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The Positive Impact of Using an Asset-Based Approach in a Racial-Ethnic Centered Pre-Health Research Program on the Education and Career Goals of Undergraduates Underrepresented in STEM

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A thesis submitted in partial satisfaction of

of the requirements for the degree Master of Science

in Biology

by

Candice Cross

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ABSTRACT OF THE THESIS

The Positive Impact of Using an Asset-Based Approach in a Racial-Ethnic Centered Pre-Health Research Program on the Education and Career Goals of Undergraduates Underrepresented in STEM

by

Candice Cross

Master of Science in Biology

University of California, Los Angeles, 2023

Professor Paul H. Barber, Chair

The medical field calls for greater diversity in its physician workforce to promote more equitable healthcare and combat health disparities. The Howard Hughes Medical Institute-funded Diversity, Health Equity and the Environment Program at University of California, Los Angeles aims to increase major retention in underrepresented minority (URM) pre-health undergraduates to promote greater diversity in medical school applicants. Qualitative analysis of student interview responses on student program experience was conducted to better understand the impact of program participation. Students most valued the program's educational content, research experience, community, and mentorship, which advanced new and already present health-related career goals. The program offers a promising approach to increasing

representation in medicine through student-centered learning and cultural support in building science identity.

The thesis of Candice Cross is approved.

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The Positive Impact of Using an Asset-Based Approach in a Racial-Ethnic Centered Pre-Health Research Program on the Education and Career Goals of Undergraduates Underrepresented in STEM

Introduction

STEM fields have disproportionately low participation of individuals from underrepresented minority groups (URM: Black, Hispanic, Native American, Native Alaskan, Pacific Islander) compared to their composition in the U.S. population. For example, in 2020, Black Americans earned 9% of STEM degrees, despite making up 14% of the U.S. population (National Science Foundation, U.S. Census Bureau 2022). Similarly, Hispanics earned 17% of STEM degrees while representing 22% of the U.S. population (National Science Foundation, U.S. Census Bureau 2022). This lack of diversity in STEM leads to slower growth in these fields as diversity promotes a greater range of creativity and innovation.

Underrepresentation in STEM college programs is attributed to systemic barriers such as lack of access to opportunities due to the stereotype that URMs are less successful in STEM (Asai, 2020). Known as stereotype threat, this has negative impacts on student cognitive performance (Spencer et al., 1999; Steele & Aronson, 1995). For example, a study done on Black American males in engineering showed that many experience microaggressions from university advisors and instructors, discouraging persistence in STEM and damaging students' sense of belonging (Burt et al., 2019). Another study found that URM students subject to microaggressions feel pressured to leave behind aspects of their cultural or ethnic identity in order to be taken seriously (Mcgee, 2016). These negative experiences accompanied by a lack of ethnic or racial centered communities within STEM cause students to feel isolated in their fields (Malone & Barabino,

2009). Post-graduation, URMs still experience high rates of discrimination in their workplace. A study done by the Pew Research Center shows that in 2017, 62% of Black Americans and 42% of Hispanics report experiencing discrimination at work compared to 13% of their White counterparts (Funk & Parker, 2019).

To combat these discrepancies in representation, many programs have been created to increase diversity in STEM. At the university level, national programs such as Maximizing Access to Research Careers (MARC), the McNair Scholars Program, the Meyerhoff Scholars Program (Meyerhoff), and Louis Stokes Alliance for Minority Participation (LSAMP) mentor and guide URM and first-generation students through the process of research and graduate school applications, promoting the success of diverse, early-career research scientists (Baber & Jackson, 2018; Burt et al., 2023; Maton et al., 2000). URM undergraduates who participated in LSAMP reported that the program strengthened their communication skills and fostered a community of peers, graduate students, and faculty. These connections along with the simultaneous research experience resulted in greater STEM retention and strengthened scientific identity, with students using LSAMP as a stepping stone towards other research programs and graduate education opportunities (Burt et al., 2023). Similarly, Black American undergraduates who participated in Meyerhoff noted the minority peer and faculty community and research experiences provided greatly added to their success as science and engineering majors (SEM). Meyerhoff students exhibited greater SEM retention, higher GPAs, and higher rates of graduate school attendance (Maton et al., 2000).

Similar to STEM, the physician workforce lacks diversity (Bradley-Guidry et al., 2022; Campbell, 2021; Ibrahim, 2019). In 2021, The Association of American Medical Colleges (Association of American Medical Colleges) reported that 63.9% of practicing physicians

identified as White, 20.6% as Asian, 6.9% as Hispanic, 5.7 % as Black American, 1.3% as Multiple Race, 1.1% as Other, 0.3% as American Indian or Alaska Native, and 0.1% as Native Hawaiian or Pacific Islander. The demographics of medical school applicants lack diverse representation at 50.4% White, 26.7% Asian, 11.3% Hispanic, 10.7% Black American, 4.5% as Other, 1.0% American Indian or Alaska Native, and 0.4% Native Hawaiian or Pacific Islander in the 2022-2023 application period, contributing to systemic barriers to admissions (Association of American Medical Colleges).

As in STEM fields, many structural barriers throughout the pipeline hamper efforts to increase diversity in the physician workforce – including recruitment, applicant pool, reward structure as physicans, and standardized testing. Medical schools discount applicants based on disadvantaged backgrounds that attended schools and community colleges that are perceived as less rigorous (Talamantes et al., 2019). URM experience higher rates of racism, microaggressions, and imposter syndrome both in the classroom and at work (Rodríguez et al., 2015). URM physicians work more for underserved patients, doing work that is highly undervalued in the medical field towards job promotions (Rodríguez et al., 2015). While medicine acknowledges a need for increased diversity and makes efforts to reduce barriers by addressing standardized testing requirements and admissions criteria, it fails to make diversity a priority in admitting students and promoting physician success (Saha, 2014).

Just as great STEM diversity results in better science, greater diversity in the medical field produces better and more equitable care throughout the medical system. URM physicians are more likely to treat and serve URM and underserved communities (Rodríguez et al., 2015; Talamantes et al., 2019), leading to better patient-physician relationships and health outcomes as patients are more trusting of physicians from shared backgrounds, identities and lived

experiences and due to relatabilility more likely to trust and listen to health recommendations (Marrast et al., 2014; Muppala & Prakash, 2021; Saha, 2014; Talamantes et al., 2019). More diversity in medical students would also promote increased perspectives in their educational and training environments. This gives increased opportunity for medicine to evolve into a more open and understanding field, an important aspect in challenging racist outlooks and behavior (Saha, 2014). As such there is a strong need to diversify the physician workforce.

Despite the need for diversifying medicine, there is a general lack of programmatic efforts to support URM pre-medical students. For example, UCLA offers a myriad of STEM diversity programs to promote URM students in research careers – MARC, UC Leadership Excellence Through Advanced Degrees (I^2URP), Amgen, Beckman, and Clare Booth Luce Scholars Programs (University of California Los Angeles). These programs can be very successful—for example 72% of URM students in PEERS complete STEM degrees compared to 39% of other UCLA URM and 70% of White and Asian STEM majors at UCLA and pursue PhDs at a rate 7 times higher than matched controls (Sellami et al., 2021).

Although the success of research-focused programs provides a model for the support of pre-medical students, programmatic efforts focused on the support of URM students in higher education are quite limited, both in number, and in scope. For example, UCLA High Aims program supports approximately 20 students per year (aap.ucla.edu/programs/high-aims/). The David Geffen School of Medicine PREP program supports a larger number of students, but only for 5 weeks. Successfully promoting the success of URM students in their pursuit of medical school requires programs specifically geared towards the needs of URM pre-medical and pre-health students, including opportunities for health-related research, diverse mentorship,

networking exposure, and community building (Cameron et al., 2012; Vincent-Ruz et al., 2018; Yaffe et al., 2014).

The UCLA-HHMI Diversity, Health Equity and the Environment program (sites.lifesci.ucla.edu/eeb-hde/) launched in 2019 with the goal of increasing the success of UCLA pre-medical STEM majors and to provide a space and coursework that affirms their desire to pursue health care careers and to advance health equity. This study examines the impact of this program on students in the 2019-2022 cohorts, and identifies specific aspects of the HHMI program that students found most contributed to their career goals and aspirations.

I analyzed qualitative, audio-recorded survey data for common trends and themes in student program experience. I hypothesize that common trends will include a greater sense of community, preparation for their next steps in higher education, confidence as a researcher, identity as a scientist, and motivation to work with underserved communities.

Program Description

The UCLA-HHMI Diversity, Health Equity and the Environment program is a year-long (3 quarters) program that includes education on health disparities presented by a diverse network of public health and medical professionals, a collaborative research experience mentored by graduate fellows, and training in science communication. Students are encouraged to participate in the program starting in their sophomore year of college, but students from all college years are considered for program acceptance. The first quarter focuses on introducing students to the definition and importance of health disparities through weekly seminars or panels. To demonstrate the wide variety of career options applicable to interests in health disparities, each seminar is given by public health professionals who work in academic, research, and treatment

settings. Students are given the opportunity to ask questions about subject content as well as career paths throughout and following the presentations. The second quarter engages the students in an independent research project on a health disparity topic. Students are guided in conducting literature searches, developing research questions, experimental design, data collection, and analysis. During the third quarter, students are taught science communication skills to enable them to share their research in both professional and outreach settings. After graduating from the program, students are offered the option to continue their collaborative research for college credits to prepare their work for publication. Additionally, students receive individual college and career mentorship from the course instructors. The program operated in-person and transitioned to remote during the last quarter during 2019-2020, fully remote during 2020-2021, and hybrid during 2021-2022.

Methods

Interview Response Collection.

Interviews occurred at a program social gathering for three different cohorts (2019, 2020, 2021). We posted four interview questions next to an iPad, where students could record audio or video files of themselves responding to the questions on a voluntary basis. Student responses were not anonymous as they were asked to state their name and cohort year prior to answering the chosen questions. Prompts included four questions:

1) For you personally, what was the most helpful?
2) What did you learn that you didn't expect to learn?
3) What did you learn that might be helpful to you in the future, as a science student, citizen, or in your future career?

4) As a course offered in the sciences, can you identify a way (or ways) in which this course was uniquely helpful?

Interview Response Analysis.

We transcribed interview responses using Descript version 50.1.2 (Mason, 2021), separating responses of individual students and each question, as some students recorded responses to all questions in a single video. I read through all responses and coded them within the major categories of Education, Research, Community, Mentorship, and Career Goals, and then reread a second time to further separate into subcategories, giving each specific definitions to distinguish between areas of potential overlap (Table 1). Education was divided into *the definition of health disparities*, *guest speakers*, *science communication*, and *career options*. Research was divided into *the research process*, *outreach*, *literature research*, and *collaboration*. Community was divided into *support*, *class minority community,* and *working with URM community*. Mentorship was divided into *faculty mentorship* and *career goal mentorship*. Career Goals was divided into *medicine*, *working in public health*, *research*, and *working with the URM community*.

Researcher Positionality.

The primary author of this study identifies as a woman of color in STEM. The author greatly values the diversification of STEM and providing support for the persistence of URMs in STEM education. Additionally, the author aims to pursue a career in college-level teaching and use her position to increase undergraduate research opportunities that bridge academics and community scientists.

Results and Discussion

Results revealed five main themes regarding most valuable and impactful experiences from the program. Broadly, 21 students gave interview responses (out of the 69 total program participants) and made positive comments on 1) the course educational content, 2) their research experiences, 3) the program community, 4) mentorship, and 5) advancement of their career goals. Within the Education category, students valued learning about the definition of health disparities, learning from guest speakers, learning how to communicate science, and learning about various career options within public health and health sciences. Regarding Research, students specifically valued engaging in a complete research process, incorporating outreach into their research, learning how to conduct literature research, and collaborating on a study. Looking closer at Community, students valued the support offered by their peers, especially given the diverse demographic of the cohorts, and engaging with URM communities outside of UCLA. Within Mentorship, students valued getting individualized faculty mentorship and guidance on career goals. Lastly, looking closer at Career Goals, students found that the previous four components of the program advanced their career aspirations in medicine, public health, and research, as well as influenced them to place a greater focus on working with URM communities. Generally, STEM undergraduate programs that incorporate mentorship, research, and education, and encourage peer collaboration lead to greater retention rates, graduation rates, and career persistence in STEM fields (Baber & Jackson, 2018; Craney et al., 2011; Wilson et al., 2012).

Education

The broader Education category was defined as a student expressing positive feelings or comments towards content taught in the program's course classroom setting. Out of the total 21 students, 16 students made positive statements regarding educational content. Within comments on educational content, students specifically mentioned they valued learning about 1) the definition of health disparities (12 students), 2) the lecture content from guest speakers (6 students), 3) how to communicate about science (6 students), and 4) career options related to health disparities (5 students).

Health Disparities: Introduced and Defined.

Introductory material can be the most impactful component from the student perspective (Brady & Gallant, 2021). For most students who participated in the program, this was their first introduction to topics in public health and exposure to knowledge on health disparities. The course content helped to define and clarify how human health is tied into the environment and how this relationship can vary for different demographic populations. "It really helped me learn about how our environment is connected to our health," "I think the most helpful thing was being just introduced to what was health disparities," and "I learned from the health disparities program and… the definition of health disparities." "One thing that I learned in this class that was really helpful to me was just sort of looking at health disparities and also just taking more of… a public health perspective on things because coming into this, I did think about medicine and… biology is my major… but I hadn't had much exposure to public health and issues like health disparities." In alignment with the study by Brady & Gallant (2021), the novelty of the topic in comparison to their typical pre-medical curriculum made the course an even more unique addition to their undergraduate experience. It's important that students interested in

medicine or health-related careers are introduced to topics like public health early in their time at college to diversify their curriculum and give them relevant exposure to topics they are interested in. This can encourage them to persist in their STEM degrees past introductory courses (Vincent-Ruz et al., 2018).

Guest Speakers.

Another way to introduce students to the wide range of work done in a particular field is to incorporate guest speakers into the program, giving students access to professionals in the field with opportunities to ask questions and relate to professionals (Ilumoka, 2012; Liu et al., 2022). These interactions with guest STEM professionals have been shown to increase science identity and self-efficacy in students and exhibit real-world applications of in-class knowledge (Carrino & Gerace, 2016; Villasenor & Movahedzadeh, 2010). When guest speakers gave seminars on their work in public health, students found their presentations very insightful into the various arrays of topics that can be pursued with an interest in health disparities. “What I found really helpful about this program was getting to learn from an array of very diverse researchers and health professionals who served as guest speakers during our seminar and gave us insight about their own research and work pertaining to health disparities.” “What was most helpful for me was that I got to kind of see… what the other expert's research was like… I thought it was very useful to interview these individuals… to kind of get to see… their expertise… and like what they're working on.” “Listening to direct leaders in public health was something that was so impactful because I don't think that there's been a space on campus, or at least another organization that has allowed me the space.” Following the impacts of guest speakers seen in previous studies, making a variety of public health professionals accessible to students through

the HHMI program can increase their confidence in working as public health scientists (Carrino & Gerace, 2016; Villasenor & Movahedzadeh, 2010). Additionally, having this network available early in college can open additional opportunities for them as they continue their college education (Burns & Chopra, 2017).

Science Communication.

For college students, having a supportive environment of peers in STEM increases confidence, sense of belonging, and gives them a network, which helps to grow communication skills (Burt et al., 2023; Matyas et al., 2022). Students found that speaking in front of the same peer audience over the duration of the program added more comfort in developing their science communication and public speaking skills. “What was most helpful in the class was honestly working as a team and doing so many presentations really got rid of my fear of presentations and made it a lot easier to speak in front of the class and a lot more casual and much less stressful overall.” “What I found most helpful was that this was a year-long program and I think it really helped to foster like a community and really helped to… meet new people and be better able to communicate.” They also found it helpful that the program participated in campus opportunities, like UCLA’s Undergraduate Research Week, as part of their science communication practice. “What was the most helpful of this program was the… undergraduate research week. I just felt that it was just very insightful to know… how to structure a presentation for our research.” When students have the opportunity to share their work with the science community, it strengthens their identity as scientists (Wilson et al., 2012). These experiences also taught students to speak to a variety of audiences, ranging from informal classroom discussions to professional, academic settings. Having this flexibility in speaking skills is highly transferable and extremely important

for students interested in health-related careers, especially when speaking with patients or impacted communities (Sari et al., 2016).

Career Options.

In making different STEM pathways approachable and accessible in the classroom, students can gain greater confidence in pursuing the career of their choice (Burt et al., 2023). In the HHMI program, students valued learning about career options from the course and felt they gained knowledge on the variety of paths available for those interested in public health and health disparities. Through in-class discussions on careers, students felt that these career options were accessible and that they could each personally succeed in the field. “That taught me a lot more about the different careers, whether that be in research or also in healthcare, and how we all as students… in this cohort can be leaders as we venture on into our careers.” “It also gave me insight to like other careers… because I feel like sometimes you go in thinking that… going into medicine is like the only… health profession there is.” The program’s content also expanded student views on potential careers following graduation. Many undergraduates interested in health-related careers enter into college believing their degree is only applicable to pursuing medicine. Students identified this gap in the biology student body’s career knowledge and recommended that more UCLA students participate in the program to remediate this issue. “I just think the uniqueness of… being exposed to different disciplines could help students decide whether they want to go into public health, pre-health, environmental science, into public policy, or just see or just be introduced to different sciences and see if that sparks their interest.” Introducing students to career options earlier in their college careers allows for ample to time to adapt their upper division courses, college experiences, and post-grad plans to best prepare them

for their desired career (Liu et al., 2022). This program additionally prepares students to make these adaptations by pairing career introductions with personalized faculty mentorship (discussed later in the results).

Research

The broader category of Research was defined as a student expressing positive comments towards their research experience – specifically, in the context of their cohort's project that was often continued past the 3 quarters of the program. Out of the total 21 students, 12 students made positive statements regarding their experience conducting research. Within comments on research, students mentioned the importance of being exposed to 1) the process of conducting research (10 students), 2) incorporating outreach into research (4 students), 3) practicing literature research (3 students), and 4) collaborating on projects (1 student).

The Research Process.

Participation in undergraduate research increases retention, graduation, and pursuit of graduate school in URM through sustaining interest in STEM (Craney et al., 2011; Hathaway et al., 2002; Lopatto, 2007). Through research collaboration and group work, students can strengthen their presentation skills, ability to incorporate feedback, problem solving, and troubleshooting skills (Burt, 2017). In the HHMI program, students felt like they gained a greater understanding of the research process through a personal, hands-on experience offered by the program. "Being able to kind of pinpoint and come up with…, research ideas and delve deeper into it… it was very, very helpful. I think just going through the entire research process from scratch… developing questions, developing surveys… targeting a demographic, collecting

responses, and… analyzing the responses, the data that we have, and then drafting a paper… being able to see that happen… firsthand was extremely helpful because now I have a better understanding of the process, the time, and kind of the group work that goes beyond developing a scientific research paper." When students feel like research is a more transparent process, it can better inform their decisions and prepare them to pursue graduate school and research careers after graduation (Seymour et al., 2004).

The opportunity to continue the research project longer-term (after a minimum of 3 quarters) is also more effective in building science identity compared to short-term participation. This allows students to ask questions they are interested in, develop a project, interpret data, relate it back to their identity as a scientist, and then take on characteristics of a confident researcher (Burt, 2017; Linn et al., 2015). The class format stresses to students that research is a long and collaborative process that can require multiple rounds of fine tuning and troubleshooting. "The research project itself, just like all of the details and all of the effort that goes into it, that needs to go into it in order to make it perfect." "I felt like this was a really valuable experience for myself and for my group members to learn a lot about… research and specific to… deploying the air monitors and just the research method." When students are engaged in the long-term nature of research studies, they can better witness their growth and progress and scientists, increasing their confidence and success in post-undergraduate education (Gilmore et al., 2015; Russell et al., 2007).

Outreach.

When students are from communities that witness or experience health disparities more often, they find high value in the ability to make an impact on society with their work (Craney et

al., 2011; Garcia, 2022; Talamantes et al., 2016). Students found an important aspect of research was making a difference for the communities that were being studied and impacted by environmental factors. “Being able to give these people information on just what air quality is and what they can do to… help change it.” Students find it important to empower the participating community with the revealed knowledge so they can make healthy changes in their lives. Connecting student research studies to their respective communities can also motivate students to engage in future research or participate in careers that focus on minority communities. “I think outreach… makes a big difference in really empowering these people… with knowledge. I think… even within our research, we saw some results where… after we kind of educated them on what PM 2.5 was, we saw changes in their behaviors.” The HHMI program takes a unique, community-minded approach to research, showing students the value of working with local populations and developing a mindset early in scientists that positive impacts on society increase research relevance (Garibay, 2018).

Literature Research.

Three students valued getting experience reading and navigating scientific literature. Through the cohort-centered independent projects, students gained skills in reading and critiquing peer-reviewed research articles, and in relating them back to their own study. Students identified this as a skill useful for future courses they might encounter outside of the program. “Specific guidance with the research itself. Definitely got more experiences with researching, like just literature research.” “Something… that I learned in this class that I feel could be applicable or useful in other life science classes is… learning how to read… research papers and… learning how to critique them.” This program allows students to be exposed to important research skills,

like reading literature, prior to taking upper division courses, setting them up for a more successful experience in those courses and positioning them as more competitive medical school applicants (Vincent-Ruz et al., 2018).

Collaboration.

Program pedagogy emphasizes group research projects because it fosters a STEM environment that teaches students how to coordinate a study with others and promotes development of individual student strengths (Burt, 2017; Burt et al., 2023). Evidence for such gains come from one student that commented how collaboration was important in building their problem-solving skills and adaptability, "…something I think that was the most… helpful thing that I learned throughout this program was how to work with others and how to problem solve when things don't go to plan." Additionally, the program uses an asset-based approach and structure that promotes collaboration between diverse individuals. These program aspects encourage students to draw upon personal experiences and view them as strengths and motivators to their work (Burt et al., 2023). Students are taught the value of their own individual experiences as well as others' and that they succeed *because* of their backgrounds, rather than *despite* their backgrounds. Through this, they learn to engage with a variety of collaborators, leading to more diversely led studies in the future.

Community

The broader category of Community was defined as students expressed a positive association with communities involved in the course. Out of total 21 students, 8 students made statements regarding the course community. Within comments on Community, students mentioned the

importance of 1) support from the classroom community (6 students) and 2) engaging with the URM community (3 students).

Support from the Classroom Community.

Meeting with a smaller, consistent subset of students for a whole academic year (or longer) can give the participating undergraduates a peer support system and sense of community, which is often lost at larger universities (Brady & Gallant, 2021; Hathaway et al., 2002). Students felt like the cohort gave them a consistent group of peers and friends that they could connect with over the 3 quarters and beyond. “HHMI has given me a family that I didn't know that I needed.” “Like feeling the support… getting to work together was just very helpful in terms of like not even just getting more involved in research and like being more open to opportunities, but also… feeling more comfortable in the environment that we were in.” This kind of environment was stabilizing and positive for students, especially during a time when students had to attend many classes from home. “Having some consistency after the year of being alone that that was really nice and the class was so supportive and having to… go to the class of the same people every single week and every single quarter was just really, really great for my mental health, honestly. And knowing that…I didn't have to like, worry about if I was gonna see these people again.” The program incorporates an important social aspect to students early in their college careers, offering them the opportunity to network and build relationships with students studying similar topics (Johnson, 2011).

Additionally, undergraduates benefit from participating in racial-ethnic centered programs, especially on campuses or in academic fields, like STEM, where they combat racial tension and underrepresentation(Hurtado & Carter, 1997). Having support from “like” communities in

college is important for URM students, as it gives them spaces where they can embrace their cultural identities (Burt et al., 2023; Jehangir et al., 2023; Mcgee, 2016). In the case of the HHMI program, the support from URM peers also frames these cultural identities as strengths in their roles as scientists. One student elaborated on the support received in the classroom saying, "getting involved with more students, like minority students of like the same background or similar background as mine" was valuable. This comment shows that an additional positive aspect of the class community was that students in the cohort shared similar ethnic and social backgrounds, offering students a safe learning environment and cultural support from their peers (Morton, 2021).

Researched Underrepresented Minority Community.

URM studnets are often motivated to pursue medicine after having first-hand experiences with health disparities in their families and communities (Talamantes et al., 2016). Students liked that the study topic of the program and the independent research projects engaged them with URM communities outside UCLA, specifically ones in which they grew up or have friends. "I feel like there's not a lot of research that like focuses on like communities… like that where I come from, like underserved communities. So, it was really nice to be able to get like participants that… were from… our communities and really seeing… the environment really impacts these people on, on like a daily life." Students were also more engaged in and passionate about their research because it involved their home communities and public health concerns they have seen or experienced personally. "I think it's the most… effective in communities when you're from the community and you are active participant also within the research… Very, very unique experience with… the HHMI program." "Specifically working with minority

communities, you like, wanna obviously put as much effort as you can into it… I thought we're kind of passionate about it as well." By working within their own communities, students can build their identity as scientists from their respective neighborhoods, allowing them to acknowledge their roots and its importance in conducting impactful research (Herrera & Kovats Sánchez, 2022).

Mentorship

The broader category of Mentorship was defined as students expressing a positive experience with course-related mentorship. Out of the total 21 students interviewed, 4 students made positive statements regarding the mentorship offered in the program, which was given outside the traditional classroom setting and class times. Within comments on mentorship, students mentioned that they valued 1) mentorship from the course faculty (5 students) and 2) personalized mentoring on their future career goals after college (2 students).

Faculty Mentorship.

Individual mentorship from course faculty results in a greater sense of belonging in STEM and the campus as students feel ensured that faculty know their names and stories (Hurtado & Carter, 1997). This is especially valuable given the large size of most lower division courses at large universities, where professors are not afforded the opportunity to engage equally with all students. Faculty mentorship increases the likelihood of further STEM participation, persistence, and high achievement (Burt et al., 2023; Cole & Griffin, 2013; Craney et al., 2011). Students who feel supported by their faculty build stronger identities as scientists, develop improved critical thinking skills, and are more likely to attend graduate school after college (Hathaway et

al., 2002; Linn et al., 2015). In the HHMI program, students liked that program faculty (Professors Paul Barber and Jeannie Barber-Choi) took the time to meet with each of them outside of the classroom and discuss their personal needs and aspirations. “Making sure that every student had all the resources that they needed, as well as constantly correcting our work and giving us feedback.” “The intimate relationships that I can build… with those people and also with Professor Barber and Jeannie.” This personalized mentorship with the program faculty gives students the comfort in knowing that they have faculty support in their college journey, professors who know them, and that they can return to for advice after the course ends. It also ensures that students have strong connections with the faculty, essential for impactful reference letters.

Career Goal Mentorship.

Career coaching from mentors can help fill gaps in previous career preparation, especially where students have not yet been exposed to particular professions (Linn et al., 2015). Additionally, students who associate their research faculty connections with career guidance often utilize these mentors for job reference letters later on (Hathaway et al., 2002). Within our program, students found that career mentorship from the faculty was greatly helpful in directing them toward specific pathways. “And also, Paul and Jeannie's unique mentorship and advice, even with like career decisions… and just life advice in general. They've been so helpful to me… narrowing down which fields I wanna go into.” “What I didn't expect to get from this course… this program is the personal touch… especially outside of, of this class in general… we were able to have a mentor… in the form of Dr. Barber and Jeannie, who helped us through… the entire, you know, career process… mentored us through what, what it's like… some of the steps

that we're taking and being able to just have someone to talk to was extremely helpful. so being able to… have someone…I can go to for career advice and… maybe some guidance was, was extremely… helpful to me.“ While the course content exhibits the wide variety of career options in health related science, individual mentorship is important in demystifying career pathways and helping students identify the aspects of each career path that they are most drawn to, based on their individual interests and preferences (Zydney et al., 2002).

Career Goals

The broad category of Career Goals is defined as a student expressing that the course has contributed positively to their career goals looking to the future, often through the avenues of education, research, community, and mentorship mentioned above. Out of the total 21 students interviewed, 9 students made positive statements regarding their career goals. While many students had initial career goals already established before the program, those students mentioned that the program added to and strengthened their already present interests. Within comments on future career goals, students expressed they had interests in pursuing careers in 1) medicine (5 students), 2) public health (3 students), and 3) research (1 student), and that they wanted to 4) incorporate URM communities into their work (1 student).

Medicine.

Programs that offer social, academic, and career support to pre-health majors increase student success and result in higher rates of medical and health-related graduate school attendance (Morgan et al., 2016; Soto-Greene et al., 1999; Winkleby, 2007). Students in the HHMI program who had goals of pursuing a career in medicine before entering the program noted that the

educational content of the program showed them how health disparities are connected to the medical field. “From this I was able to see, wow, this is what health disparities were, and… also connected to my medical career that I wish to aspire in the future.” One student even noted the importance of increasing the accessibility of healthcare, an issue that perpetuates already existing health disparities. “Something that I will take away from this experience is just being able to understand that healthcare is not accessible. Being an aspiring physician one day, I want to make sure that healthcare is accessible to those who do not have the education to pursue it, let alone understand it.” These comments show that students who were initially interested in medicine before the program gained new motivations for pursuing their medical careers, which can strengthen their persistence through college and beyond. This motivation to focus on the status of healthcare in underserved communities is essential in combating health disparities as it frames it as an essential aspect in working in and providing healthcare (Garcia, 2022).

Within these holistic pre-health support programs, students have identified that faculty mentorship can be the most impactful towards career persistence in medicine (Morgan et al., 2016). In the HHMI program, one student noted that the support gained from the faculty mentors and peers in the cohort encouraged them to return to pursuing medicine. “And has pushed me to be, to push myself… in the health field, in both public health and also to pursue medicine again… I remember that I had some really tough conversations about possibly, you know, leaving the journey of going into medical school, and this cohort brought me back to that.” This comment shows that participation in the HHMI program can help to decrease the “leaky pipeline” present in URMs pursuing STEM careers. Having a community of peers from similar backgrounds can offer support by acknowledging specific struggles that minority students face in

STEM fields and emphasizing the value of their backgrounds in transforming their field (Gasman et al., 2017).

Public Health.

When students have the opportunity to participate in programs geared towards their future interests, they gain more confidence in pursuing the next step in higher education (Brady & Gallant, 2021). Within the program, students who previously were unaware of health disparities or career options in public health showed a newfound desire to incorporate public health into their future career plans. “It also sparked my interest in wanting to get my master's in public health eventually.” “Nobody really knew what it was and just being introduced to it led to my interest into public health, and I'm hoping to go into a Master of Public Health. Either before med school or during med school. So that was something that I loved because of what I was introduced to through the program, finding out what public, what health disparities was.” Additionally, introduction to public health topics aided a student already interested in the field prior to the program. “These are all things that I, we touched on in my MPH program. And so already having had that prior knowledge and experience from this class wasn't something that I even expected… it was so helpful and it honestly helped me transition into graduate and professional school so much easier.” These comments show that participation in the HHMI program leads to new interests in pursuing higher degrees in public health and that the rigor of the program greatly prepares students for post-college degree programs.

Research.

An introduction to research through an undergraduate program can spark an interest in pursuing a career in research (Linn et al., 2015). Programs like this that do not require prior research experience can be helpful in offering research experience at universities where lab openings are scarce and competitive. It can also give students research experience that qualifies them for future research positions in college or after (Espinosa, 2011). As most students in the course were biology majors, which operates as a major within UCLA's Ecology and Evolutionary Biology Deparment, they were primarily exposed to labs conducting non-health related biology research (e.g., topics in ecology or evolution). The HHMI program offers a unique opportunity to pre-med and pre-health students in the major by introducing them to research through relevant studies applicable to their career interests, filling a needed gap in the department and reducing the major's structural barrier.. "They really helped in establishing like by having, um, different guest speakers talk about different types of research and they, it really helped in figuring out the different steps of the research process. And it just really did help to, um, kind of introduce me to research and kind of made me see like, um, make sure that this is something that I would wanna go into." Exposing students to hands-on, real-world experience in their field of interest keeps students excited about their future career options in STEM and can introduce new ones (Villarejo et al., 2008).

Careers Working with URM Communities.

Exhibiting to students how they can blend their passion for their communities with their career goals increases motivation, persistence, and sets a foundational mindset for their careers (Jehangir et al., 2023). As a result of the HHMI, participating students place greater value on working with URM communities in their future career. They found importance in incorporating

URM communities into their career through working with URM communities in their research project and in having the opportunity to give personal input into the topic of their study. “So, I think something that I learned that I feel like I will continue learning with throughout my career in medicine is just the importance of having, um, the communities, um, input an opinion into research.” When students are exposed to this mindset in their undergraduate courses, it establishes a strong foundation for their future careers – both in a community-aimed framework and interdisciplinary habits. Additionally, when students gain a better understanding of how science impacts society through college experiences, they are more likely to conduct societally meaningful research after graduation (Garibay, 2018).

Limitations

The broad-scale implications of this study are limited by the volunteer aspect of the study participants as well the number of participants (21 students volunteered out of the total 69 who participated in the program over the surveyed 3 cohorts) (Alsaawi, 2014). In addition, each cohort experienced a different program structure as a result of the COVID-19 pandemic, including hybrid (2019, 2021) and fully online (2020), and students who volunteered their responses could have come from any of the 3 different cohorts (as each experienced a different program attendance structure). The open-ended nature of the survey questions, option to answer any or all questions, and absence of questions inquiring about non-helpful program aspects can also create bias in the most valued aspects of the courses when compared relatively to each other. Lastly, the lack of a pre-program interview or other input data could portray an overconfident picture of the characteristics of students that exit the program, as there could be bias in the characteristics of students who chose to participate in the program (Adelson, 2019).

Considering these limitations, we believe that the qualitative nature of the study and coding of student responses still clearly portrays specific positive gains from program participation. Additionally, many responses identified unique aspects of the program in the context of all other offerings at UCLA, exhibiting how the program's structure and focus can still contribute to a large, highly ranked university with well-established STEM departments.

Conclusion

Student interviews revealed that the UCLA-HHMI Diversity, Health Equity and the Environment program offers valuable educational content, research experience, community building, and faculty mentorship for STEM undergraduates. The student-centered approach additionally increased interest and passion for the research projects. Considering the positive impacts on STEM retention and career development these components have been shown to have in other programs, UCLA's HHMI program shows promise in having similar effects on students interested in health-related careers.

Establishing a racial-ethnic centered campus community for URM students interested in health careers acknowledges student-lived hardship and the obstacles they face in entering the field. The emotional and mental support these students gain from the community can help build their confidence as scientists, showing them that their unique backgrounds are an asset to the future of medicine and healthcare. This program aspect also helps them build a highly relatable network of students, faculty, and professionals – giving students a smaller, relevant community within a large university. By connecting students to a wide range of UCLA health professionals, the HHMI program demystifies the various pathways towards health-related careers. The exhibition of these various pathways along with the course content also places medicine and

health interests in a more interdisciplinary framework, showing how these topics connect to environmental factors (topics more often studied in Ecology and Evolutionary Biology department where the course is offered) and how they can be pursued through graduate school, medical school, or both. Given the absence of a consistent URM health career program on campus, the HHMI program offers a new space to prepare URM students to be competitive applicants to medical school, public health programs, and other healthcare job opportunities.

Centered around the student-lived experience, the program also answers healthcare's call for a more community-focused approach to studying and practicing medicine. It builds a strong foundation that encourages students to prioritize caring for underserved communities. Establishing this mindset before students apply to medical and graduate school can positively influence the opportunities and projects they choose to pursue later in their education and careers. Additionally, when students experience educating their home communities on health issues, they feel like they can empower their communities. This also encourages URM students to be proud of being scientists from their communities, attributing a portion of their science identity to their unique backgrounds.

The HHMI program takes an asset-based approach to supporting URM pre-health students, challenging the traditional outlook on diversity in medicine that has too often emphasized how students have succeeded *despite* their backgrounds. This program emphasizes that students are successful as researchers and doctors *because* of their minority backgrounds. It places less emphasis on grades and traditional measures of "intelligence" and instead focuses on skills in collaboration, troubleshooting, problem-solving, and communication – all of which are transferable to careers in medicine and advance medical school learning environments. Through practicing science communication in the program, the students witness the value of URM

scientists educating URM communities. This makes them more impassioned to practice this in their careers, promoting the trustworthiness of healthcare for URM patients.

Overall, the UCLA-HHMI Diversity, Health Equity and the Environment program takes a highly effective approach to increasing URM persistence in health and medical-related careers. Its support promotes URM student success in pursuing higher education and imbues them with values necessary to increase diversity in medicine and combat health disparities.

Figures and Tables

Table 1. Student Response Categories. Categories, subcategories, and the definitions of each generated from coding student interview responses.

Category	Definition	Subcategories	Definition
Education	Student expressed positive comments towards content taught in the classroom/course setting	Definition of health disparities	Student valued learning what health disparities are and why they are important
		Guest speakers	Student valued instruction and content of guest speaker lectures
		Science communication	Student valued learning how to communicate about science ideas and their research
		Career options	Student valued learning about career options from the course
Research	Student expressed positive comments towards their	The research process	Student valued learning the process and steps to conducting research

	research experience and cohort-specific project	Outreach	Student valued incorporating outreach into their research project
		Literature research	Student valued getting experience reading and navigating research literature
		Collaboration	Student valued working with others to develop research
Community	Student has expressed positive comments on communities involved in the course	Support	Student felt they gained support from their cohort of classmates
		Class minority community	Student valued having URM classmates
		Working with URM community	Student valued working and engaging with URM communities through the course research
Mentorship	Student expressed positive comments on program-related mentorship	Faculty mentorship	student valued mentorship specifically from course faculty
		Career goals	Student valued getting personalized mentorship on career-related topics
Career goals	Student has expressed that the course has contributed positively to their future career goals	Medicine	Student has expressed interest in a medical career
		Working in public health	Student has expressed interest in working in public health post college
		Research	Student has expressed interest in a research-related career
		Working with URM community	Student values the idea of working with URM communities in their future

			career as a result of the program

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