and Occupational Health (EOH) Handbook as required by the Council of Education for Public Health (CEPH). Of the DrPH foundational competencies, this dissertation addressed competency (2) design a qualitative, quantitative, mixed methods, policy analysis or evaluation project to address a public health issue, (6) integrate knowledge, approaches, methods, values, and potential contributions from multiple professions and systems in addressing public health problems, and (10) propose strategies to promote inclusion and equity within public health programs, policies and systems. This research study utilized a mixed methods research design that involved analyzing secondary data from PH WINS, conducting in-depth interviews, and conducting an online survey to triangulate the results. The results from PH WINS analysis provided the basis for the in-depth interviews and online survey by showing the makeup of the public health and environmental health workforce. Research was conducted on how other industries work to increase diversity in their workplaces. There was more research published on increasing diversity in public health and health care fields than environmental health specifically. Although the literature was not environmental health specific, it was still meaningful in identifying common practices to increase diversity. Addressing inclusion and equity could help increase diversity in environmental health. Organizations hoping to attract more minority students would benefit from offering scholarships, mentorship, and internship opportunities for individuals from disadvantaged backgrounds and working with HBCUs and Hispanic institutions.

The DrPH EOH concentration competencies addressed were competency (7) interpret results of data analysis for public health research and policy and (8) synthesize and evaluate

research on an environmental/occupational public health topic conducted by others. This dissertation involved a mixed methods approach requiring the use of various analytical techniques to interpret the results of the findings. There were both qualitative and quantitative results to interpret from analysis. Coding matrices used for the qualitative interviews were reported using a thematic table to highlight the key themes identified. This research required the interpretation of t-test, Chi-square, and ANOVA results to communicate the significance of survey responses as they related to the research question. The literature review allowed for data published by others to be synthesized and evaluated. Research studies and other relevant literature were identified through the review.

Appendix D: Interview Guide

Increasing Racial and Ethnic Diversity in the U.S. Environmental Health Workforce

Thank you for participating in this research project. We hope to learn more about what influences minority participation in the U.S. Environmental Health Workforce and how we can increase minority representation in the workforce. The interview will take approximately 30-45 minutes. I will ask several questions about your background and experiences and audio-video record the interview. You can stop the interview at any time. Do you have any questions before we proceed? So that I do not forget anything, I would like to audio and video record the interview. I want to make sure you are still okay with that. [Press record after response]

1. First, I would like to hear about how you became interested in Environmental Health.
 - a. What led you into the field?
 - b. What experiences influenced you to pursue EH?
 - c. Probe: Please tell me more about that.

2. Please describe the process of how you went about pursuing your career in Environmental Health.
 - a. What were some positive experiences along the way?
 - b. Did you have any negative experiences?
 - c. If so, what were those?
 - d. Probe: Please tell me more about that?

3. Since you began your environmental health career, what have been the most positive/rewarding/beneficial experiences?
 - a. Probe: Working relationships in the office and field, general job well done, and protecting public health
 - b. Since you began your environmental health career, what have been the most negative/challenging experiences?
 - c. Probe: Please tell me more about that.

4. I am also interested in your college background and experiences.
 - a. Was the program you graduated from accredited?
 - b. If so, by what accrediting body?
 - c. Did you have mentorship?
 - d. Did you receive any scholarships?
 - e. What would you say about the level of racial/ethnic diversity in your classes or among faculty?

5. If you had to give 3-5 recommendations to inspire racial and ethnic minorities to pursue a career in Environmental Health, what would those recommendations be?
 - a. Is there anything else you would like to add before we conclude?

Appendix E: Interview Demographic Questionnaire

Study ID: _____

1. Which of the following best describes your race (check all that apply)?
 - African American/Black
 - Asian
 - Native American/Alaskan Native
 - Native Hawaiian/Pacific Islander
 - White/Caucasian

2. Which of the following best describes your ethnicity?
 - Hispanic, Latino, or Spanish Origin
 - Non-Hispanic, Latino, or Spanish Origin

3. Which best describes your current age group?
 - 18-24 years
 - 25-34 years
 - 35-44 years
 - 45-54 years
 - 55-64 years
 - 65+ years

4. Which best describes how long you have worked in the US Environmental Health field?
 - <1 year
 - 1-5 years
 - 6-10 years
 - 11-15 years
 - 16-20 years
 - 21+ years

5. Which best describes your gender?
 - Female
 - Male
 - Transgender
 - Non-binary
 - None of these

6. Are you currently a student in environmental health, or a closely related field?
 - Yes
 - No

7. Which of the following NEHA credentials do you hold? (Select all that apply)
 - Registered Environmental Health Specialist/Registered Sanitarian
 - Certified Professional – Food Safety

- Certified Foodborne Outbreak Investigator
- Certified in Comprehensive Food Safety
- Food Safety Auditor
- None of the above

8. How long have you been a member of NEHA?

- <1-5 years
- 6-10 years
- 11-15 years
- 16-20 years
- 21+ years
- Not a member

Appendix F: Interview Recruitment Script (Email or Phone)

Dear Environmental Health Professional,

I am writing/calling to request your participation in a voluntary research study that is being conducted to better understand why racial and ethnic minorities enter the field of environmental health and increase representation in the US environmental health workforce.

The study is called “Increasing Racial and Ethnic Diversity in the US Environmental Health Workforce” and involves minority environmental health professionals (EHPs). During the interview, participants will be asked to respond to questions about their experiences leading up to a career in environmental health and while working in the field. The focus group discussions should take about 45-60 minutes and will be held virtually on Microsoft Teams.

The responses we receive from the participants will help us find ways to increase minority representation in the US environmental health workforce. To participate in the interviews, you must be at least 18 years old, have worked in environmental health in the US for at least one year, are a member of NEHA, and are a member of a racial/ethnic minority group.

We are writing/calling to evaluate your interest and recruit minority EHPs to participate in the virtual interviews as part of the study. We will not ask for personal information; your responses will remain anonymous. Study participants will receive a \$20 gift card at the end of the study.

If you would be interested in participating in the study, or have any questions, please contact Maurica Bynum by phone or email (757-556-9114 or bynumm20@students.ecu.edu).

Sincerely,

Maurica Bynum, MPH, REHS, CP-FS
Doctor of Public Health Candidate and Principal Investigator

Appendix G: Consent to Participate in Research

UMCIRB#: 23-000275

Principal Investigator: Maurica Bynum, MPH, REHS, CP-FS

You are being asked to participate in this research study. This research project aims to gain insight into minority participation and experiences in the US Environmental Health Workforce to increase minority representation. We seek participation from minority environmental health professionals (EHPs) to understand their unique experiences.

If you agree to participate in this research study, we would like to ask several questions to understand your experiences leading up to your career and experiences while working in the field. This information would help us better understand ways to encourage or facilitate more minorities entering the field of environmental health.

Participation in this project is voluntary and involves minimal risks. There is no direct benefit to you. The University and Medical Center Institutional Review Board (UMCIRB) at East Carolina University will oversee this project. Therefore, research data may be reviewed by UMCIRB members or staff. The information collected will not be linked to you and your responses will be kept confidential. To the extent permitted by university policy and governing laws, ECU investigators will collect, store, and maintain all provided data in a private and secure way. Publications of the data will include summary information. Your participation is voluntary. You may choose not to answer any or all questions. You may stop at any time for any reason. There is no penalty for taking part in this study.

If you agree to participate, the focus group interviews should take approximately 30 minutes. The interviews will be timed and recorded. You will receive a \$20 gift card at the end of the interview. We will not ask for any personal information. To remain anonymous, you will be assigned a study ID number during the interview.

If you have any questions or concerns about the project, you can call Maurica Bynum at (757) 556-9114. If you have questions regarding your rights as a study participant, you may contact UMCIRB at 252-744-2914.

Now that I have told you about the project, do you have any questions?

ID # _____ Date ____ / ____ / ____

Appendix H: Online Survey Consent Paragraph

You are invited to participate in a **research** study titled “Increasing Racial and Ethnic Diversity in the US Environmental Health Workforce,” conducted by Maurica Bynum, a Doctor of Public Health Candidate at East Carolina University in the Department of Public Health. The goal is to survey environmental health professionals of all racial and ethnic backgrounds to better understand their experiences. The survey consists of 24 questions. It should take 10-15 minutes to complete. This information will help us better understand the experiences and perceptions of environmental health professionals across the US. Your responses will be kept confidential, and no data will be released or used with your identification attached. Your participation in the research is **voluntary**. You may choose not to answer any or all questions, and you may stop at any time. There is **no penalty for not taking part** in this research study. Please call Maurica Bynum at 757-556-9114 for any research related questions or the University & Medical Center Institutional Review Board (UMCIRB) at 252-744-2914 for questions about your rights as a research participant.

Appendix I: Online Survey Questions – Insights from Environmental Health Professionals

1. Which best describes your current age group?
 - 18-24 years
 - 25-34 years
 - 35-44 years
 - 45-54 years
 - 55-64 years
 - 65+ years
2. Which best describes your race?
 - African American/Black
 - Asian
 - Caucasian/White
 - Native American/Alaskan Native
 - Native Hawaiian/Pacific Islander
 - Two or more races
3. Which best describes your ethnicity?
 - Hispanic/Latin American
 - Non-Hispanic/Latin American
4. Which best describes your gender?
 - Female
 - Male
 - Transgender
 - Non-binary
 - None of these
 - Prefer not to say
5. Are you currently a student in environmental health, or a closely related field?
 - Yes
 - No
6. Do you hold any of the following credentials? (Check all that apply)
 - Registered Environmental Health Specialist/Registered Sanitarian
 - Certified Professional – Food Safety
 - Certified Foodborne Outbreak Investigator
 - Certified in Comprehensive Food Safety
 - Food Safety Auditor
 - None of the above
7. Which best describes your current workplace region?
 - Midwest
 - Northeast
 - West
 - South
 - Outside of US
8. Are you currently employed in a community with a high population (>50%) of racial/ethnic minorities?
 - Yes

- No
 - Unsure
9. In your opinion, how would you rate the racial and ethnic diversity of your current workplace?
- 1 – No racial and ethnic diversity
 - 2 – Little racial and ethnic diversity
 - 3 – Neutral
 - 4 – Moderate racial and ethnic diversity
 - 5 – Significant racial and ethnic diversity
10. In your opinion, to what extent has your racial or ethnic background impacted your professional career?
- 1 – Very negatively
 - 2 – Negatively
 - 3 – No impact
 - 4 – Positively
 - 5 – Very positively
11. In your opinion, at what level does your current workplace encourage or discourage diverse ideas and perspectives?
- 1 – Strongly discourages
 - 2 – Discourages
 - 3 – Neutral
 - 4 – Encourages
 - 5 – Strongly encourages
12. How would you rate your level of comfort to share ideas with others at your current workplace?
- 1 – Very uncomfortable
 - 2 – Uncomfortable
 - 3 – Neutral
 - 4 – Comfortable
 - 5 – Very comfortable
13. I feel comfortable standing up for what I believe is right at my current workplace. (Please select your level of agreement with the statement above)
- 1 – Strongly disagree
 - 2 – Disagree
 - 3 – Neutral
 - 4 – Agree
 - 5 – Strongly Agree
14. In your opinion, how would you say that you are treated in relation to your peers at your current workplace?
- 1 – Very unfairly
 - 2 – Unfairly
 - 3 – Neutral
 - 4 – Fairly
 - 5 – Very fairly
15. In your opinion, how would you say your opinions and expertise are valued in your current workplace?

- 1 – Not valued at all
- 2 – Valued sometimes
- 3 – Neutral
- 4 – Valued most of the time
- 5 – Always valued