Public Health Workforce Diversity: The Role of Academic Institutions

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Introduction

The U.S. population has become increasingly diverse. It is estimated that minority groups[i] will constitute 50% of the U.S. population by 2026.[1] Despite improvements in health indicators, racial and ethnic disparities remain a public health challenge. These disparities were further exacerbated by COVID-19, which brought to the surface structural racism that widened the gaps in access to care and health outcomes, disproportionately affecting racial and ethnic minorities.[2,3] A racially and ethnically diverse workforce can be instrumental in addressing these existing disparities.[4,5] Diversity is a key indicator in workforce development, and there is widespread agreement that more diverse and representative workforces can better serve diverse populations.[6,7] Yet, the public health workforce employed in the public sector at state, federal, and local health departments is not diverse and is underrepresented racially and ethnically at supervisory and managerial levels. For example, the Public Health Workforce Interests and Needs Survey (PH-WINS) suggests that the workforce in the public sector is not representative of the nation, where 59% of the workforce is White compared to 16% Non-Hispanic Black and 13% Hispanic workers.[8,9,10] Additionally, evidence suggests that shortages in the public health workforce employed by the public sector may be understated as approximately 22% of staff plan to retire by 2023 and 24% consider leaving their organization for reasons other than retirement in the coming year.[11] While this can further strain the already over-burdened public health workforce, it creates an opportunity to build a more diverse future workforce that represents the changing population demographics.

The lack of diversity can occur due to a myriad of factors, including the underrepresentation of marginalized groups in the public health care education pipeline. While there has been substantial growth in the degrees conferred in public health, the growth of Black and Hispanic graduate students enrolled in public health programs, and tenured faculty in public health has not shown a similar increase.[12,13,14] Additionally, the 20-year increase for graduate student enrollment is less than five percentage points, and among tenured faculty has been less than three percentage points for Black, Hispanic, and Native American groups.[15] Increases in racial/ethnic diversity among students, graduates, and faculty in schools and programs of public health can contribute to parallel increases in racial/ethnic diversity in the public health workforce. Therefore, policies to improve the diversity of the workforce are generally focused on diversifying the educational pipeline through complex transformations of the education system.[16] Institutions of higher education play a significant role in prioritizing admission strategies to recruit public health students with diverse backgrounds and offer an environment with strong mentoring, advising, and skill development. However, little is understood about institutional-level diversity, recruitment, and retention of students from disadvantaged groups. Evaluating student diversity at U.S. colleges and universities is important, timely, and socially relevant. Decisions about student admissions are made at the institution level. It seems logical that different colleges and universities have different profiles and can impact the diversity of the student body.[17] However, existing research has focused on the benefits of diversity in a university context, barriers to increased diversity, ways to increase and maintain diversity, and, more recently, the importance of ethnic and cultural diversity to regional economic growth and innovation.[18] Little research has focused on quantitative measures of student diversity. While diversity can be understood as heterogeneity of the student/faculty bodies in several dimensions: class, race, ethnicity, and sexual identity, this paper defines diversity in terms of race and ethnicity.

The study's objectives are two-fold: first is to create an institutional-level Diversity Index (DI) by comparing the diversity of public health graduates to the diversity of the U.S. population between the ages of 20 and 35, the general age of graduates of public health.[19] The second objective is to evaluate the relative contributions of institutional characteristics such as for-profit status, geographic location,

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[i] Non-Hispanic Blacks, Asians and Pacific Islanders, Hispanic/Latinos, American Indians and Alaskan Natives, and individuals who are two or more races

urbanicity, and faculty diversity to the student body diversity at the institutions providing public health education. The findings from this study will provide a data-driven strategy to track the diversity at the institutional level using a DI and explore the factors associated with increased diversity in the educational pipeline to help inform future investments and recruitment and retention strategies. The DI, a diversity statistic, will potentially enable cross-comparison of higher public health education institutions in the U.S. It will also provide a diversity "benchmark" that compares student body composition to the institution's catchment or service area.

Methods

Our primary data is from the Association of Schools and Programs of Public Health (ASPPH), which contained information on its former and current members (i.e., schools and programs of public health) for seven academic years from 2014-2015 to 2020-2021. In this dataset, as of April 10, 2022, except for six schools that applied for accreditation by the Council on Education for Public Health (CEPH), all other schools were CEPH-accredited institutions. The ASPPH data had unique advantages. It had information about the composition of students for each stage of the student lifecycle, from applications to acceptances, enrollments, and graduates. In addition, it contained information about the racial/ethnic composition of faculty members affiliated with each public health school or program. The data consisted of three datasets: 1) the composition of the student body, 2) the composition of faculty, and 3) institutional characteristics. The first dataset recorded the composition of the student body by head counts of students in each of all possible combinations of student characteristics for each stage of the student lifecycle in each degree level (bachelor's, master's, and doctoral) for each ASPPH member school/program in each academic year. The student characteristics included demographics (gender, race/ethnicity group, and citizenship), the area of study, and the degree delivery type (campus-based, distance learning, and executive format). The second dataset included the composition of the faculty by headcounts and full-time equivalent (FTEs) faculty members in each possible combination of faculty characteristics for each ASPPH member school/program in each academic year. The faculty characteristics included demographics (gender and race/ethnicity group), the area of study, and the academic title. The third dataset had institution-level characteristics, such as zip codes, ownership, and institutional type (public health program or school of public health). We also used additional datasets to complement the ASPPH data. First, we used the American Community Survey (ACS) 1-Year Data from 2016 to 2020 to estimate the population diversity in the state where each ASPPH member was located. Second, we used the 2010 Rural-Urban Commuting Area Codes (RUCA) Zip code file from the U.S. Department of Agriculture (USDA) to determine the rurality of the ASPPH members with their zip codes. Finally, we used data from the Integrated Postsecondary Education Data System (IPEDS) of the National Center for Education Statistics (NCES) to cross-validate the consistency of the institutional characteristics in the ASPPH data over time and to obtain additional institutional characteristics, such as an indicator for historically black colleges and universities (HBCUs).

We first aggregated the data file for the student composition to the ASPPH member level in each academic year for each stage of the lifecycle of students in each degree level. Next, we merged it with the faculty data file, aggregated to the ASPPH member level in each academic year and with the institutional characteristics of each ASPPH member. Then, we merged it with the state-level racial/ethnic diversity estimates from the ACS data, the rurality flag from the U.S.DA RUCA data, and other institutional characteristics obtained from the IPEDS. Finally, we applied three exclusion criteria to construct our analytic sample: 1) schools/programs with a total number of domestic students less than ten, 2) school/programs where 50% or more of the total domestic students did not specify their race/ethnicity, and 3) schools/programs where 50% or more of the total full-time equivalents (FTEs) of the faculty did not specify their race/ethnicity. As a result, our analytic sample for trend analysis had 1,088 observations from 111 ASPPH members. For the regression model, some variables of interest were only available after

2016. Therefore, we used the sample subset covering five academic years from 2016-2017 to 2020=2021, which had 806 observations from 109 ASPPH members.

The key dependent variable in our analysis is the percentage of underrepresented minorities (URM) among the total domestic graduates. We defined Black or African Americans, Hispanics, American Indians and Alaska Natives (AIANs), and Native Hawaiians and Pacific Islanders (NHPIs) as the URM group. Independent variables included the percentage of:

- URM among the population aged 20 to 35 in the state where the ASPPH member was located,
- foreigners among the total graduates,
- domestic graduates who earned degrees via distance learning or with minimum face-to-face interaction required,
- domestic graduates with degrees in one of the six main areas of study (Biostatistics, Epidemiology, General Public Health, Global Health, Maternal and Child Health, and Health Policy and Management),
- FTEs of URM faculty members,
- FTEs of faculty members who did not specify their race/ethnicity,
- indicators for whether the ASPPH member was public (for which the omitted group was private), and
- whether the ASPPH member was the school of public health (for which the omitted group was a public health program).

We clustered standard errors at the school level to account for the possibility that observations across different degree levels in different years were correlated with each other within the same ASPPH member. The diversity index (DI) of the ASPPH members was constructed by dividing the percentage of URM among the total domestic graduates by the percentage of URM among the state population aged 20 to 35 for each ASPPH member in each year for each degree level. We first explored the trends in the average DI of our analytic sample as a whole and separate trendlines for the three degree levels. We also compared the average DIs of applicants, accepted applicants, and enrollees to examine whether there was a leak in the diversity pool along the students' educational lifecycle. For the main analysis, we used ordinary least squares (OLS) to examine the relationship between the diversity of the public health graduates of the ASPPH members, the diversity of the states' population, and the ASPPH members' student/faculty/institutional characteristics.

We conducted additional analyses to enrich our primary analysis. First, we did robustness checks on the model above by including ASPPH member random effects and year fixed effects to see changes in the magnitude and direction of the point estimates after absorbing the time-invariant unobservable of ASPPH members and annual secular trends across ASPPH members. Second, we conducted a subgroup analysis by running the same OLS model on undergraduate degrees (e.g., bachelor's) and graduate degrees (e.g., master's and doctoral). Third, we conducted another subgroup analysis by running the same OLS model on Black and Hispanic graduates to examine whether our main findings hold for each race/ethnicity group. Lastly, we also included the diversity of applicants two to three years ago in the OLS model to examine the relationship between the diversity of graduates and the diversity of their application stage. For the last one, we focused on master's degree programs given their shorter length of study with small variations compared to the other two levels of degrees.

Results

Sample Characteristics

Our study sample consisted of 109 schools and programs of public health that are members of ASPPH. Among the total ASPPH members in our analytic sample, almost one-third (n = 37) were private

([Table 1](#)). While all the members conferred a master's degree, less than half of them conferred a bachelor's (41.28 percent) or doctoral degree (40.37 percent). Most members were located in metropolitan core areas (93.5 percent), while no one was in rural areas. No ASPPH member was categorized as a historically black college or university. The number of ASPPH members in the sample has grown from 78 in 2016 to 97 in 2020.

Table 1. Number and proportion of schools and observation by selected characteristics, all degree levels, 2016-2020

	Number of Schools/Programs (Percent)	Number of Observations (Percent)
Ownership Type		
Private	37 (33.94%)	215 (26.67%)
Public	72 (66.06%)	591 (73.33%)
Institution Type		
Public Health Program	48 (44.04%)	178 (22.08%)
School of Public Health	61 (55.96%)	628 (77.92%)
Degree Level[a]		
Bachelor's	45 (41.28%)	185 (22.95%)
Master's	109 (100%)	454 (56.33%)
Doctoral	44 (40.37%)	167 (20.72%)
Institution Location		
Metropolitan Area Core	103 (93.5%)	781 (96.9%)
Metropolitan Area High Commuting	2 (1.83%)	2 (0.25%)
Micropolitan Area Core	4 (3.67%)	23 (2.85%)
Rural Areas	0 (0%)	0 (0%)
Historically Black College or University	0 (0%)	0 (0%)
Year[b]		
2016	78 (71.56%)	144 (17.87%)
2017	87 (79.82%)	153 (18.98%)
2018	95 (87.16%)	166 (20.6%)
2019	97 (88.99%)	170 (21.09%)
2020	97 (88.99%)	173 (21.46%)
Total	109	806

[a] The number of schools for each degree level does not add up to the total number of schools because one ASPPH member can confer multiple degree levels. [b] The number of schools reporting each year does not add up to the total number of schools because one ASPPH member can confer degrees in multiple years.

Of the total graduates, including domestic and foreign students, 10.64% were foreign students ([Panel A: Table 2](#)). Among domestic students, the mean proportion of graduates who earned degrees in General Public Health was the highest (23.24%), followed by that of graduates with degrees in Epidemiology (14.44%) and graduates with the Health Policy and Management degree (13.75%). On average, 9.43% of domestic graduates earned their degrees through distance learning. The mean diversity index of the URM graduates across all degree levels provided by all ASPPH members in all years was 0.78 ([Panel B: Table 2](#)), implying the under-representation of this group compared to the state racial/ethnic composition. While the mean diversity index for Black, NHPI, and AIAN graduates was greater than one, it is far less than one for Hispanic graduates (mean = 0.59). The distribution of the diversity index for each of all minority groups was skewed right with the longer right tail, but the distribution of NHPI graduates and that of AIAN graduates was extremely skewed right given their medians and maxima, implying that a few extreme outliers drove the diversity index for those groups. Like the student's race/ethnicity

composition, the proportion of URM and each minority group among the faculty members were also skewed right (Panel C: Table 2). The overall mean proportion of URM faculty members was 14.28%, of which Black faculty took the highest portion (8.53%), followed by Hispanic faculty (5.02%).

Table 2. Summary statistics of diversity index of graduates, student body composition, and faculty composition among the study sample, all degree levels, 2016-2020

	N	Mean	Std. Dev.	Min	Median	Max
Panel A: Student Body Composition						
Percent of Foreign Students Among the Entire Graduates	806	10.64	10.26	0	7.69	48.39
Percent of Graduates in Distance-Learning	806	9.43	20.99	0	0	100
Percent of Graduates in Biostatistics	806	4.08	7.03	0	0	45.45
Percent of Graduates in Epidemiology	806	14.44	15.53	0	10.5	100
Percent of Graduates in General Public Health	806	23.24	37.36	0	0	100
Percent of Graduates in Global Health	806	2.99	8.90	0	0	100
Percent of Graduates in Maternal and Child Health	806	1.24	4.29	0	0	40.37
Percent of Graduates in Health Policy and Management	806	13.75	15.39	0	9.09	81.32
Panel B: Diversity Index						
Diversity Index of URM Graduates[a]	806	0.78	0.47	0	0.68	4.09
Diversity Index of Black Graduates	806	1.07	1.12	0	0.88	12.28
Diversity Index of Hispanic Graduates	806	0.59	0.49	0	0.51	3.94
Diversity Index of NHPI Graduates[b]	785	2.26	16.52	0	0	382.89
Diversity Index of AIAN Graduates[c]	805	1.4	4.28	0	0	42.04
Panel C: Faculty Composition						
Percent of URM Faculty (FTEs)[a,d]	806	14.28	10.00	0	11.69	59.14
Percent of Black Faculty (FTEs)[d]	806	8.53	8.00	0	6.35	55.26
Percent of Hispanic Faculty (FTEs)[c,d]	806	5.02	5.82	0	3.42	39.28
Percent of NHPI Faculty (FTEs)[b,d]	806	0.28	1.45	0	0	16.42
Percent of AIAN Faculty (FTEs)[c,d]	806	0.45	2.88	0	0	48.39
Percent of Race Unknown Faculty (FTEs)[d]	806	2.34	4.48	0	0	37.01

[a] URM stands for Under-Represented Minority. [b] NHPI stands for Native Hawaiian and Pacific Islander. [c] AIAN stands for American Indian and Alaska Native. [d] FTEs stands for full-time equivalents.

Trend Analysis

The overall mean diversity index trendline suggested gradual improvement in the diversity among the graduates over time (Figure 1). For example, the DI was 0.7 in 2014 but increased slightly over 0.8 in 2020. However, the mean DI is still less than one implying the underrepresentation of the URM graduates compared to the population they would serve. Overall, the mean DI for each of the three degree levels is less than one, implying the under-representation of the URM group among the total graduates in each degree level compared to the state population. Further, we found differences in DI at the degree-level, where the average DI for the undergraduate degree (0.98) was the highest, followed by master's (0.82) and the lowest for doctoral degrees (0.62). Thus, the mean DI was reduced as the degree-level advanced (Figure 2). Finally, we compared the mean DI across the student's educational lifecycle, i.e., mean DI for the applicants, to mean DI for the students who were accepted and enrolled (Figure 3). The mean DI for URM among the accepted (0.9) students and that for URM among the newly enrolled students (0.95) was

lower than the mean DI for URM among the applicants (~1). We also found that the DI for applicants, enrollments, and applicants was higher in 2020 in 2019.

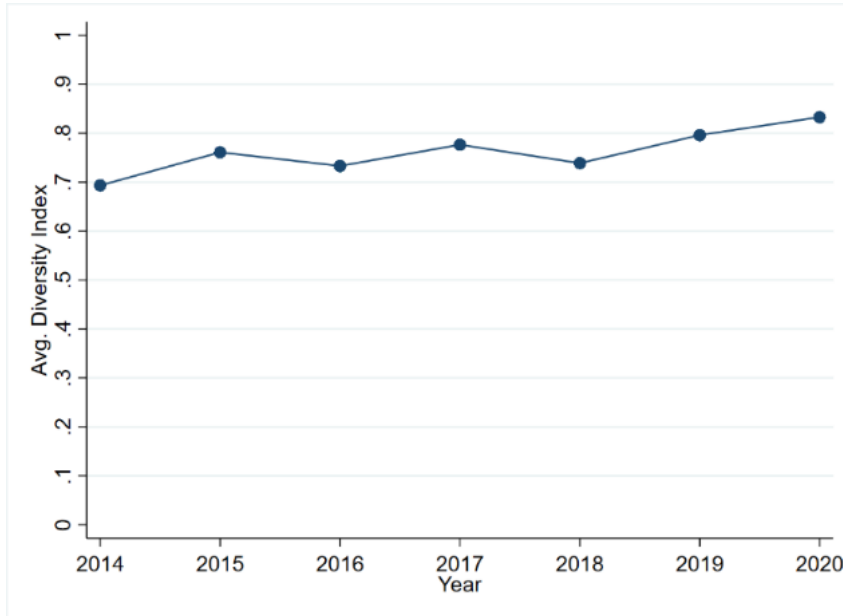**Figure 1. Trend of the mean diversity index of under-represented minority graduates, 2014-2020**

Figure 2. Trend of the mean diversity index of under-represented minority graduates, by degree level, 2014-2020
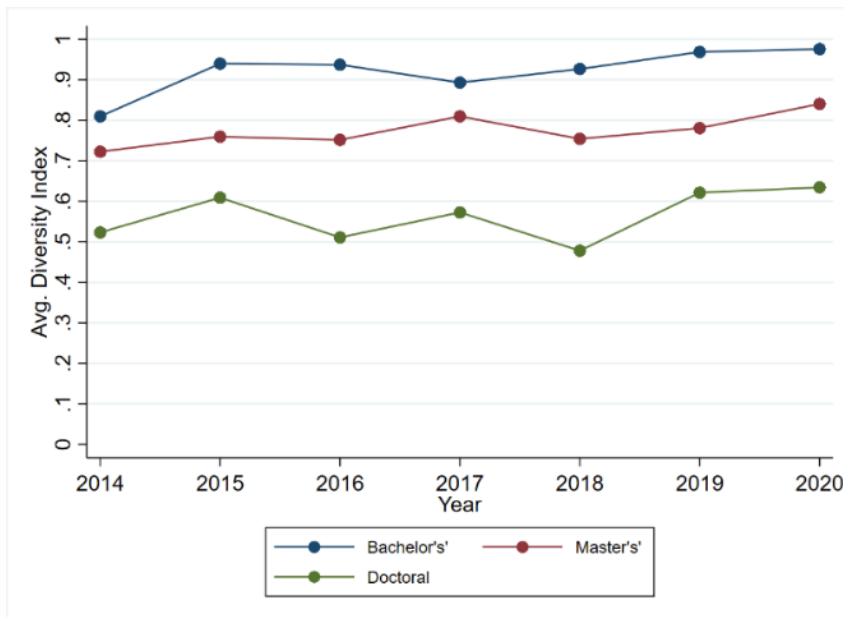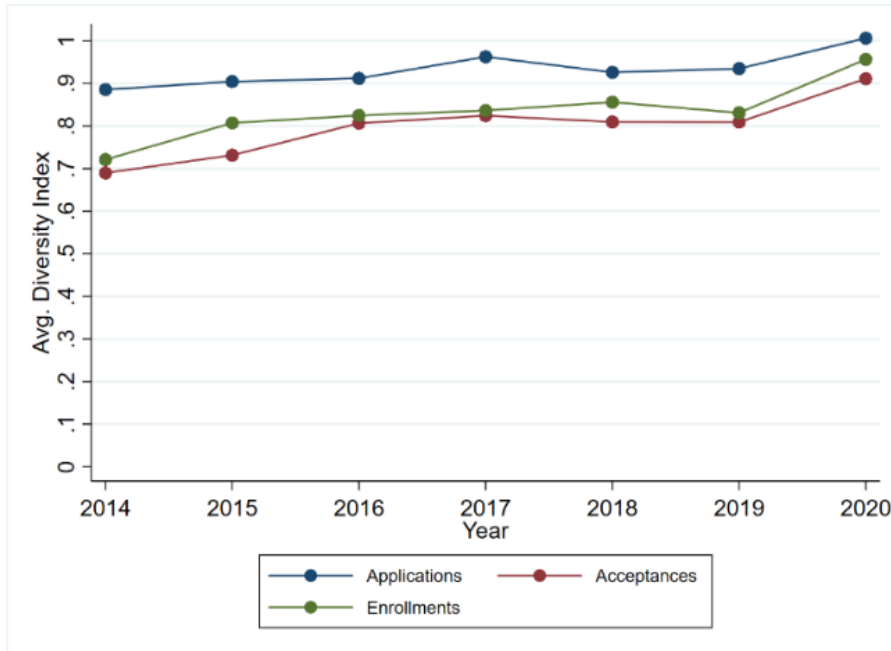

Figure 3. Trend of the mean diversity index of under-represented minority, by stage of the student lifecycle, 2014-2020

Regression Analysis

Our main findings suggested that controlling for other characteristics, one percentage-point increase in the proportion of URM among the state population aged 20 to 35 was statistically significantly associated with a 0.3 percentage-point increase ($p < 0.001$) in the proportion of URM among the total domestic graduates (Column A: Table 3). In addition, one percentage-point increase in the proportion of URM among the faculty members was associated with a 0.7 percentage-point increase in the proportion of URM graduates ($p < 0.001$). On the other hand, the proportion of graduates who earned their degrees in Biostatistics was negatively associated with the proportion of URM graduates (b = -0.28; $p < 0.01$). Compared to the bachelor's degree program, the proportion of URM graduates was lower in the doctoral degree program by 8.91 percentage points ($p < 0.01$), which confirmed the trendline by degree level shown above (Figure 2). All the other characteristics, including the ownership type of the ASPPH member, were not statistically significantly associated with the proportion of URM graduates (Column A: Table 3).

The robustness check with the school/program-level random effects and year fixed effects confirmed the positive relationship between the proportion of URM among the state population aged 20 to 35 and between the proportion of URM among the domestic graduates (b = 0.41, $p < 0.001$) (Column B: Table 3). Despite the change in the magnitude of the correlation coefficient, the robustness check also confirmed the positive association between the proportion of URM among the faculty and the proportion of URM graduates (b = 0.32, $p < 0.01$) and the negative association between the proportion of graduates who earned a Biostatistics degree and the proportion of URM graduates (b = -0.19, $p < 0.01$). However, findings also suggest that the proportion of graduates with a Global Health degree was positively associated with the proportion of URM graduates (b = 0.13, $p < 0.05$). The discrepancy in the proportion of URM graduates between the bachelor's and doctoral degrees became marginally significant (b = -4.98, p = 0.06). However, it still confirmed that the proportion of URM graduates in doctoral degree programs is lower than in bachelor's degree programs (b = -4.98, p = 0.06).

Table 3. Change in the proportion of under-represented minorities among the total domestic graduates in all degree level programs, by selected characteristics, 2016-2020

	Dependent Variable:

	Percent of URM Graduates[a]			
	Column A: OLS		Column B: RE + FE	
	b	s.e.	b	s.e.
Percent of URM among the State Population Aged 20-35[a]	0.30***	(0.06)	0.41***	(0.07)
Student Characteristics				
Percent of Foreign Graduates Among Grand Total	0.16+	(0.08)	0.05	(0.06)
Percent of Graduates in Distance-Based Program	0.03	(0.04)	0.02	(0.04)
Percent of Graduates in Biostatistics	-0.28**	(0.09)	-0.19**	(0.07)
Percent of Graduates in Epidemiology	0.05	(0.05)	-0.01	(0.05)
Percent of Graduates in General Public Health	0.02	(0.03)	0.04+	(0.02)
Percent of Graduates in Global Health	-0.03	(0.07)	0.13*	(0.06)
Percent of Graduates in Maternal and Child Health	-0.05	(0.12)	-0.02	(0.11)
Percent of Graduates in Health Policy and Management	-0.03	(0.05)	-0.00	(0.04)
Faculty Characteristics				
Percent of URM Faculty (FTEs)[a,b]	0.70***	(0.15)	0.32**	(0.11)
Percent of Race Unknown Faculty (FTEs)[b]	0.06	(0.14)	0.07	(0.14)
Degree Level (ref. Bachelor's Degree)				
Master's Degree	-3.65	(2.24)	-1.87	(1.90)
Doctoral Degree	-8.91**	(2.81)	-4.98+	(2.65)
Institution Type (ref. Public Health Program)				
Graduate School of Public Health	3.18	(2.19)	2.77	(2.06)
Institution Ownership Type (ref. Private)				
Public	2.40	(1.95)	0.59	(2.21)
Constant	2.52	(4.12)	3.74	(3.77)
Member RE	No		Yes	
Year FE	No		Yes	
Observations	806		806	
R-squared	0.43			

Standard errors in parentheses were clustered at the ASPPH member level. *** $p<0.001$, ** $p<0.01$, * $p<0.05$, + $p<0.1$. [a] URM stands for Under-Represented Minority. [b] FTEs stands for full-time equivalents.

Subgroup Analysis – Degree Level

We conducted a subgroup analysis by splitting the data into two levels of degree programs, undergraduate (bachelor's) and graduate (master's and doctoral) degree programs. We ran the same OLS model on each subset of the data (Table 4). The subgroup analysis of undergraduate degree programs produced results quite different from the main analysis. The results for undergraduate degree programs found a positive relationship between the proportion of URM faculty and the proportion of URM graduates (b = 0.9, p < 0.001), but all the other statistically significant associations found from the main analysis were no longer statistically significant, although they held the same direction of the effect. However, we also found that bachelor's degree programs provided by public institutions had 14.5 percentage points more URM among their domestic students than private institutions (p < 0.05). The results from the analysis on graduate degree programs were more aligned with the results from the main analysis. Like the main model, these results also confirmed that the proportion of URM among the state population aged 20 to 35 and URM faculty members were positively associated with the proportion of URM graduates, respectively (b = -0.3, p < 0.001; b = 0.68, p < 0.001). The proportion of domestic graduates who earned the Biostatistics degree was negatively associated with the proportion of URM graduates (b = -0.28, p < 0.05). Also, on average, the doctoral degree programs had a lower proportion of

URM graduates than the master's degree programs by 5.25 percentage points (p < 0.001). The similar magnitudes and significance levels of relationships found in the subgroup analysis on graduate degree programs compared to the findings from the main analysis might suggest that the results from the main analysis seemed to be masked by relationships found in graduate degree programs.

Table 4. Change in the proportion of under-represented minorities among the total domestic graduates in undergraduate and graduate degree programs, by selected characteristics, 2016-2020

	Dependent Variable:			
	Percent of URM Graduates[a]			
	Bachelor's		Master's + Doctoral	
	b	s.e.	b	s.e.
Percent of URM among the State Population Age 20-35[a]	0.20	(0.12)	0.30***	(0.06)
Student Characteristics				
Percent of Foreign Graduates Among Grand Total	0.48	(0.42)	0.13	(0.08)
Percent of Graduates in Distance-Based Program	-0.20	(0.21)	0.04	(0.04)
Percent of Graduates in Biostatistics	-0.49	(0.31)	-0.28**	(0.09)
Percent of Graduates in Epidemiology	-0.27	(0.63)	0.02	(0.06)
Percent of Graduates in General Public Health	0.08+	(0.05)	-0.04	(0.04)
Percent of Graduates in Global Health	0.05	(0.10)	-0.09	(0.07)
Percent of Graduates in Maternal and Child Health	-0.20	(0.13)	0.04	(0.18)
Percent of Graduates in Health Policy and Management	0.01	(0.09)	-0.04	(0.06)
Faculty Characteristics				
Percent of URM Faculty (FTEs)[a,b]	0.90***	(0.22)	0.68***	(0.16)
Percent of Race Unknown Faculty (FTEs)[b]	0.40	(0.28)	0.03	(0.13)
Degree Level (ref. Master's Degree)				
Doctoral Degree			-5.25***	(1.40)
Institution Type (ref. Public Health Program)				
Graduate School of Public Health	5.48	(3.80)	1.19	(2.40)
Institution Ownership Type (ref. Private)				
Public	14.50**	(4.90)	0.14	(1.91)
Constant	-13.92	(8.47)	4.01	(4.39)
Observations	185		621	
R-squared	0.47		0.44	

Standard errors in parentheses were clustered at the ASPPH member level. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. [a]URM stands for Under-Represented Minority. [b]FTEs stands for full-time equivalents.

Subgroup Analysis – Black and Hispanic Graduates

      We conducted another subgroup analysis on Black and Hispanic graduates separately by utilizing corresponding measures specific to these two minority groups (Table 5). For example, we used the

proportion of Black/Hispanic graduates, the proportion of Black/Hispanic residents among the state population aged 20 to 35, and the proportion of Black/Hispanic faculty members. Both subgroup analyses confirmed that the proportion of each minority group among the state population aged 20 to 35 (Black: b = 0.43, p < 0.001; Hispanic: b = 0.37, p < 0.001) and the proportion of faculty members in each minority group (Black: b = 0.77, p < 0.001; Hispanic: b = 0.46, p < 0.05) were positively associated with the proportion of graduates in each minority group, respectively. Both analyses also confirmed that the doctoral degree programs had a lower proportion of graduates in each minority group on average than the bachelor's degree programs (Black: by 4.44 percentage points, p < 0.05; Hispanic: by 5.02 percentage points, p < 0.001). In both analyses, the negative relationship between the proportion of graduates in biostatistics and the proportion of graduates in each minority group became no longer statistically significant. The subgroup analysis on Hispanics further showed that the proportion of faculty members who did not specify their race/ethnicity was positively associated with the proportion of Hispanics among the total domestic graduates (b = 0.14, p < 0.05). Furthermore, the master's degree programs were found to have a lower proportion of Hispanic graduates on average than the bachelor's degree programs by 2.93 percentage points (p < 0.01).

Table 5. Change in the proportion of Black and Hispanic graduates among the total domestic graduates in all degree level programs, by selected characteristics, 2016-2020

	Dependent Variable:			
	Percent of Minority Graduates			
	Black		Hispanic	
	b	s.e.	b	s.e.
Percent of Black Residents among the State Population Aged 20-35	0.43***	(0.11)	0.37***	(0.04)
Percent of Hispanic Residents among the State Population Aged 20-35				
Student Characteristics				
Percent of Foreign Graduates Among Grand Total	0.14+	(0.07)	0.02	(0.03)
Percent of Graduates in Distance-Based Program	0.03	(0.03)	-0.01	(0.01)
Percent of Graduates in Biostatistics	-0.10	(0.06)	-0.05	(0.04)
Percent of Graduates in Epidemiology	-0.00	(0.05)	0.03	(0.02)
Percent of Graduates in General Public Health	0.01	(0.03)	0.02	(0.01)
Percent of Graduates in Global Health	-0.04	(0.07)	-0.00	(0.03)
Percent of Graduates in Maternal and Child Health	-0.12	(0.09)	0.10	(0.08)
Percent of Graduates in Health Policy and Management	-0.01	(0.05)	-0.00	(0.03)
Faculty Characteristics				
Percent of Black Faculty (FTEs)[a]	0.77***	(0.14)		
Percent of Hispanic Faculty (FTEs)[a]			0.46*	(0.22)
Percent of Race Unknown Faculty (FTEs)[a]	-0.02	(0.10)	0.14*	(0.07)
Degree Level (ref. Bachelor's Degree)				
Master's Degree	-0.78	(1.89)	-2.93**	(1.00)
Doctoral Degree	-4.44*	(2.22)	-5.02***	(1.31)
Institution Type (ref. Public Health Program)				
Graduate School of Public Health	-0.09	(1.65)	2.07+	(1.09)
Institution Ownership Type (ref. Private)				
Public	3.08	(1.92)	-0.06	(0.71)
Constant	-0.99	(4.72)	0.62	(1.53)
Observations	806		806	

R-squared		0.44		0.54

Extended Analysis – Applicants and Graduates

Finally, we extended our analysis to examine the relationship between the applicants' diversity and their diversity when they came to graduate (Table 6). The length of study for master's degree programs is two years in general. Still, to account for the possibility that some students might defer their places or take a leave of absence for a year during the program, we came up with two different measures of the applicants' diversity: 1) the proportion of URM applicants two years ago, and 2) the aggregate number of URM applicants two years and three years ago divided by the aggregate total number of domestic applicants two years and three years ago. Both the extended analyses confirmed that the proportion of URM among the state population age 20 to 35 (b = 0.13, p < 0.01; b = 0.13, p < 0.05) and the proportion of URM faculty members (b = 0.37, p < 0.001; b = 0.46, p < 0.001) were positively related to the proportion of URM graduates in master's degree programs. In both analyses, we found no statistically significant relationship between the proportion of graduates who earned the Biostatistics degree and the proportion of URM graduates. Most importantly, we found the positive relationship between the proportion of URM applicants and the proportion of URM graduates when they were expected to graduate (b = 0.73, p < 0.001; b = 0.7, p < 0.001).

Table 6. Change in the proportion of under-represented minorities among the total domestic graduates in all degree level programs, by selected characteristics and the diversity of applicants, 2016-2020

	Dependent Variable:			
	Percent of URM Graduates [a]			
	Option 1		Option 2	
	b	s.e.	b	s.e.
Percent of URM among the State Population Aged 20-35[a]	0.13**	(0.05)	0.13*	(0.05)
Percent of URM Applicants 2 Years Ago	0.73***	(0.07)		
Percent of URM Applicants 2 Years and 3 Years Ago			0.70***	(0.07)
Student Characteristics				
Percent of Foreign Graduates Among Grand Total	0.02	(0.09)	0.04	(0.10)
Percent of Graduates in Distance-Based Program	-0.02	(0.03)	-0.03	(0.03)
Percent of Graduates in Biostatistics	-0.02	(0.08)	0.07	(0.11)
Percent of Graduates in Epidemiology	-0.03	(0.06)	-0.05	(0.06)
Percent of Graduates in General Public Health	-0.04	(0.04)	-0.04	(0.04)
Percent of Graduates in Global Health	0.02	(0.09)	0.04	(0.11)
Percent of Graduates in Maternal and Child Health	-0.16	(0.16)	-0.14	(0.19)
Percent of Graduates in Health Policy & Management	0.03	(0.04)	0.06	(0.04)
Faculty Characteristics				
Percent of URM Faculty (FTEs)[a,b]	0.37***	(0.09)	0.46***	(0.11)
Percent of Race Unknown Faculty (FTEs)[b]	-0.00	(0.13)	0.04	(0.15)
Institution Type (ref. Public Health Program)				
Graduate School of Public Health	0.01	(1.84)	-0.88	(2.07)
Institution Ownership Type (ref. Private)				
Public	-0.83	(1.74)	-0.56	(1.88)
Constant	-1.11	(3.77)	-1.31	(3.70)

Observations	402	302
R-squared	0.70	0.73

Standard errors in parentheses were clustered at the ASPPH member level. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. [a] URM stands for Under-Represented Minority. [b] FTEs stands for full-time equivalents.

Discussion

This study implemented a longitudinal analysis of a unique dataset from ASPPH to examine what institutional characteristics are associated with the diversity of its public health student cohort. To our knowledge, this is the first study that explored the diversity of the public health graduates at the public health school/program level by creating a diversity index at the institutional level. Our study findings suggest that while the diversity of the public health educational pipeline has shown an upward trend, racial and ethnic minority students continue to remain underrepresented in public health. Additionally, several institutional characteristics, such as the faculty diversity, degree level of the program, and area of study, were associated with the diversity of the institutions' public health student cohort.

In our study, the mean diversity index of the URM graduates across all degree levels provided by all ASPPH members in all years was 0.78. However, we found significant differences in the DI across racial and ethnic groups. For example, while the mean DI for Black, NHPI, and AIAN graduates was greater than one, the DI for Hispanic graduates was far less than one suggesting that Hispanic students are significantly underrepresented in the public health graduate cohort. As we explored the distribution of the DI for each minority group, we found a highly skewed distribution of NHPI and AIAN graduates, implying that a few institutions drove the DI for those groups. The findings on the overall lack of diversity in the public health workforce are consistent with a previous study by Goodman et al.[15] However, our results provide additional insight into the school-level diversity relative to the diversity of the communities in which these schools/programs are located. As schools consider strategies at their institutional level to improve the diversity of their student body, a DI provides an overall assessment of areas in which recruitment and retention efforts can be focused. It can also serve as a potential tool for accountability and tracking the diversity of the public health academic pipeline.

Another important finding is that the applicants to public health programs have become increasingly diverse, but the diversity in the acceptances and enrollments continues to lag. We also find that the diversity of the study cohort decreases with higher degree levels, with the highest diversity at the undergraduate degree. This increased racial/ethnic diversity among undergraduate students can potentially increase racial/ethnic diversity among graduate students and, ultimately, among faculty and other leaders in public health. However, the findings also suggest systemic barriers to higher education continue to impact student diversity negatively. Admission processes and decisions must actively incorporate a student-centric approach, such as using holistic reviews of applications, not just grade-point averages and standardized test scores.[20,21] Given its social justice focus, the public health discipline can be an attractive career path, particularly for those underrepresented in the sciences and health professions (e.g., persons from racial and ethnic minority groups, first-generation students, and students from low socio-economic status).[22] Additionally, COVID-19 has brought public health to the forefront and generated a renewed interest in the field. According to a recent report by the Association of Schools and Programs of Public Health (ASPPH), between March 2020 and March 2021, public health programs saw a surge in interest, with applications to master's in public health (MPH) programs increasing by 40%.[23] Public health graduates are an essential part of the educational pipeline that feeds into the public health workforce and are employed in the public and private sectors. Institutions conferring public health degrees thus play a critical role in improving this educational pipeline's diversity.

Universities and colleges promulgate "diversity plans" that propose goals for student and faculty diversity and retention plans for maintaining diversity among those groups. Faculty diversity is viewed as important by offering students a richer instructor background and providing minority students with model

instructors. The minority faculty pipeline, in turn, is dependent on the diversity of the undergraduate student population. The positive association between faculty diversity and student diversity in our study suggests that schools that are invested in faculty diversity are also invested in student diversity. It could indicate that students pay close attention to the faculty diversity of the institutions while making academic decisions. Thus, higher education institutions need to continue making active investments and push efforts to recruit and retain diverse faculty.[15]

The study findings should be viewed in light of its limitations. First, our analysis includes only schools and programs of public health that are ASPPH members. This might limit the external validity of our study findings. Future research can include additional schools and programs of public health that offer public health degrees. Second, we combined several racial and ethnic minority groups due to a lack of data. Third, these data are reported by the ASPPH members and may be subjected to nonresponse errors.

Implications

A diverse student body is seen as part of the higher education experience in the U.S.; students gain a university education not only in the classroom but also by learning from the experiences of a wide spectrum of fellow students. Finally, providing access to higher education improves social mobility for students who may not have historically had access to careers and training available at higher education institutions. At the federal level, investments are being made in public health, including the recent passage of the American Rescue Plan Act of 2021, which calls for $7.7 billion to establish, expand, and sustain a public health workforce.[24] There is a window of opportunity to make significant investments in improving the diversity of our public health workforce. Data-driven strategies are necessary for enhancing workforce diversity. However, workforce data, specifically diversity-related data, are not regularly tracked nationally. The study's findings will create transparency through an evidence-driven analysis of the current state of public health education and identify opportunities for public health schools and programs to reflect upon their roles in contributing toward a diverse and equitable public health workforce.

References

1. Vespa J, Medina L, Armstrong D. Demographic turning points for the United States: Population projections for 2020 to 2060. Current Population Reports, P25–1144. Washington, DC: U.S. Census Bureau. *U.S. Census Bureau*. Published online 2018:1-13.

2. Moore JT, Ricaldi JN, Rose CE, et al. Disparities in Incidence of COVID-19 Among Underrepresented Racial/Ethnic Groups in Counties Identified as Hotspots During June 5–18, 2020 — 22 States, February–June 2020. *MMWR Morbidity and Mortality Weekly Report*. 2020;69(33):1122-1126. doi:10.15585/MMWR.MM6933E1

3. Karmakar M, Lantz PM, Tipirneni R. Association of Social and Demographic Factors With COVID-19 Incidence and Death Rates in the U.S. *JAMA Network Open*. 2021;4(1):e2036462-e2036462. doi:10.1001/JAMANETWORKOPEN.2020.36462

4. Mitchell DA, Lassiter SL. Addressing Health Care Disparities and Increasing Workforce Diversity: The Next Step for the Dental, Medical, and Public Health Professions. *American Journal of Public Health*. 2006;96(12):2093. doi:10.2105/AJPH.2005.082818

5. Cohen JJ, Gabriel BA, Terrell C. The Case For Diversity In The Health Care Workforce. *https://doi.org/101377/hlthaff21590*. 2017;21(5):90-102. doi:10.1377/HLTHAFF.21.5.90

6. Jackson CS, Nadine Gracia J. Addressing health and health-care disparities: the role of a diverse workforce and the social determinants of health. *Public Health Rep*. 2014;129 Suppl 2(Suppl 2):57-61. doi:10.1177/00333549141291S211

7. Saha S, Shipman SA. Race-Neutral Versus Race-Conscious Workforce Policy To Improve Access To Care. *https://doi.org/101377/hlthaff271234*. 2017;27(1):234-245. doi:10.1377/HLTHAFF.27.1.234

8. Sellers K, Leider JP, Gould E, et al. The state of the U.S. governmental public health workforce, 2014–2017. *American Journal of Public Health*. 2019;109(5):674-680. doi:10.2105/AJPH.2019.305011

9. Bogaert K, Castrucci BC, Gould E, et al. The Public Health Workforce Interests and Needs Survey (PH WINS 2017): An Expanded Perspective on the State Health Agency Workforce. *Journal of Public Health Management and Practice*. 2019;25:S16-S25. doi:10.1097/PHH.0000000000000932

10. Juliano C, Castrucci BC, Leider JP, McGinty MD, Bogaert K. The Governmental Public Health Workforce in 26 Cities: PH WINS Results from Big Cities Health Coalition Members. *Journal of Public Health Management and Practice*. 2019;25:S38-S48. doi:10.1097/PHH.0000000000000929

11. Sellers K, Leider JP, Harper E, et al. The Public Health Workforce Interests and Needs Survey: The First National Survey of State Health Agency Employees. *J Public Health Manag Pract*. 2015;21 Suppl 6(Suppl 6):S13-S27. doi:10.1097/PHH.0000000000000331

12. Leider JP, Plepys CM, Castrucci BC, Burke EM, Blakely CH. Trends in the Conferral of Graduate Public Health Degrees: A Triangulated Approach. *Public Health Reports*. 2018;133(6):729. doi:10.1177/0033354918791542

13. Leider JP, Castrucci BC, Plepys CM, Blakely C, Burke E, Sprague JB. Characterizing the Growth of the Undergraduate Public Health Major: U.S., 1992–2012. *Public Health Reports*. 2015;130(1):104. doi:10.1177/003335491513000114

14. Healton CG. The shape of our river. Am J Prev Med 1999;16(3S):1–4. *American Journal of Preventive Medicine*. 1999;16(4):373. doi:10.1016/S0749-3797(99)00047-1

15. Goodman MS, Plepys CM, Bather JR, Kelliher RM, Healton CG. Racial/Ethnic Diversity in Academic Public Health: 20-Year Update. *Public Health Reports*. 2020;135(1):74. doi:10.1177/0033354919887747

16. Coronado F, Beck AJ, Shah G, Young JL, Sellers K, Leider JP. Understanding the Dynamics of Diversity in the Public Health Workforce. *J Public Health Manag Pract*. 2020;26(4):389. doi:10.1097/PHH.0000000000001075

17. Franklin RS. The Roles of Population, Place, and Institution in Student Diversity in American Higher Education. *Growth Change*. 2013;44(1):30. doi:10.1111/GROW.12001

18. Franklin RS. Benchmarking Student Diversity at Public Universities in the United States: Accounting for State Population Composition. *Ann Reg Sci*. 2012;49(2):355. doi:10.1007/S00168-011-0454-4

19. Salsberg E, Richwine C, Westergaard S, et al. Estimation and Comparison of Current and Future Racial/Ethnic Representation in the U.S. Health Care Workforce. *JAMA Network Open*. 2021;4(3):e213789-e213789. doi:10.1001/JAMANETWORKOPEN.2021.3789

20. Kreuter MW, Griffith DJ, Thompson V, et al. Lessons Learned From a Decade of Focused Recruitment and Training to Develop Minority Public Health Professionals. *Public Health*. 2011;101:188-195. doi:10.2105/AJPH.2011

21. Duffus WA, Trawick C, Moonesinghe R, Tola J, Truman BI, Dean HD. Training racial and ethnic minority students for careers in public health sciences. *American Journal of Preventive Medicine*. 2014;47(5 Suppl 3):S368-75. doi:10.1016/J.AMEPRE.2014.07.028

22. A report of the sullivan commission on diversity in the healthcare workforce. Accessed August 4, 2022

23. The Fauci effect: Interest spikes in health crisis communication. Accessed August 4, 2022. https://www.axios.com/2021/05/27/the-fauci-effect-interest-spikes-in-health-crisis-communication

24. Text - H.R.1319 - 117th Congress (2021-2022): American Rescue Plan Act of 2021 | Congress.gov | Library of Congress. Accessed August 7, 2022. https://www.congress.gov/bill/117th-congress/house-bill/1319/text